HIGHWAY RESEARCH BOARD

Special Report 62

Formulating Highway Construction Programs

Workshop Conference Proceedings

September 19-20, 1960

National Academy of Sciences—
National Research Council

publication 817

HIGHWAY RESEARCH BOARD

Officers and Members of the Executive Committee

1961

OFFICERS

W. A. BUGGE, *Chairman* R. R. BARTELSMEYER, *First Vice Chairman*

C. D. CURTISS, *Second Vice Chairman*

FRED BURGGRAF, *Director* ELMER M. WARD, *Assistant Director*

Executive Committee

REX M. WHITTON, *Federal Highway Administrator, Bureau of Public Roads* (ex officio)

A. E. JOHNSON, *Executive Secretary, American Association of State Highway Officials* (ex officio)

LOUIS JORDAN, *Executive Secretary, Division of Engineering and Industrial Research, National Research Council* (ex officio)

HARMER E. DAVIS, *Director, Institute of Transportation and Traffic Engineering, University of California* (ex officio, Past Chairman 1959)

PYKE JOHNSON, *Consultant, Automotive Safety Foundation* (ex officio, Past Chairman 1960)

R. R. BARTELSMEYER, *Chief Highway Engineer, Illinois Division of Highways*

E. W. BAUMAN, *Director, National Slag Association, Washington, D. C.*

W. A. BUGGE, *Director of Highways, Washington State Highway Commission*

MASON A. BUTCHER, *County Manager, Montgomery County, Md.*

C. D. CURTISS, *Special Assistant to the Executive Vice President, American Road Builders' Association*

DUKE W. DUNBAR, *Attorney General of Colorado*

H. S. FAIRBANK, *Consultant, Baltimore, Md.*

BURTON W. MARSH, *Director, Traffic Engineering and Safety Department, American Automobile Association*

GLENN C. RICHARDS, *Commissioner, Detroit Department of Public Works*

C. H. SCHOLER, *Applied Mechanics Department, Kansas State University*

WILBUR S. SMITH, *Wilbur Smith and Associates, New Haven, Conn.*

K. B. WOODS, *Head, School of Civil Engineering, and Director, Joint Highway Research Project, Purdue University*

Editorial Staff

FRED BURGGRAF ELMER M. WARD HERBERT P. ORLAND

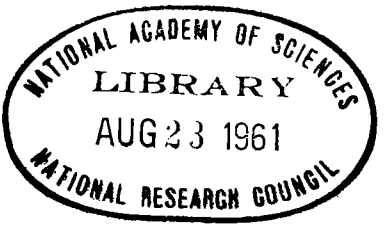
2101 Constitution Avenue Washington 25, D. C.

N.R.C. **HIGHWAY RESEARCH BOARD**

Special Report 62

Formulating Highway Construction Programs

Workshop Conference Proceedings
September 19-20, 1960



Division of Engineering and Industrial Research
NATIONAL ACADEMY OF SCIENCES—
NATIONAL RESEARCH COUNCIL
Washington, D.C.
1961

Department of Economics, Finance and Administration

Guilford P. St. Clair, Chairman
Director, Highway Cost Allocation Study
Bureau of Public Roads, Washington, D. C.

W.F. Babcock, Director, North Carolina State Highway Department, Raleigh
A.K. Branham, Engineer of Transportation, Public Works Planning, U.S. Bureau of the Budget, Washington, D.C.
Nathan Cherniack, Economist, The Port of New York Authority, New York
Ellis Danner, Professor of Highway Engineering, University of Illinois, Urbana
Harmer E. Davis, Director, Institute of Transportation and Traffic Engineering, University of California, Richmond
H.C. Duzan, Chief, Differential Cost Studies Group, Highway Cost Allocation Study, Bureau of Public Roads, Washington, D.C.
H.S. Fairbank, Consultant, Baltimore, Maryland
Fred B. Farrell, Regional Engineer, Bureau of Public Roads, Chicago, Illinois
Yule Fisher, Research Counsel, National Highway Users Conference, Washington, D.C.
Carl E. Fritts, Vice-President in Charge of Engineering, Automotive Safety Foundation, Washington, D.C.
Sidney Goldstein, Chief, Economic Impact Research Branch, Bureau of Public Roads, Washington, D.C.
Eugene L. Grant, Professor of Economics of Engineering, Stanford University, Stanford, California
William L. Haas, Highway Management Associates, Madison, Wisconsin
Harold W. Hansen, Senior Planning Engineer, Portland Cement Association, Chicago, Illinois
Patrick Healy, Jr., Executive Director, American Municipal Association, Washington, D.C.
R.G. Hennes, Professor, University of Calcutta, Calcutta, India
John C. Kohl, Director, Transportation Institute, University of Michigan, Ann Arbor
R.W. Kruser, Deputy Assistant Commissioner for Administration, Bureau of Public Roads, Washington, D.C.
David R. Levin, Chief, Highway and Land Administration Division, Bureau of Public Roads, Washington, D.C.
James W. Martin, Director, Bureau of Business Research, College of Commerce, University of Kentucky, Lexington
Louis R. Morony, Director, Laws Division, Automotive Safety Foundation, Washington, D.C.
Charles M. Noble, Consulting Engineer, Princeton, New Jersey
Wilfred Owen, Senior Staff Member, The Brookings Institute, Washington, D.C.
William D. Ross, Dean, College of Business Administration, Louisiana State University, Baton Rouge
Carl C. Saal, Chief, Division of Traffic Operations, Bureau of Public Roads, Washington, D.C.
C.A. Steele, Chief, Highway Economics Branch, Bureau of Public Roads, Washington, D.C.
H.S. Wiley, Director, Planning Division, New Mexico State Highway Department, Santa Fe
Robley Winfrey, Chief, Division of Highway Needs and Economy, Bureau of Public Roads, Washington, D.C.

DIVISION OF FINANCE, TAXATION AND COST STUDIES

James W. Martin, Chairman
Director, Bureau of Business Research
College of Commerce
University of Kentucky, Lexington

Robley Winfrey, Vice-Chairman

COMMITTEE ON HIGHWAY COSTS

Robley Winfrey, Chairman
Chief, Division of Highway Needs and Economy
Bureau of Public Roads

Dwight Alderson, California Division of Highways, Sacramento
J. P. Buckley, Chief Engineer, Highways Division, Automotive Safety Foundation, Washington, D.C.
Donald O. Covault, Associate Professor of Civil Engineering, Georgia Institute of Technology, Atlanta
John D. Cruise, Chief Planning Engineer, Michigan State Highway Department, Lansing
Fred B. Farrell, Regional Engineer, Bureau of Public Roads, Chicago, Illinois
Gordon D. Gronberg, Chief, Highway Investments Branch, Bureau of Public Roads Washington, D.C.
Harold W. Hansen, Senior Planning Engineer, Portland Cement Association, Chicago, Illinois
Roy E. Jorgensen, Roy Jorgensen and Associates, Washington, D.C.
Theodore F. Morf, Engineer of Research and Planning, Illinois Division of Highways, Springfield

Participants

AT THE WORKSHOP CONFERENCE ON FORMULATING HIGHWAY CONSTRUCTION PROGRAMS SEPTEMBER 19-20, 1960 WASHINGTON, D.C.

Aitken, H. L., Director, District of Columbia Department of Highways and Traffic
Babcock, Willard F., Director, North Carolina State Highway Commission
Bidell, William B., Program Engineer, Ontario Department of Highways
Brown, Donald M., Public Information Officer, Washington State Department of Highways
Burnes, Clinton H., Chief, Highway Needs Branch, Bureau of Public Roads, Washington, D.C.
Buswell, H. T., Planning Survey Manager, Montana State Highway Commission
Currie, R. A., Engineer of Highway Planning, Missouri State Highway Commission
Donnell, Philip M., Engineer Director, Tennessee Department of Highways
England, Arthur C., Assistant Chief, Staff Services, Connecticut State Highway Department
Foster, Kenneth B., Special Assistant to Deputy Assistant Commissioner, Bureau of Public Roads, Washington, D.C.
Granum, James O., Deputy Chief Engineer, Automotive Safety Foundation, Washington, D.C.
Hall, Edward M., Street Improvement Administrator, Phoenix, Arizona
Hart, T. J., Chief of Programing, Wisconsin State Highway Commission
Holshouser, Eugene C., Research Associate, University of Kentucky
Johnson, Ralph D., Engineering Counsel, National Highway Users Conference, Washington, D.C.
Johnson, Walter, State Highway Engineer, Kansas State Highway Commission
Kimley, Robert J., Advance Planning Engineer, North Carolina State Highway Commission
Lang, Donald R., Assistant Vice-President for Engineering, The Chesapeake and Potomac Telephone Companies, Washington, D.C.
Legarra, J. A., Assistant State Highway Engineer, California Division of Highways
Levin, David R., Chief, Highway and Land Administration Division, Bureau of Public Roads, Washington, D.C.
Livingston, R. E., Planning and Research Engineer, Colorado Department of Highways
Martin, James W., Director, Bureau of Business Research, College of Commerce, University of Kentucky
McCaa, D. B., Administrative Assistant to Director, Mississippi State Highway Department
Morf, Theodore F., Engineer of Research and Planning, Illinois Division of Highways
Paterson, Robert W., Director of Bureau of Business and Economic Research, University of Missouri
Schwender, Harry C., Director, Planning and Survey Division, West Virginia State Road Commission
St. Clair, G. P., Director, Highway Cost Allocation Study, Bureau of Public Roads, Washington, D.C.
Swanson, John A., Regional Engineer, Bureau of Public Roads, Albany, New York
Tacke, Walter, Deputy Commissioner of Public Works, Milwaukee, Wisconsin
Walker, Merle J., Highway Engineer, Michigan State Highway Department
West, A. L., Assistant State Highway Engineer, Florida State Road Department
Wilson, Dean, Assistant to Chief Engineer, Missouri State Highway Commission
Wiley, Hope S., Director, Planning Division, New Mexico State Highway Department
Winfrey, Robley, Chief, Division of Highway Needs and Economy, Bureau of Public Roads, Washington, D.C.

HIGHWAY RESEARCH BOARD STAFF

Burggraf, Fred, Director
Campbell, M. Earl, Engineer of Economics, Finance and Administration
McWane, Kenneth G., Engineer of Traffic and Operations

OBSERVERS

Christensen, M.B., Chief, Construction and Maintenance Division, Bureau of Public Roads, Washington, D.C.
Houston, Sam, Attorney, The Chesapeake and Potomac Telephone Companies, Washington, D.C.
Titus, Robert, Planning Engineer, West Virginia State Road Commission

Foreword

Highway construction programing is the translation of construction warrants into capital budgets, thence matching work flow to the flow of revenue. The programing process affects directly or indirectly nearly every activity of the highway department because it deals with the total planning and execution of capital investments and the consequences of these investments. In the United States the total highway and street construction budgets are currently running to more than $10 billion a year.

The problem areas encompassed in construction programing include directly the administration, planning and engineering functions in a systemic relationship. Fiscal control, coordination of complementing activities within the highway department and among other branches of government, public relations with concerned private groups and individuals, economic scheduling, and many other considerations, bring problems that are important, complex and urgent.

The Workshop Conference on Highway Construction Programing stressed philosophy, concept, and theory. This stress, rather than one on procedures, methods, and details, was chosen to provide a full understanding of the fundamentals of effective programing. With this understanding of objectives a highway department can develop the necessary procedures and judge the quality and progress of programing achieved. A conceptual framework of the total process will suggest the most effective approach, and the details applicable in a given situation.

This Conference provided a forum for a small group of informed men for the exchange of ideas, for the pooling of experience, for sharpening perspective. It was not intended that policy recommendations should come out of the workshop but rather that in addition to a deeper understanding, research problems should be identified which would guide a committee on programing in understanding the scope of the problem and in selecting important segments of the problem for immediate study.

In addition to the acknowledgments of sincere appreciation recorded in the proceedings for the time spent in preparation and in performance by the presiding officer, discussion leaders and participants, grateful acknowledgment is specially made to Robley Winfrey, the general chairman of the Conference, who ably guided the pre- and post-conference arrangements, and served as general chairman during the two-day conference. Special acknowledgments are tendered also to G. P. St. Clair, who took the responsibility for the fiscal arrangements, and to Clinton Burnes, Philip M. Donnell, James O. Granum, Kenneth B. Foster and Staff Engineer M. Earl Campbell, who served with Mr. Winfrey as a Committee on Program and Arrangements.

The deep appreciation of the Board is also expressed for the financial assistance from the Automotive Safety Foundation and from the U. S. Bureau of Public Roads which made this Conference possible.

Fred Burggraf, Director

Contents

PARTICIPANTS iv

FOREWORD vi

Page

SESSION ONE-A—Introductory Remarks 1

Welcoming Remarks—Fred Burggraf 1
Remarks of Department Chairman—G. P. St. Clair 2
Purpose of the Conference—Robley Winfrey 3

SESSION ONE-B—Objectives and Approach 6

Problems in Formulating Highway Construction Programs—James W. Martin 6

Discussion 15

Concepts of and Approaches to Capital Budgeting—Robley Winfrey 20

Discussion 26

SESSION TWO—Investment Planning 30

Scheduling Capital Improvements—Donald R. Lang 30

Discussion 39

Role of the Legislature, Executive Branch, and Other Agencies in Highway Construction Programing—J. A. Legarra 41

Discussion 46

Basic Information Needed for Sound Capital Investment Planning—Philip M. Donnell 50

Discussion 54

Accounting and Budgeting Requirements for Advance Construction Programs—Eugene C. Holshouser 57

Discussion 60

The Case for Capital Budgeting in the State Highway Departments—Eugene C. Holshouser 63

Discussion 72

SESSION THREE—Priority Analyses—Project Selection 75

Physical and Economic Rating Methods for Priority Considerations—M. Earl Campbell 75

Discussion 93

Balancing of Physical and Economic Ratings with Other Considerations to Establish Project Priorities—Arthur C. England 95

Discussion 99

SESSION FOUR—Scheduling Letting Dates for Specific Projects 109

Coordinating the Highway Construction Schedule with All Agencies Concerned—John A. Swanson 109

Discussion 113

The Role of Time and Money as Related to Construction Schedules—William B. Bidell 119
Discussion 138
Control and Adjustments of Construction Schedule—M. J. Walker 145
Discussion 154
SESSION FIVE—Administration and Management 160
Highway Programing Law—David R. Levin 160
Discussion 169
Administrative Requirements for Highway Construction Programing—W. F. Babcock 174
Discussion 179
Public Relations Aspects of Highway Construction Programing—Donald M. Brown 183
Discussion 186
SUMMARY AND SYNTHESIS 188
Formulating Highway Construction Programs—A Case Study and Summary—Clinton H. Burnes 188
APPENDIX A—Glossary 197
APPENDIX B—Selected Bibliography on Highway Construction Programing 204

Session One-A

Monday, September 19, 1960, at 8:50 A. M.

INTRODUCTORY REMARKS

ROBLEY WINFREY, General Chairman, Presiding

Welcoming Remarks

FRED BURGGRAF, Director, Highway Research Board

It is a distinct personal pleasure to welcome you on behalf of the Highway Research Board to this informal workshop conference on highway construction programing.

Conferences such as this one are unique because the motive is that of voluntary sharing, of blending the component parts of understanding into a pool of composite wisdom to reward the thirsty seeker after truth.

In a few moments you will be told the special purpose of this Conference. But first let us take a brief look at the Conference purpose in context with our broad problem—the problem of deciding how, when and where to best invest nearly ten billion dollars a year. To invest every dollar of that amount wisely, to "get out of every cent of it what anyone can get out of a dollar," is truly a challenge to the engineer and to the administrator.

An oversimplification of the definition of programing is that it is the translation of highway needs into capital budgets, matching the flow of available revenue with the flow of urgent needs. But the translation is troublesome and full of problems. There are many versions of translations and many interpretations of versions. We find, for example, 36 versions of sufficiency ratings with no two identical. And all of the activities leading from needs studies to contract lettings are full of specialized problems.

One of the chief general purposes of this workshop is to identify areas of agreement and the problem areas where research would be fruitful.

It was a year ago at the conclusion of the Workshop Conference on Economic Analysis that several participants expressed a desire for a conference on programing, among them Harry Schwender of the West Virginia State Road Commission and Carl Fritts of the Automotive Safety Foundation. Since then many have joined with them in the same expression.

I want to acknowledge our appreciation for the wide-spread interest in this venture. I extend special thanks to G. P. St. Clair, Chairman of the Department of Economics, Finance and Administration, who was a "Committee of One" on Ways and Means, who through his gift of persuasion obtained the additional resources needed.

A special vote of thanks is due the Automotive Safety Foundation and the U. S. Bureau of Public Roads for underwriting the conference.

We are also especially grateful to the Arrangements Committee for a job well done and done through a labor of love. To Robley Winfrey, the Chairman, and to members Granum, Burnes, Donnell, Foster and Campbell—our thanks.

And now I want to express our sincere thanks to the discussion leaders. They have also had "homework" to do. I want to thank the presiding officers for their acceptance of our invitation not only to keep things running smoothly here but to do some special homework upon their return.

To each one of you who were chosen to participate I extend, on behalf of the Executive Committee of the Board and also on my own behalf, a warm and sincere welcome.

Remarks of Department Chairman

G. P. ST. CLAIR, Chairman, Department of Economics, Finance and Administration

I will not tresspass on your time more than a minute or two, I just want to express my pleasure that you could have a conference on this very important subject, and I am looking forward to hearing some very interesting and important papers and discussion.

This is the third workshop conference that the Department of Economics, Finance, and Administration has held, and I have no doubt that it will be the most successful, because that is the way things work.

When it was first proposed, and in my thinking about this conference, I have wondered just what the scope of a conference on programing is. It seemed to me that the subject of programing impinges on planning, on research, on design, on location, on the highway budget. I do not know whether all of these subjects will come up for examination, but they are surely collateral.

It seems to me, then, that that is true of almost any highway subject—that it is a question of where you put the spotlight, what things you are focusing on. Any given subject includes by inference all other highway subjects. You cannot get away from that continuous connection.

But the matter of programing is of supreme importance these days, and it is very well that we have, in this particular conference, put the spotlight on that subject.

Purpose of the Conference

ROBLEY WINFREY, General Chairman

"Formulating highway construction programs" is a rather formal title. In simple language, we can say "programing highway improvements." The more formal and extensive title was chosen by the Committee to indicate the sincerity, depth of interest, seriousness, and importance of the process whereby ideas for highway capital improvements get translated into signed contracts for the construction thereof.

All officials of government and all officials of private industry shoulder the important function of directing the destinies of their respective organizations. These destinies are determined, to a large extent, by the policies and plans surrounding financial operations. The allocation of financial resources to functional operations within each organization is a highly important managerial act. Broadly speaking, these financial resources are allocated first, to current operating expenses for the purpose of maintaining and operating an organization, and, second, to so-called capital improvements—the procurment of fixed assets, that is, long lasting assets which result in fixed permanent property, useful over several future years.

Each of these financial allocations in the end, results in the disbursement of money. Money can be disbursed only once. Does this one disbursement, as a result of the wisdom, forethought, and clairvoyance of those who must make the decisions, achieve the most desirable over-all benefits? Regardless of uncertainties, risk and responsibilities, the decisions to disburse money must be made. One of the objectives of the workshop conference is to show how these decisions may be made with minimum risk, or conversely, with the maximum of certainty.

A second objective of the conference is to evolve a set of principles, theories, philosophies, and procedures whereby the allocation of financial resources to construction improvements can be made with the greatest degree of equity, economy, and certainty of the best choice of improvements to construct in a given year. This phase of the decision making process brings into the picture the weighing of one desirable improvement against all other desirable improvements in order that those projects to be built first will be those that will accord the greatest amount of good to the greatest number of people.

A third objective of this workshop conference is to bring into printed form an authoritative discussion—a taking apart and putting together—of the factors, aspects, and considerations pertaining to the process of formulating a program of construction in a highway department. The programing of construction is as old as are the highways themselves. The literature contains hundreds of references on the subject. Nowhere, however, is there a compilation of literature on the programing of highway construction such as will materialize from this workshop conference. We will bring into one volume an authoritative discussion of all aspects related to highway construction programs. This is one reason why you find in the program a breadth of subject material covering financing, budgeting, accounting, management procedures, public relations, and requirements of the statutes. We will miss our goal if the proceedings of this conference are not in demand by all highway officials concerned with the important task of allocating financial resources to creating permanent fixed assets in highway facilities.

In the process of putting together a highway construction program, I suspect that few engineers or highway officials are conscious of the many factors involved, and to which they give weight in reaching their decisions. With the help of Clinton H. Burnes, I have listed a total of 45 of these factors in six groups as follows:

FACTORS WHICH MAY AFFECT DECISIONS TO PROGRAM HIGHWAY IMPROVEMENTS

Group A: Long-Range Outlook

1. Long-range physical needs
2. Long-range financial needs
3. Long-range highway system plans

Group B: Financial

1. Money available - next fiscal year
2. Money available - short-range ahead
3. Money available - long-range ahead
4. Feedback and probable adjustments

Group C: Priority

1. Rate of return or benefit-cost ratio
2. Traffic services (amount and type of service to be achieved)
3. Traffic generation
4. Physical and structural conditions of highway
5. Accident record and safety
6. Comparative needs between systems, areas, projects
7. Emergency (diaster) needs

Group D: Program Balance

1. Distribution of work by highway systems
2. Distribution of construction dollars by geographic areas
3. Distribution of work by type—earth work, pavement, structures
4. Adequacy of contractor supply vs competition
5. Adequacy of labor and material supply

Group E: Project Selection — Technical and Operative

1. Continuity of route improvement
2. Protection of investment—surfacing jobs, additions and betterments
3. Temporary vs permanent improvements
4. Maintenance costs
5. Construction season length vs time to complete project
6. Sequence of work and stages of work
7. Size of project and construction time
8. Small vs large projects vs stage construction
9. Availability of planning information
10. Study time to reach decision as desirability
11. Local planning and commitments
12. Lead time for negotiations—other agencies, utilities, land development
13. Preparationof plans vs letting dates
14. Right-of-way acquisition vs letting dates
15. Industrial or other land use developments
16. Coordination with other public agencies
17. Approvals of and agreements with other agencies
18. Adequacy of department-wide staff

Group F: Management and Policy

1. Desires of top level public officials
2. Desires of local level public officials
3. Demands of pressure groups
4. Demands of private citizens
5. Legislative policy and legislative outlook
6. Public defense needs
7. Requirements for public health and disaster prevention
8. Requirements of law

These factors, and others which you may think of, are those that will receive our attention during these two days. I am certain that the relative role of these factors will become more certain in our minds as we progress through the discussions.

These factors suggest two divisions of the process of programing construction: first, considerations due the technical, administrative and public factors, and second, the procedure of programing—the mechanics by which proper and just weight is given to these factors. Each division is equally important and the study of the two divisions embraces the whole of construction programing.

In order to reach depth in the discussion of these subjects, we have brought together the 42 of you, each hand-picked because of interest, experience, soundness of ideas, and willingness to exchange opinions in order that the inside of the programing responsibility can be exposed to the view of everyone. There is represented here this morning the doers who have the know-how of getting construction programs together and the top flight approvers who, in the end, approve or reject the individual proposals in a year's construction program. Through you individuals, in addition to the distribution of the final proceedings, we expect the missionary work to begin and to extend throughout the land to the many hundreds of individuals whom we cannot accommodate in conference here today, but must reach through your efforts.

In closing, I wish to pay special tribute to the members of the committee on arrangements who so faithfully worked to get this group together this morning. These gentlemen are Messrs. Burnes, Campbell, Donnell, Foster, and Granum. To each of them I extend my personal thanks for their work and appreciation of their full cooperation and tolerance. I want also to let you know that we are appreciative of the financial support received through the Bureau of Public Roads and the Automotive Safety Foundation.

Session One-B

Monday, September 19, 1960, at 9:30 A. M.

OBJECTIVES AND APPROACH

ROBERT J. KIMLEY, Presiding

Problems in Formulating Highway Construction Programs

JAMES W. MARTIN

The problems involved in formulating highway construction programs are of several orders. In this paper some human relations issues are explored. To lay the groundwork for understanding the problems discussed, brief attention is accorded the nature and general structure of the highway budget—the basic management tool for efficient programing and economical use of highway funds. The summary does not follow the experience of any one highway department, but it should be reasonably applicable to most well-managed departments.[1]

The paper reflects a diagnosis of construction programing problems viewing the central issue as one of attaining a climate which allows full management exploitation of budgeting. The problems are viewed from a positive angle; they are not treated as excuses for an inadequate programing job. The particular problems considered include the following questions examined constructively in relation to program development through budget practice:

1. How is budget administration leadership to secure departmental management unity in view of the traditionally predominant role of nonmanager personnel? In other words, how may a state develop excellent budget management in the light of the scarcity and modest position of professional management people in the typical state highway agency?

1/ The basic writings on budgeting are illustrated by the following examples in English. Henry Carter Adams, "Science of Finance" (New York: Holt, 1898), especially pp. 178-191; A.E. Buck, "Public Budgeting" (New York: Harper, 1929) and "The Budget in Governments Today" (New York: Macmillan, 1934); Jesse Burkhead, "Government Budgeting" (New York: Wiley, 1956); Eugene R. Elkins, "Program Budgeting: A Method of Improving Fiscal Management" (Morgantown: West Virginia University, 1955); James W. Martin and Frank C.E. Cush, "Administration of the Turkish Ministry of Finance" (Ankara: Ministry of Finance, 1951); Frederick C. Mosher, "Program Budgeting: Theory and Practice with Particular Reference to the U.S. Department of the Army" (Chicago: Public Administration Service, 1954); National Resources Planning Board, "Long-Range Programming of Municipal Public Works" (Washington: Government Printing Office, 1941); Catheryn Seckler-Hudson (ed.), "Budgeting: An Instrument of Planning and Management" (mim.) (Washington: American University, 1944-1952), especially Unit IV; Herbert A. Simon, "Administrative Behavior" (New York: Macmillan, 1948); Arthur Smithies, "The Budgetary Process in the United States" (New York: McGraw-Hill, 1955); Rene Stourm, "The Budget" (New York: Appleton, 1917); J. Wilner Sundelson, "Budgetary Methods in National and State Governments" (Albany, J.B. Lyon & Co., 1938). On the particular problem of the management relationships among highway department personnel, perhaps the best book available is Edmund P. Learned, David N. Ulrick, and Donald R. Booz, "Executive Action" (Boston: Harvard University, 1951). Although these authors based much of their discussion on private business experience, the conclusions appear equally applicable to highway administration.

2. How can the planning agency of each highway department with cooperation from other departmental personnel be made keenly aware of its responsibility for recommending a wise and comprehensive program viewed simultaneously (a) by highway systems, (b) by geographical areas (districts), (c) by phase of work, (d) by routes, and (e) by classes of projects? How can this information, when approved as the official construction budget, be made of maximum utility in the total management of the department?

3. How can the dozen or two top administrators in a highway department be made keenly conscious of management needs and of the contribution budget administration can make toward meeting those needs? How can maximum efficiency in the dissemination of knowledge of how to use budget information be attained? From the viewpoint of programing, these questions may have special relevance to the planning and political personnel of the department; but the arrangements cannot be of maximum usefulness until the departmental supervisory personnel generally becomes enthusiastic for good management.

THE HIGHWAY BUDGET

The management tool for formulating and executing a highway construction program is the budget. Budgeting involves both the current budget and the long-term plan or the capital budget. To build highways most effectively administrators must utilize both.

Differentiation between the capital and current budget is less important than understanding the comprehensive budget conception, that is, the idea inclusive of both long-range construction plan and the total plan for the current year. Supervisory personnel generally must understand that "To budget is to operate the total Department function within and according to a plan."[2]

The budget cycle has been conceived as involving (a) preparation of estimates by the highway department, (b) submission of them for approval, (c) legislative or other sanction, (d) execution, and (e) audit (or control). Programing literature has emphasized the issues which have to do with the preparation of estimates. It has stressed especially the determination of construction priorities even though often with inadequate consideration of the numerous classes of criteria which must be taken into account. And there can be no doubt that the establishment of a highway building program based on rational selection of projects is of critical importance.

However, the job is only begun when the estimates are prepared, that is, when, in the light of accurate cost figures, a construction program made up of top priority projects is integrated with a financial plan, for, say, six years[3] to constitute a long-range capital budget. Moreover, the development of such estimates involves some prior decisions of great importance to the conduct of an intelligent state highway service.

Fundamental to the success of highway construction programing is the comparatively neglected area of budget execution. In many state departments having defensible execution of the current budget, there is little or no effective management of construction projects from a budget angle. Thus, one of the technical issues which requires consideration is the means of marshalling construction progress in such a manner as to provide engineering supervisors and executive personnel the most effective tools for the day-to-day administration.[4] For adequate conception of budgetary technicalities, it is

---

2/ Charles R. Lockyer, "Project Statement: Machine Control of Construction Budgeting" (Unpublished memorandum, Kentucky Department of Highways, February 8, 1960). An effective current budget plan may be a practical prerequisite to efficient construction budget administration.

3/ Six years appears to be an appropriate period for the long-term highway budget. This is close to the maximum time required from the initial planning stage to final settlement for construction of major projects. Detailed planning much beyond this period of time becomes rather tenuous.

4/ Because this issue is of different order from the "problems" to be considered subsequently in this paper, it will be discussed in summary form incident to the descriptive analysis of the highway budgetary process.

important to emphasize that in current-year execution the construction budget is merged with and is a part of the operating program. To provide a basis for the execution of the construction budget—as well as to develop statistics which can aid in further programing—the highway department needs a project record as its construction budget is converted into new roads and streets. The record system should obviously be planned in such a manner as to produce both physical and financial progress reports for each project.

Reasons for a Construction Budget

Although budgeting for current activities requires relatively minor emphasis on a long-term view, all highway construction necessitates advance planning if the program is to be handled economically.[5] This is the case for numerous reasons, some of which are enumerated:

1. Without such advance planning, in view of the long period required for the completion[6] of major projects, the considerations which determine priorities cannot be deliberately weighed.
2. Unless management can have a long-range plan, it cannot administratively make economical disposition of manpower and equipment. This is more true of highway work than of other general state construction because in the latter case the architectural and engineering labor is characteristically handled under contract. Moreover, while the right-of-way problem in highway work is technical and exacting, land procurement for other state construction may be entirely unnecessary or, in nearly all cases, administratively an easy task. The state highway department generally uses employed manpower and owned equipment—short of the actual construction—to a much greater extent. Thus, it must efficiently employ relatively more men and machines.
3. The plans must be formulated to capitalize on available resources and must look toward using them with maximum effectiveness. That Federal-aid is offered in categories makes necessary careful blueprinting for each system. And at the boundaries, certain considered decisions must be made in the interest of balance. For example, will an urgent suburban Federal-aid secondary street be constructed with urban aid or with Federal-aid secondary funds?
4. The program must not only provide for a balanced distribution of construction among the geographical areas of the state, but it must also be so planned that all classes of employees[7] will be fully and continuously at work with a minimum of transfer between administrative districts.
5. The program must be devised to facilitate management adjustments to seasonal requirements. For example, in those parts of the country where many construction activities must be discontinued in winter, the supervising engineers must be advised of all phases of the advance construction requirements to make possible the efficient planning of personnel assignment.[8]
6. While all these considerations are being examined simultaneously, the planners, partly in order to implement them, must take account of route development policy and must select kinds of projects (bridge, grade and drain, paving, and certain types of reconstruction) in the light of manpower and contractor resources available. This criterion in some cases depends on a careful examination of other public (and sometimes private) prospective building.

5/ On this point from the angle of a highway department head, see especially James W. Martin, "Programming Highway Construction," Proceedings of the Kentucky Highway Conference March 12-13, 1958 (Lexington: College of Engineering, University of Kentucky, 1958), pp. 11-15.
6/ The series of processes, location, field survey and design, preparation of working drawings and specifications, right-of-way procurement, contract procurements, construction, and final inspection and settlement constitute the productive process from plan to highway. They are all envisaged as necessary for completion of a project.
7/ For example, location engineers, field surveyors, road and structural design personnel, right-of-way workers, and construction men.
8/ The dispostion of machines and manpower, particularly in the field, requires careful planning under over-all supervision.

Work of the Budget Staff

As the budget is the handmaiden of general administration, the departmental budget staff needs to be in close association with the executive head of the highway administration. Its manpower should be composed mainly of professional management personnel with an intimate knowledge of the state government in general and of the highway organization in particular. The staff's success depends on an efficient working relationship with the personnel responsible for both planning and record-keeping.

Incident to the process of selecting construction priorities, for which the planning staff does the technical work,[9] the budget staff determines the resources available and does the detailed financial planning, advises the planning staff, and to the extent appropriate participates in policy conferences looking toward the establishment of, or addition to, the long-term construction program.

After program budget decisions are made final, the budget staff prepares the construction budget document and assists in following up for execution. Regardless of the method for handling construction project records, each periodic report and some special reports can well be signals for budget staff explanation, written and oral, as to exactly the meaning of the reports. In personal conferences the staff can aid in identifying the decision-making which the reports suggest for the various supervisors.

For an effective working relationship with the state budget office, the departmental budget staff should be the highway department's liaison with the state agency.

In keeping with the budget calendar, which the budget staff, collaborating with other persons concerned, works out and publicizes within the highway department, the departmental staff must carry on other construction budget operations. Each year, the planning staff, in the light of changed conditions and of experience with the established program, must submit recommendations which will (a) revise the six-year program to the extent that the evidence indicates positively essential and (b) extend the planned program by one year to compensate for the lapse of time. The capital budget plan, with these suggested procedures,[10] is said to have built-in plans for revision.

Possibly the only circumstance which should bring about need for revision if the initial six-year program is well planned is amendment to deal with new problems and especially with schedule change to correct for error of estimate. An alteration in support policy may arise from either state or Federal legislation; it may be considerable. Similarly, cost estimates may prove systematically biased so as to necessitate changes in contemplated rate of progress. Although errors of either sort necessitate revision, the budget alterations can usually be limited to moving each stage of planned action toward construction to an earlier or a later date and, if appropriate, revising revenue or cost estimates in the process.

PROBLEMS

Securing Management Unity

The problem of securing management unity requires persistence in any business or governmental setting; in highway administration, it is doubly difficult. The situation is partly an outgrowth of history, partly one of personnel, and partly one of communication. It involves also other less obvious factors.

9/ Decision-making with respect to the highway investment program is a budget function. Because in highway development an already-established, sizeable, specialized staff is necessary for this work, there seems to be good reason for handling project priority rating in cooperation with the budget staff.

10/ As James O. Granum and Clinton H. Burnes have shown in an admirable address on "Advance Programming Methods for State Highway Systems" at the 1960 Highway Research Board meeting in January, some states simply work out a one-shot program. Such a plan seems less fortunate than that suggested in the text because (a) it is unduly rigid; (b) it implies too little confidence in the dynamic character of the future; and (c) it fails to provide an ongoing, continuous approach which appears to be fundamental in a dynamic society. Experience in Maryland in recent years is eloquent testimony on that point.

Fullest development and use of a continuous construction budget demand the skills of professional management specialists. This fact poses difficulties. The political department head, whether a board or an individual, the head of the engineering staff, and the chief accountant are all likely to think of themselves as managers—each of course from a different viewpoint. That the functions of the professional management man are so little differentiated in the minds of top-echelon highway department personnel means that his services are often unsought. Thus, lack of understanding may defeat budgeting at its best before it is fully initiated.

If the adequate-staffing hurdle is surmounted, however, the problem of fitting management specialists into the highway operating pattern still remains. In a department in which there are basically three classes of top-level line people—the political head, the engineering staff, and the accounting personnel—the acceptance of the budget staff in a management capacity becomes an issue of importance. And the issue is rendered even more serious by the fact that most of the bona fide management experts having the personality traits requisite for highway budget administration are employed in private businesses, usually at salaries out of reach of highway departments.

That one important phase of budget administration at the technical level is characteristically delegated to a planning staff operating in a cooperative capacity should simplify the construction programing and budgeting operation seems obvious. Yet in some states exactly the opposite may be true. Some of the highway planning agencies have been called on to do traffic, statistical, mapping, and inventory studies but have not been expected to plan project priorities in any sense of the word. They lack staff to take account of the variables which must be recognized for such planning. Some of them even lack any professional planners. Under these conditions, the specialized planning staff must be reworked or superseded, preferably the former, before it can contribute adequately to orderly programing.

Another difficulty is one of work habit. The emphasis in programing which has been placed on the selection of construction projects in some settings tends to suggest to responsible highway officials that efficient staff work in planning is a substitute for a construction budget administration. Programing activity in a planning agency functioning efficiently as a major contributor to capital budgeting nonetheless must be a continuous process that is subject to specific deadlines. If such over-all conformity with unified management must be newly developed, that fact may introduce a frictional element even with the most cordial cooperation between the budget staff and the planning director. Fortunately, some state highway planning agencies which have little or no development in bona fide project priority planning do have the continuity of operation and the respect for deadlines which are requisite for participation in the capital budgeting process.

Another problem in certain states, regardless of structural arrangements, has to do with the position of the planning agency in the departmental administration pattern. In some cases the office of the chief engineer and of the department head find little occasion to consult planning personnel to obtain the factual basis for decisions. Rather, they seek the impressions of field employees. This situation of course may result from the fact that the planning staff has little that is significant to offer. Sometimes, it is merely a practice which has survived the reason for it. Whatever the cause, failure to use planning information and analysis is a sort of "vote of lack of confidence" which must be overcome in the development of planning participation in the construction budgeting process.

The supervisors of highway design, of bridges, of right-of-way activity, and of construction as such, whether in the central office or in the field, are potential beneficiaries of efficient construction budgeting. But, before the institution of orderly programing, these people may have difficulty in visualizing any major contribution of an alleged "financial control" gadget to their own work. A real sense of participation must be developed before the capital budget can attain even a reasonable share of its potential. Thus, again, personnel outlook must be modified; and a unified management posture must be developed.

This limitation of viewpoint toward budgeting may pervade the staff responsible for accounting. So "selling" the idea of budgetary management among accounting

people is basic, especially if accounts must be adapted to provide the necessary reports. When construction budgeting is begun in any department, accounting adaptations are practically always essential, as general financial controls are not characteristically maintained on an adequate project basis and the usual cost records produce inadequate reports for budget administration.

Budget Orientation

As has already been implied, budget orientation is especially urgent for the planning staff if, as is suggested, that staff is to make route and project priority recommendations. Fortunately, planning personnel is likely to be comparatively receptive to such an outlook. Nevetheless, it may be helpful to comment on some of the ingredients in the orientation.

First of all, the planning personnel must maintain continuing awareness of the numerous dimensions of the program which forms a basis for the capital budget. It must develop project priorities by classes of highways (highway system), by districts, by phase of work, and by character of project. Policy regarding particular routes, too, is reflected in the project selections. Continuously, also, the planning agency must make route studies and offer recommendations regarding route plans—all as an element in the background for project proposals in programing the capital budget.

In the second place, the planning staff must maintain a tolerant and flexible attitude toward the kind of evidence to be considered in determining priorities on each system in each part of the state. There is an understandable urge among some highway planners for the sort of definiteness in planning criteria that can be mathematically formulated. Sometimes even sufficiency ratings alone have been urged as a basis for establishing priorities. A more sophisticated, but still inadequate, suggestion contemplates that a formula-based benefit-cost or rate-of-return-on-investment analysis can supply the basis for project selection.[11]

Budget students experienced in comparative project-priority analysis appear to agree that such rigid approaches to project selection for budget purposes are altogether too much over-simplified (and too rigid) to be acceptable in practice. They insist that the criteria to be applied, although including considerations of a formulaic character, must also take account of dynamic factors which differ from place to place and are altered from time to time even in the same place. For example, assume that sufficiency ratings, traffic measurements, or benefit-cost analyses indicate that two urban expressways in a city are about equally urgent. Suppose the route in one case would pass through the edge of a series of parks and playgrounds to which local residents are both recreationally and sentimentally attached, but requires, incident to right-of-way acquisition, little disturbance of homes or businesses. Procuring right-of-way for the alternative route would uproot numerous family residences and business establishments. On which route in a period of slow business should projects be assigned highest priority?[12]

The kinds of factors which have a bearing on route or project priority determination (and in either case on programing) are numerous; but perhaps it is not possible to enumerate all of them for the reason that values change with the passage of time, for example, with changes in production plant locations and consequent alterations in transportation requirements.

Although the purpose at the moment is to emphasize the need for a flexible-minded

---

11/ This generalization usually rests on a recognition of few of the remote effects of a project. Also it largerly ignores the fact that a project for highway improvement is an arbitrarily severed part of a road or street. It is not an economic unit even in the limited sense that has been deemed to justify the mathematically-formulated benefit-cost criterion in application to water developments.

12/ A kindred problem, which addresses itself only indirectly to project selection, arises when design considerations are about equal and the two situations described are alternative routes for the same expressway. This problem, like that posed in the text, can be solved intelligently only by weighing social considerations which, in part, are not susceptible of mathematical formulation.

planning staff approach, not to analyze the basis for investment decisions, it may be helpful to comment on two or three aspects of background for such decision-making.

1. In dealing with the concept of cost, to take an obvious example, is the planner concerned with current capital cost or with annual cost? It seems apparent that, although annual cost is far more meaningful for general comparisons, such as those incident to rate-of-return-on-investment or benefit-cost analysis, the planner on occasion may have to take account of out-of-pocket cost as well. This consideration of the aggregate cost of preconstruction engineering, of right-of-way work, and of construction as such may be a significant element in deciding whether field survey on a particular project for a given highway system should be fitted into the second or the last year of a six-year budget in the light of all other requirements on and off the system in that part of the state.

2. Political factors in some cases may constitute technical considerations of varying importance from time to time and from place to place. For example, one state which is heavily committed to recreational facilities, not only for reasons of providing diversions for its own people but also as an instrument for economic development, recently found that an overwhelming proportion of its out-of-state vacationers came from the states immediately to the north. The state's own population centers are mainly in the northern part of the state, and its recreational centers are southward. To the extent that the state wishes to emphasize the vacationer's use of its roads for recreational reasons, the highway planner may be called on to give substantial weight to traffic on the north-south main roads considered for replacement or reconstruction. In particular, this recreational objective may constitute one consideration in fixing interstate system priorities.

3. In certain states considerable population is found in remote areas more or less cut off from urban and other social centers. In such a case, reduction of social isolation may be an objective considered in comparing certain projects for access roads with others where the traffic might be expected to be heavier but where there is now no problem of isolation. The weight given to such a consideration may or may not depend on general state policy. For example, a state wishing to provide consolidated schools in the area which is cut off might place greater emphasis on reducing social isolation than would be proper under other conditions.

A third programing factor is that highway planners in some states may give more emphasis to engineering considerations[13] than the relative importance of such factors justifies.[14] Aside from the whole gamut of general economic factors, there are special influences which may bear on costs or on the rate at which construction-focused activities can be carried on, such as availability of specialized manpower, of road construction resources, and of road materials. Some of these may bear on priorities directly; others may affect the definition of feasible projects and therefore indirectly influence priority determinations. Then, there are general social as well as governmental factors. The impact of road construction may affect not only the rate of economic progress nearby and on alternative routes, but also the activities and costs of local government, the relative prosperity of different communities, and many general social aspects of community life. Some of the influences grow out of right-of-way actions; others grow out of the services of the completed road. None of these issues may be deliberately ignored in planning a highway construction program.

13/ Priority planning rests on basic assumptions as to cost. In turn cost depends on the kind of improvement undertaken; hence the necessity for clearly-defined planning assumptions as to design. Any project, after advancement to the design stage, should doubtless be referred to planning for a review of priority-rating if the actual highway-improvement plan departs from the assumed one sufficiently to affect costs materially.

14/ One of the most stimulating discussions of this line of enquiry is the work of an eminent engineer known to all participants in the present conference. See M. Earl Campbell, letters to Harry Schwender, September 28, October 1, October 21, December 4, December 28, 1959, and January 21, January 25, and March 21, 1960

Finally, the planning staff in its priority-rating capacity needs insistently to maintain its position as a staff agency. The planning relationships to the budget administration on the one hand and to the officers who finally approve planning recommendations, on the other, must be kept on a cooperative and advisory footing, respectively.

Although technically-complex project priority ratings are a basic output of the planning staff, that staff does more in relation to the budget staff than provide this phase of budget work. The planners, to make their own output most useful, must adhere carefully to work schedules planned by the budget staff (with collaboration from other administrators). In particular, the former must meet prescribed deadlines. Again, from experience in budget execution, the planning staff can have a statistical basis for scheduling rates of progress toward highway construction which are in line with practice rather than merely with what planners think progress should be.

Understanding Budget Data

In the typical state highway department, nearly all administrative positions are filled by personnel advanced because of functional achievement. In the case of construction branches, the top men have usually demonstrated capacity in building production as such. The director of structural design, for example, has usually won his administrative position by the production of an unusually large number of exceptionally high quality bridge designs. Supervisory personnel throughout the department have secured their positions for kindred reasons having to do with technical excellence in the work they now supervise. Such a plan for the selection of upper-echelon personnel is widely commended.

It is clear, however, that this generally-preferred method presents difficulties in terms of assuring that administrators have some background for understanding the significance of budget data and methods for their use. The administration of the highway department budget thus involves a problem of diffusing budget lore not only to the department head, usually a layman (in relation to budgetary management as well as to highway engineering), but also to the several other supervisors of departmental acitivities.

Responsibility of the budget staff for making all branches of the highway administration aware of management knowhow deserves great emphasis.

1. One budget-staff obligation is to aid colleagues toward an operating understanding of budget processes. This obligation is urgent in general; it is still more pressing in the case of the construction than of the current budget because the former is more generally of operating concern to all construction-oriented supervisory personnel.
2. Awareness throughout the highway department of budget execution information and of its management significance is pecularily urgent. As data processing equipment now makes possible full detail regarding both the operational advances of, and the expenditures for, each project, the budget staff opportunity to aid all construction-focused administrators is many times as great in this respect as it would have been without such adequate report-producing apparatus.
3. The opportunity of the budget staff to contribute to a pervasive sense of departmental unity is much enlarged by the use of a construction budget.
4. The budget staff in connection with the responsibilities already noted must discharge its obligation to show that its own activities are basically of a service character. The budget staff worth its salt knows that a department of highways does not exist to prepare or execute budgets. Rather, its job is to aid other administrators.

As has been observed, "The highway department budget is for highway engineers."

The findings in studies of methods of disseminating budget information[15] are unequivocal in certain respects: (a) the clearing process must be continuing; (b) it must be made a matter of record; (c) it necessitates oral discussion on each occasion;

15/ Compare Learned, Ulrick, and Booz, loc. cit., for example, which clearly develops the evidence.

and (d) the task of seeing that such discussions are held must be the responsibility of a designated individual. In line with these findings and of the nature of programing administration, a specific suggestion is set out for making the budget function—especially the construction budget function—a generally-appreciated tool.[16]

Once the construction budget idea is accepted and formal arrangements made for operation, including the designation of a competent budget director placed in the administrative framework readily accessible to the department head, specific plans can be formulated to make management a going concern. The budget staff should develop a budget manual for department head promulgation, including a calendar for preparation of current and capital estimates (backed up with a calendar, previously agreed upon, of planning staff work and reporting), for approval of the estimates, for various steps in the execution process, and for audit and report. That staff should receive all budget accounting reports for distribution. It should immediately prepare explanatory memoranda for all the departmental personnel which have or may have an interest. In the case of current budget reports, the departmental budget staff, the state budget officer, and the head of the department of highways may be the only personnel immediately and urgently concerned. In this case, the memorandum will be directed to the department head. It will be submitted to him with the statements attached at the earliest opportunity. This report will not be sent to the department head but will be delivered by the budget director in person; the latter will give a full oral explanation of the implications. The department head or an aide will cross-question the director as fully as he wishes. The budget staff will discuss issues with such additional department personnel as the top administrators direct.

In the case of construction budget reports, the procedures are similar but are designed to serve the greater number of administrators typically concerned directly. The departmental personnel involved will include the same individuals as in the instance of the current budget, chief highway engineer, and the individuals in charge of each major construction-focused activity. It will also include the director of planning. An individual memorandum is prepared for each of these persons, and each is personally visited by the budget director (or a subordinate). In many cases, once the program is in full swing, the directors of functional activities will wish their subordinates briefed by the budget staff. If this is the case, especially if traveling is involved, budget staff personnel generally will have to be employed in interviewing. And subordinate budget staff members may conduct some interviews, even with major departmental officials, once the procedure is established. Delegation of interviewing to subordinate staff members should prove constructive both in the budget staff and in its relationship to other departmental manpower once the prestige of the budget director becomes secondary to the service rendered.[17]

If the budget staff adequately reflects management capacity to achieve the best use of scarce resources[18] and if the outlined procedures are followed, the highway department top manpower can be greatly aided. Personnel can be rendered enthusiastic for management use of budget data and techniques to the maximum extent. By the same token they can easily become enthusiastic contributors to the programing process.

The budget staff relationships to the department head and to the planning staff under such an operating program can rapidly become intimate and can complement the work of the latter in a happy fashion. The inflow of information, the interchange or loan of personnel between the production-focused administrators and the planning staff, and other forms of intra-departmental budget-inspired cooperation can bring the planning staff recommendations of priorities to a level of promptness and acceptability not otherwise possible.

16/ This in turn should contribute to better cooperation by departmental manpower with the planning, accounting, and budget staffs in programming activity.

17/ The budget staff, as far as circumstances permit, will interview subordinate staff personnel in the presence of the immediate line supervisor. Compare Learned, Ulrick, and Booz, op. cit., chap. 13.

18/ Compare John D. Millett, "Management in the Public Service: the Quest for Effective Performance" (New York: McGraw-Hill, 1954), especially p. 224.

ACKNOWLEDGMENTS

The author's colleagues, Miss Utha R. Conrad, Kenneth E. Cook, Eugene C. Holshouser, and Mrs. Arlene T. Shadoan, have contributed helpful criticism of an earlier draft of this paper. Dr. Holshouser aided extensively.

Discussion

Granum.—Do I gather that basically what is being suggested here is that a budget staff be the programing agency of a department?

Martin.—Yes, and no. I suggest that the establishment of priorities, the analysis of factual data which goes into the establishment of priorities, the whole planning process, should be a function of planning. In state highway departments, unlike most of the cities, there is a separate planning agency already established. And in most of the states that planning agency has a professional atmosphere that places it in the strategic position for the establishment of priorities.

Circumstances in different states differ widely. But I have suggested that the budget staff emphasis is primarily a management emphasis and secondarily a financial emphasis. Consequently, the task of integrating the established priorities set up by the planning agency with the financial plan, which is developed by the budget staff, or developed by the budget staff in conjunction with appropriate administrators, is a separate task. Of course, in some states the budget function is to all intents and purposes lodged in a planning agency.

I am not disagreeing with that operation. There are two functions to perform, and whether they are lodged together or separately is of secondary importance. I think they are likely to be more successful, however, if separate.

Granum.—You are emphasizing the financial aspects of integrating planning and money to get ultimately a construction program. Regardless of whether you might call it a budget office or a programming office, is it not true that there are many aspects, other than money, which need to be considered? For example, the budgeting of available manpower in a department to produce plans? Where would this fit in?

Martin.—The distribution of manpower is a function of line administrators rather than of either planning people or budget staff; and budget information can contribute heavily to that process; but there is no substitute for the engineering staff of a highway department determining the disposition of engineering equipment and engineering personnel. The budget function should thus be considered as a helping function.

Primary emphasis should be on management in the budget process with secondary emphasis on the fiscal side of the operation. It appears to me that the shortages in highway departments have been primarily shortages of professional management personnel and professional management know how, and in that respect highway departments suffer much more heavily than other business organizations of similar size and character. This condition ought to be relieved.

It can be relieved most effectively, in the initial sense, by focusing on the products of financial administration and planning administration. Products of financial administration means basically reports of exactly what has occurred.

I emphasized the basic importance of dovetailing financial information and engineering information. It is possible to bring this information together only by the use of data processing equipment.

Burnes.—Are you suggesting the use of performance budgeting, from the viewpoint of financial control? It has been my experience that it is absolutely necessary to coordinate finance and planning in formulating long-range or short-range programs. Are you leaning toward the need for performance budgeting, which would include a control on the construction program as well as the other accounting activities?

Martin.—Performance budgeting, as the concept is usually understood in municipal practice, where it is best developed, grew out of program budgeting. The first stage

of development is program budgeting. Performance budgeting is a further development.

In much of the highway industry, the states have not reached the data producing basis for performance budgeting in the sense in which that term is used in local government. Moreover, performance budgeting focuses on the preparation of estimates but it does not exclude other aspects of budgeting.

I am trying to focus on the execution of the estimates, rather than the preparation of them. I am not doing that because I think one is more important than the other, but simply because the execution process is the process where I think it can be shown very readily that all supervisors in a highway department can profit enormously from budget activity; and because the area of execution has been relatively neglected in highway discussions.

The answer to your question, as formulated, is yes or no. It can be either program budgeting as such, or it can be, from certain points of view, more refined performance budgeting. At the present time in most state highway departments true performance budgeting would be premature.

Babcock.—What do you feel is the relationship and responsiblity of a state budget officer in the budgeting of a highway department or a highway commission?

Martin.—In some states, none at all. That is a situation heavily dependent on the situation within the particular state. In some states, the state budget office has been developed to such a degree that it is of very substantial assistance to the state highway department. In this particular matter Oregon has gone further than any of the other states, as a practical proposition. There, the highway department and the state budget office have worked together to implement the assistance that the state budget office can render to the state highway department; so that to whatever extent it can render assistance, within financial limitations, it is being done.

There are different legal relationships. There are different practical relationships in the various states. I am not suggesting any alterations in those relationships. In some states the general budget office can be of help to the state highway department. In other states, it cannot be of very much assistance. Far more states are probably in the latter category than in the former.

Babcock.—Do you think the state budget office should have control over the highway budget, and control the execution of it?

Martin.—I think of a budget staff as what the military would call a staff agency. It is an outfit set up to help other administrators and not one to deal finally with problems in the sense of control in an administrative relationship. If the attitude and the outlook of the state budget office is one of assisting the agencies of state government, then we need to recognize that the state highway departments need all the assistance they can get. If it is one of exercising administrative control over the state highway department, then it seems the less of it we have, the better.

Babcock.—In North Carolina, according to our law, we have a rather detailed budget, about 1500 pages, adopted by the General Assembly. And that budget, comes under the authority of the state budget officer to over-see. We have to go through him for every allocation of funds.

Is that a common practice in most states? Are state budget officers given control, or are highway departments given great latitude?

Martin.—Our survey indicates that the practice has varied widely on that score; but it also indicates that in a good many states, where the law is as it is in North Carolina, the actual operation of the allocation process and the approval process is more or less perfunctory. The director of the budget of the state approves what he is asked to approve if the request comes from the state highway department. That is not invariable, but that flavor exists to a very considerable extent.

Kimley.—Seeing that we do have representatives from two municipalities present, and this is supposed to be applicable to all units of government, do you feel that your procedure would be equally as applicable to municipalities as it would be to a state government?

Martin.—The answer is yes, but with several reservations. Many of the cities have developed effective over-all planning agencies covering many facets of government responsibility. If there is an agency in the city government having such diversified functions, including adequate planning for construction, as is the case in many cities, then by and large, what I have suggested would apply almost exactly in the same way to cities as to states.

In some of the other planning-conscious cities, the long-term planning function is lodged in a budget-related office. The planning function is integrated with the rest of the budget activity, both of these functions being in one office. Usually, where a combined budget-planning office exists, the situation is likely to be a happier one than exists in the state government because the city operation is dominated by a management outlook, rather than by a planning outlook or an engineering outlook.

Most of the functions of either state or city highway development are jobs for engineers and you are bound to get an engineering point of view from the engineers. The engineers need to be assisted by having brought to them management considerations that are also important in their decision making. By and large, however, the states will be better advised to develop budget and planning as two separate operating units, because there is so much in planning that does not have a budget relationship.

Granum.—Your discussion seems to indicate that the chief engineers and the other traditionally active heads of departments are not, in your opinion, managerial people in the professional sense. Do you think that is a fair statement, broadly speaking?

Martin.—That will vary from one state to another, and I do not have the knowledge to give an answer to that categorically. Comptrollers and chief engineers both are people whose assignments are primarily management assignments. The comptroller has usually come up through an accounting process. He is a professional accountant in many instances. The chief engineer is a professional engineer.

You need people whose background and emphasis has been management as such, operating not in a decision making capacity, but operating in a capacity that will assist the chief engineer and subordinate engineers as well as comptrollers and other people in making decisions.

Granum.—No one could take exception to the need for that in an assistance capacity, but somehow I get the impression that you feel that the solution to the problems we have would involve predominantly a professional management group to tie in and coordinate these various activities. The achievement of that professional management operation in a department might vary a great deal. For instance, the engineer and the accountant could be educated in good management techniques.

I would disagree with any assumption that it is necessary to bring in a layer of professional management personnel to resolve highway problems per se. It seems that it is more than just a professional group of people that is involved here, it is a professional attitude that should be involved throughout. Is that not true?

Martin.—Yes. I indicated some agreement with the very point that you make, and proposed a specialized group for providing assistance in the development of that pervasive attitude that you refer to.

Babcock.—In North Carolina there are two appointive officials, one the director of highways, and the other the comptroller. By law, the comptroller is actually the business manager who is responsible for all audit systems and reports. Is that the type of operation you are referring to?

Martin.—No, I do not refer to that, because that has to do with the operating side of the department.

Babcock.—The comptroller also assists in the preparation of budgets.

Martin.—Well, in many states, in practice, the comptroller's function includes the budget work. But the function or operation I refer to should be a high level type of management activity on a helping basis, and not on a control basis as the typical comptroller exercises it.

The comptroller makes decisions within his realm of interest that are akin to the decisions made within the purview of the chief engineer in his bailiwick. That is as it should be, but the comptroller's decisions should not be mixed up with budgeting as such. Budgeting needs to be on a helping basis and not on an operating management basis. Budgeting needs to be pervaded by a professional management outlook.

One of the things that may not have been sufficiently emphasized is the coordination between the comptroller, and the engineering staff. The prevailing attitude is too frequently that of, "I will look after my business to the extent that I can, and I will let the other people look after theirs." The engineers are likely to take this attitude toward the comptroller's job. The comptrollers are likely to take it toward the engineers. That is not the best way to run a railroad. All should be working toward the same end. So it seems necessary, as is true in other businesses, to have somebody whose functions are management liaison, among other things, to assist the top level officials in bringing together these two professionally different groups of people, both absolutely essential to getting a job done.

Johnson.—Is that not actually the chief administrator's function in the department? In management literature, for example, we learn that the function of a manager or of a chief administrator particularly, is to plan, organize, and control. That is his main job.

It seems to me that there is the coordination, the linkage between these various things. We have operations-oriented people, unfortunately, in some of these top jobs in the departments, rather than people that are oriented towards all phases of this particular problem of developing an adequate highway system, to put finances and budgeting and planning in its proper relationship to all of the other things. These become orphan children in the department, rather than the essential job of top management in the department.

Donnell.—Your idea is that the planning and engineering personnel should advise the management or budget group of their needs. Then the budget group should tell the planning group how much funds are available for them to work with. Is that your recommended approach?

Martin.—It seems to me that the problem of estimating money availabilities, which has been rather poorly done in the state highway departments, is a fairly sizeable undertaking in itself.

The formulation of a budget document and the assistance to the top level administrators in making that budget document a living instrument for management is a joint function of planning and budget administration.

I have indicated that those two functions may be administered by one function, or they may be administered by more than one. The budget-management approach is likely to be a totally different approach than establishing priorities system by system. This whole approach is a collaborative process and actually involves the collaboration of personnel other than highway planners or budget personnel. It is a collaboration process that involves the entire operating department.

The matter of estimating revenue availabilities and establishing priorities, constitutes a dynamic process to which there is no end. And the process basically seems to me of necessity one of collaboration.

Livingston.—I think that the estimate of available revenues is a vital part of the planning function. But then, after estimate of revenues is tied to the construction program, we get part of the budgetary team on both the pre- and post-audit function, where they join up. But it would seem to be practically impossible to do a proper planning job unless the estimate of revenues is geared to the priority schedule.

I do not suggest that it should not be a team, but I would like to define the functions of planning and budgeting as being professionally carried out on both sides. Usually, the people who work with budgets do not have the statistical information to prepare the estimates and the forecasts of revenues that will be available for a long period of time.

Martin.—If you emphasize the budget process, as the literature for a hundred years

has done, as including the process of formulating the estimates, the process of submission for approval, the process of actual formal approval of whatever sort is required, the process of executing the plan, and the process of checking up on that executed plan, then the budget function should include all of the estimating and forecasting.

Now, in highway work, the part of it that has to do with the preparation of the estimates is pulled out and to a considerable extent handled by the planning agency. The job of exercising that function is one that ought to be collaborative between budget staff and planning staff, if they are separate; but not separate and distinct.

The planning staff secures its information from sources which reveal highway needs, basically. The budget staff secures its information from the other operating agencies of the department, as well as from the statistics and other information that reveal highway needs. These pieces of information need to be brought together, rather than separated, in the process.

The task is one of collaboration. They are two parts of one thing and need to be so considered. Generally, it would be a mistake to assume that highway planners know more about the finances than the financial people do.

Concepts of and Approaches to Capital Budgeting

ROBLEY WINFREY

What is capital budgeting? In terms of industry, capital budgeting is allocating or setting aside specific funds for purchasing or constructing specific fixed property, such as heavy machinery, buildings, heavy construction and other physical property used to produce the products of the organization. In highways, capital budgeting is allocating funds for constructing specific highway facilities necessary for the adequate, safe, and fast movement of traffic on the highways.

Money spent for capital purposes is distinguished from money spent for current operating functions because of the difference in time duration that the products of the expenditures serve their functions. Expenditures for operations are for the administrative chores, the maintenance of the physical highways, and the operation of traffic and other daily services essential to transportation over the highway. Financially, it is as important to seek the best decisions in making one type of expenditure as the other. Capital expenditures for identical functions or purposes are not repetitive, but the expenditure for maintenance and operating functions are generally repetitive, month after month.

Expenditures for maintenance and for capital purposes each are important. Expenditures for maintenance and operating functions produce, primarily, immediate benefits and serve immediate needs. (Recognition is given to the function of maintenance for the purpose of preserving capital property against deterioration from weather and wear.) Expenditures for capital property produce benefits and satisfactions lasting far into the future.

Within capital budgeting, there is a choice of many projects or properties to construct or to buy. This choice is what makes allotting money to construction projects a most difficult administrative responsibility.

FINANCING—ITS RELATION TO CAPITAL BUDGETING

Although the financing of capital improvements in itself is not a part of programing the improvements, the program does depend upon how much money is available and when. Selecting specific projects to construct is therefore controlled to some extent by the total sum allocated to construction for a specific time period.

Financing for families, for public works, and for industry has much similarity. To aid in understanding later discussions on capital budgeting, some methods of financing are presented in Table 1.

TABLE 1
METHODS OF FINANCING EXPENDITURES

Family	Public Works	Corporation
1. Cash on hand	1. Cash on hand	1. Cash on hand
2. Open account	2. Open account (future current income)	2. Open account
3. Personal interest bearing notes	3. Short-term interest bearing notes	3. Short-term interest bearing notes
4. Mortgage or other liens	4. Bonds, secured by tax income	4. Mortgage bonds
		5. Sale of stock shares

The decisions of a family, a public agency, or a corporation as to capital budgeting

are conditioned upon not only the desirability of acquiring the fixed assets through capital expenditure, but by the amount of money it is thought wise to raise through one source or other to finance the expenditure for the capital property.

So frequently, the desires and the needs for capital improvements exceed the moneys available or that amount which could be wisely raised by borrowing or extending current credit. In industry, for example, the management usually finds it desirable to spend less for capital investment than could be spent with good prospects of earning a reasonable profit. For this reason, the purchases or improvements to which money is committed are those proposals selected from the upper range of prospective rates of return. The shortage of money to finance all desirable improvements forces this selection from among those that offer the greater probable returns.

The same principle of financial management applies to public highways. Those projects which show the promise of rendering the greatest benefit are those that should be included in next year's construction program within the sum of money available for capital improvements. It is often unfortunate, however, particularly in public works, that a compromised decision is made whereby a second or third choice of capital improvement gets into the program because of insufficient financial resources to finance the No. 1 choice. In the long run, such procedure is costly to the public, but because of public opinion and pressure, there are occasions when a solution of lesser benefits is followed.

CAPITAL BUDGETING FOR FAMILIES, PUBLIC WORKS, AND CORPORATIONS

Let us take a look at the budget decision responsibility from a personal family viewpoint, from the top executive officer or commission of a highway department, and from the chair of the general manager or board of directors of an industrial corporation.

Consider yourself as head of your family, or at least as an equal voting partner in its financial management. Here are proposals now facing you. Buy a new automobile for $3,000, a household freezer for $350, wall-to-wall carpeting for $1,000, and take an $800 vacation in Florida. These needs and desires represent day-by-day considerations in American families, and decisions must be made as to how much money to spend for what. The automobile, the freezer, and the carpeting are capital improvements of reasonably long life. They are likewise nonrepetitive in successive years. The vacation trip is an operating expense rather than a capital investment, but in this case it is one of the alternative uses of the limited family funds. Considerations involve (a) cash on hand and immediate future earnings, (b) money needed for operating and maintaining the family activities for a future period, (c) what items will bring to the family the greatest benefits and satisfactions, (d) to what extent will these benefits and satisfactions warrant borrowing immediate money, or delaying reduction of existing debts, and (e) within the total money available, which of the several wants (you cannot finance all of them) will render the greatest satisfaction in the long run. The decision process is handicapped because of the lack of any tool to convert the anticipated benefits into money values so they can be laid out on a yardstick of dollars and compared to the readily calculated costs in dollars. But you do reach a decision—wise or unwise.

Now, look at a highway department. The commission, or commissioner thereof, has before it identically the same problems as you have as head of your family. Shall the highway commissioners build a bridge over the North Fork River costing $2,000,000, repave the urban arterial route on 10th street for a cost of $3,500,000, relocate Route 16 around Centerville at a cost of $1,500,000, install $500,000 worth of lighting at heavily traveled intersections, or catch up on long delayed roadway maintenance. The commissioners may first decide that $16,000,000 is required for maintenance and operations, leaving an anticipated $45,000,000 for capital construction for the calendar year 1962.

Unlike the head of the family, the highway commissioners do not have under their control the decision of whether to borrow money. The decision to borrow money lies with the people at large. Therefore, the highway department is compelled, in its 1962 program, to stay within its estimated receipts from the existing rates and modes

of taxation, or from action of the legislature which appropriates these highway user revenues to highway purposes. In any case, there is a limit to the amount of money available. The commissioners' responsibility is to determine, within the amount of money available, a specific listing of construction projects to which to allocate the limited resources of $45 million. The decision is theirs to make; the process by which they reach the decision is also theirs to make.

Let us now turn to private industry. The board of directors of the XYZ Manufacturing Corporation has these propositions before it: (1) Construct a new plant at a cost of $3,000,000, (2) purchase new automatic machinery at $1,500,000, (3) spend $2,500,000 on development of a new product which shows possibility of reaching a profitable sales volume, (4) repair and repaint the central office building at a cost of $300,000.

Here we find that the board of directors has before it the same basic problem as does a family and a highway department. Each must estimate the probable short-range and long-range benefits. Industry is concerned with making a reasonable rate of return on its investment in order that it can continue to attract the necessary capital funds at reasonable rates. But, unlike the family management, this industry management can translate its benefits from each choice of expenditure to dollars without too much uncertainty. If it misjudges the future unfavorably the company will lose money, lose financial backing, and ultimately the stockholders may lose their investment. Presumably, any bondholders will take over and recoup what can be salvaged on their mortgages. The first decision of the board of directors is to determine how much money is to be spent for capital improvements and how much is to be reserved for current operations. But within the amount of money provided for capital improvements comes many different levels of decisions as to what capital improvements are desirable next year, the year following, and so on, and the adoption of an orderly, reasonable long-range program. At the same time, the method of financing the capital investments is decided.

Fundamentally, the family, the highway department, and the corporation make the same type of decisions, for the same basic purposes, and by the same general processes of weighing the sacrifices against the benefits. The differences lie within the ease, completeness, and reliability that the benefits can be forecasted and compared with the costs.

The family is without a dollar yardstick for estimating its benefits on most of its decisions and is forced to use judgment without reliance on monetary comparisons of benefits and costs. Its situation is simplified, however, because it need consider no others whom may be affected by its decisions. The highway department is in an improved situation over the family, because dollar benefits and dollar costs, current and future, can be supplied for many of its proposals. However, many intangibles and nonreducibles are involved in reaching final decisions, and its decisions must be made in light of the consequences to whomsoever they may accrue. The corporation is in the most favorable situation becuase it can reduce most of its proposals to comparable and reliable money values. Also, it is concerned only with its own future. It can ignore the consequential effects upon its competition and society in general.

Each of these three economic units, however, is required to practice capital budgeting—formulate a program of expenditures for long-term investment in physical property. Each must allocate its limited resources to specific current improvements. How well the job is done depends upon their skills, conceptual abilities, degrees of exactness, and pains with which they examine all factors involved, present, immediate future, long-range future, tangible, and intangible.

ECONOMIC AND SOCIAL EFFICIENCY

A fair question to ask is, "Why budget for capital improvements?" As a responsible family member it is our desire to invest our financial income so that we can get the maximum of satisfaction (benefit or return) from our expenditures—currently as well as in the long run. Certainly, should we choose the wall-to-wall carpeting over the other items, it is because, all factors considered, the carpeting will return to us

the greater benefit or return commensurate with cost. Money for operation and maintenance comes first; the family must be fed, clothed, and housed. But here also, choices prevail which control the total amount available for capital goods. What is left, plus borrowings, is available for capital purposes.

Public works services (highways) result in no monetary profits which may be used as a measure of the wisdom of their construction. Highways do produce benefits, however, which can be reduced to money values, and other benefits which cannot be readily or reliably reduced to money terms. But the same principles prevail—the obligation to construct public works projects—highways—only when, (a) the benefits have greater value than the cost to obtain them, and (b) to construct projects in chronological order following the order of decreasing satisfactions, or rate of benefits as related to cost.

Turning to private industry, we find the same basis for our decision—return on the investment and over-all long-time benefit to the company. But, herein, unlike within a family and a highway department there is a tangible measure of the benefits—monetary profits. These predictable profits (returns) are a quantitative guide to the probable benefits from alternate choices of capital investments.

The following quotation states and enlarges upon these principles:

> Economic efficiency, accordingly, is defined as a situation in which productive resources are so allocated among alternative uses that any reshuffling from the pattern cannot improve any individual's position and still leave all other individuals as well off as before. Of course, any change in the pattern of resource employment may improve the conditions of some people, but if this is done at the expense of others it may be only a redistribution of income. Income redistribution can be regarded as more efficient only when those whose positions have been improved by the changes have gained more than enough to compensate the losses suffered by others. Economic efficiency implies that, given his income, every individual will allocate his expenditures in such a way as to maximize his satisfaction. It implies also that, given the demand for the resulting goods and services, productive resources will be so employed that no reallocation could achieve the same level and composition of output with a smaller expenditure of resources. When these conditions are fulfilled, the economy is operating with maximum efficiency.[1]

Another quotation from Krutilla and Eckstein is appropriate to explain the economic behavior of an individual:

> Accepting the assumptions of the competitive model, we begin by focusing on the individual in a free society. Our assumption of rational behavior requires that he make the following allocations: On the one hand, he allocates his time between work and leisure so as to equate his marginal valuation of his productive services to the market rate of remuneration in the occupation of his choice. On the other hand, he allocates his income between consumption and saving so as to equate the market rate of interest on his saving to the sacrifice of current satisfaction entailed by the marginal dollar of saving. The portion of income left after savings becomes his consumption budget. His purchases of alternative goods and services are so budgeted as to equate his marginal valuation of each to its market price.[2]

Now we can answer the question, "Why budget our resources for capital improve-

---

1/ John V. Krutilla, and Otto Eckstein, "Multiple Purpose River Development," pp. 16-17, The Johns Hopkins Press, Baltimore 18, Maryland, 1958.
2/ Ibid., p. 40

ments?" The answer is: So that we can be reasonably assured, (a) that we are maximizing our benefits, and (b) that we have so allocated our resources to specific functions and projects that any other allocation "cannot improve any individual's position and still leave all other individuals as well off as before."

The inclusion of a specific highway improvement project in a specific year's construction program will result in benefiting certain individuals certain amounts. Omit the project and these benefits are not received; include a substitute project and the benefits are conferred upon a different set of individuals. But is this substitution a wise one? The answer is found in the successive testing of all proposals against each other until that combination is found which leaves all individuals with the maximum benefits measured in mass. Important to keep in mind is that the word "benefits" includes all net favorable consequences, that is the intangible, social, and community benefits as well as those easily measured in dollars.

HIGHWAYS VS OTHER PUBLIC CAPITAL IMPROVEMENTS

It is desirable to look further into the field of public works than to the immediate highway department. As a matter of public policy, highway officials are custodians of the financial resources provided for highway functions. But as agents of the public, highway officials have a responsibility to advise the public and the legislature as to elements of public policy. Taxes for highway purposes could become unduly large so that taxes and budgets for governmental activities such as health, public welfare, and education would become too small. The public at large must make a decision as to what proportion of its resources it wants allocated to each of the functions of government, including highways. It is, therefore, important in the budgeting of money for capital construction in highways that this money is budgeted to those projects which have the highest rate of return and which serve the real economic and social needs of the public—not merely desires.

The public should give serious attention to allocating its resources to priority needs. Taxing and budgeting for public purposes have to be realistic and effective under those controls and incentives that are desirable in producing the most good for the greatest number of citizens. Beyond this, government officials have a responsibility in the expansion of the economy of the nation in order to maintain adequate employment and proper fulfillment of the needs of its citizens.

Needless to say, any public works program of a large scale, such as the current national highway program, does affect the financial market and the over-all economic activity of the Nation. This is illustrated by the simple statement that if we were not spending $6.7 billion a year on capital outlay for highway construction, what would we be spending the $6.7 billion for? Or perhaps we would not be spending it all. If we are not spending it all, what would be the consequences on the economic activity of the Nation, including the earnings of its 68.6 million workers?

TANGIBLE AND INTANGIBLE FACTORS WEIGHED BY JUDGMENT

When it comes to the budgeting of funds for capital improvements, the highway administrator may find himself without many of the tools and guides he desires to have. The fields of science and technology have developed many specific tools through which specific things are accomplished. Highway engineers know how to design an adequate highway, utilizing the natural resources of earth, wood, minerals, and metals. This design and its construction utilizes the well-known laws of science and engineering. Although we cannot say that the process is wholly exact, it certainly is reliable. The end results are predictable within narrow tolerances. On the other hand, science and technology have not yet found the method of solving with certainty problems in economy, in sociology, in government, and in the problems which involve judgments pertaining to human behavior.

By reasonably reliable studies of engineering and economy, we can predict that Project A will cost 1 million dollars more than Project B, and that the tangible money based benefits from Project A will likely be equivalent to a rate of return on the investment of 12 percent per year, as compared to Project B with an estimated rate of

return of only 8 percent on the investment. Sufficiency ratings and maintenance costs are also available. The administrator can rely upon these figures as being reasonably sound, but such factual answers are only part of the foundation on which his decision must rest. Unanswered questions are: What are the consequences in health and safety on the areas affected by Projects A and B? What are the long-range consequences socially on the population affected? What are the consequences in the changes of land use in the areas affected? What are the comparative advantages of Projects A and B in the utilization of materials and labor? What are the comparative availabilities of materials and labor? What are the respective rankings of Projects A and B in the defense facilities for the Nation? Would greater benefits accrue to the public by building Project B, and one or two other small ones, with the million dollars difference in cost of Project A less B?

These factors and others face the administrator who must make the choice between Projects A and B. Thus, it becomes not solely a question of financial disbursement, of economic cost, of engineering economy, but of factors pertaining to health, morale, and social activity, as well as over-all governmental responsibilities.

We hear a lot today about electronic computers. True, electronic computers are available to solve all mathematical problems that man can devise. On the other hand, no computer today has yet developed an ability to reason. This statement is made notwithstanding that the electronic computer is on the way to becoming the world's champion chess player. Such championship will be achieved only through progress by trial; the computer learns not to repeat a play under a given set of conditions which in its past experience led to loss of the game.

It is desirable to apply electronic computers to the management decision process, and already the electronic experts have penetrated fairly deeply into computer programming toward this objective. Such development with computers will not replace management decision, but it will come a long way in disclosing to management the possible consequences of the many possible decisions, and the effects of variation in weights placed upon the several factors on which decisions are based. When many choices of decision are available, the computer can eliminate the less desirable ones and thus leave the decision maker fewer proposals for which to select his choice. The allocation of scarce resources to multiple needs can be made more dependable through linear programing methods.

To translate this thinking into highway programing responsibilities requires a computer program by which such factors as financial cost, economy, traffic served, land area served, available labor, available materials, land use, pavement conditions, and road-user benefits can be studied in such a way that the factors having the greatest effect on the consequences can be easily isolated. The decision maker then has a much better guide for final decision than he would have otherwise.

THE RESULT OF SOUND CAPITAL BUDGETING

Capital budgeting is a necessary device of good management, whether it be in household finance, public works or industrial manufacturing. Capital budgeting for highways is just one of those management tools by which control and strategy are applied to the process of investing the dollar in orderly construction of improvements which will serve the public for years ahead. Without orderly, well-designed capital budgeting, the highway improvement program would degenerate into a hodgepodge, catch-as-you-can, politically dominated, fluid operation reaching toward a fluctuating unknown goal. The over-all construction program must have a long-range objective, and a long-range detailed plan. Yet this long-range program must be variable enough to permit short-range moves to meet the changing of times, to take advantage of the newer and better ideas that evolve, and to provide for overcoming omissions which are bound to occur as we judge the long distant future.

A systematic study of the construction needs for a highway system, when preparing a construction program for a specific year, may raise the question of the benefits that would accrue from an accelerated construction program.

The list of proposed projects may be greatly in excess of what can be programed

for the imediate future, because of limited funds. When this situation prevails, a study would be in order of the advantages and cost of financing a heavier program through the proceeds of a bond issue or an increase in highway user tax rates.

The objectives to be gained by planning a highway construction program are as important to the city, to the county, and to the state, as they are to captial budgeting by any organization. There is practically no difference in concept and in basic procedure and objectives between such construction programing in the city, county, and state. The magnitudes of the program, their involvements and complications will vary, of course, but once we understand and put into practice a good workable procedure for developing short- and long-range programs, any highway department—city, county, state or special authority—will have a working tool well suited to its responsibilities.

In the field of planning ahead for highway capital improvements, we are assured of the certainty of uncertainties. But by adhering to those procedures and judgments known to be sound when applied systematically to the construction programing function, these uncertainties will reduce to a minimum; the likelihood of rendering the most possible service to the greatest number of people will rise to a maximum.

Discussion

Morf. —I believe that your presentation of this is such an over-simplification of the case that for a group of working people it is apt to be somewhat deceptive.

For example, the Congress Street Expressway in Chicago, which would carry 160,000 vehicles a day, with other portions of the Interstate System in Illinois, which would carry perhaps 5,000 to 6,000 vehicles a day.

Are we to say that we should only build "Congress Streets," because their return for the dollar spent is more? Should we never build bridges? Should we never think in terms of anything except this return?

It becomes a matter of how you are going to measure your return. So far, your discussions on Krutilla and Eckstein have been equating this in terms of dollars. There are other factors that should be considered also. We are not just begining to build a highway system. During the last eight years we built many miles of road in Illinois and have increased our mileage by 200. We are stuck with a large mileage of roads that we have to continue to maintain and service at various levels of service. And there is no doubt that when some of these roads are to be re-built, their return, measured in the terms that you have been speaking about here, will be far less than that of other roads.

I would like to have you amplify on this aspect of it.

Winfrey. —We have to weigh the benefits and they have to be greater than the cost. Those projects whose benefits are far greater than the cost are those that should receive top priority. All of these benefits are not measurable in dollars, but nevertheless, the benefits are there.

Because of our position, as highway administrators, we must make a decision as to which projects to build first, and every decision that you make to build a highway facility, whether it is the installation of a permanent traffic signal at an intersection, or a system of signals, or whether it is on the widespread scale of highway lighting, or whether it is building the Congress Street Expressway at $10 million a mile, you have made the decision that the benefits from that expenditure of money is greater than the benefits that the public would receive from the construction at that time of any other highway facility.

If you did not make that decision on that premise, you did not make the right decision. And I say that with all sincerity, because you should be trying to achieve the greatest return for the money you expend.

We cannot always reduce those returns to dollars. But still the benefits accruing from that capital expenditure of money must be greater than the benefits that could be achieved by any other expenditure of money for that year. When we are dealing with

the future we cannot always see it as it turns out to be; but at the time the decision is made, it must be made on the premise that the expenditure of money will offer the greatest benefit today and in the future.

When we come to reconstruction, there is a tremendous amount of it to do. But nevertheless, the benefits achieved by the traveling public and by our social forces in the country, which are affected by highways, must be greater because of that reconstruction or repaving or whatever it may be, than could be achieved through some other expenditure of money.

That is an ideal situation. But why should we not have ideals? Why should we not set our goals at the moon? The moon is not so far off nowdays. We are going to get there. And you can get there in construction program if you set your objectives accordingly.

But as long as we are swayed by pressure groups, and as long as we give in to them to get rid of them we will not make it. But if we have this kind of a program, and we stand behind it, then we have a chance of so programing these scarce resources of money to construction that we will come a long ways toward this ideal that is mentioned in the quotation from Eckstein and Krutilla.

Wiley.—Would this apply, then, that every section of road that any work is done on must be self-supporting and that work should always be done on perhaps the one that carries the biggest volume, because it does the most good, even if there are isolated communities that have perhaps one road connecting them to the outside world with a low traffic volume but no work would be done on that road because it would not do as much good as on the heavier traveled road? Or is there another value that is immeasurable at the present that you would assign to that type of a road?

Winfrey.—You can spend your money on the most expensive piece of road, and yet do less good than could be done in another locality spending one-tenth of the money. And I say this on a quantitative basis; not a rate or percentage basis.

If it is put on a rate basis, on percent return, or a benefit-cost ratio, or some other basis, it is being comparatively indexed. But when the benefits received from many of our local roads and streets are measured, they are tremendous per dollar of outlay.

I do not know how to measure the benefit to the nation of daily delivery of mail, or the five-day-a-week transport of children to school. But certainly those benefits are great, are they not? Even though they apparently return little of a tangible nature, the value of those benefits must be tremendous.

But it must be admitted that we do not know how to quantify many of them in terms of dollars. But a basis must be established for making the final decisions and that basis must include the social function, and education.

R. Johnson.—I am not going to argue with the fact that long-range planning should be performed in a way to maximize benefits through the power of allocation; but I think there is a factor which becomes far more crucial than that. A basic objective of highway departments is the development of an adequate highway system.

Without long-range plans, we have no assurance of developing an adequate system, since highway funds are limited. It is inconceivable that we will ever have sufficient funds to do the entire job, to cover every minor inadequacy, and even some major inadequacies.

Therefore, we have to have an objective so far as adequacy is concerned and allocate our resources specifically to attain the objective. And if we do not do this, there is not much chance that we ever will obtain an objective.

This poses some very specific problems to us in the whole realm of highway programing: What level of highway development is adequate? Have we specifically set a standard of adequacy which can be applied to each section of the state highway system? Has the standard been accepted by the public and been given public support? What progress is being made in obtaining the adequate level of highway development at the current rate of highway expenditures? Do we have a procedure for making a constant assement of progress in terms of standards of desired adequacy? Do we have a method

of determining the rate of obsolescence and its effect on the attainment of the desirable level of adequacy? Does the method that we use give a rate of obsolescence in dollars? Are the data developed by any foregoing procedures clearly summarized by the guidance of the highway department, for the information of the public and the legislature? And does our planning activity provide estimates of cost to give full development of adequate roads in each of the systems for which the highway departments are responsible?

A planning unit can perform the data gathering function, and a budgeting unit can perform a similar function so far as the allocation or termination of financial resources and the coordination with the planning function is concerned. But neither one of these agencies can properly establish the plan or unilaterally make important decisions. This should be done and can be done only by top management, with representation of all the functional units in the department.

Winfrey.—I do not have the answers to those questions. Those are the issues that face the administrators of highway departments. But yet, the answers to those questions have to be found within the framework of the philosophy just given you. We have only certain tools to help us measure that maximum. A large part of it has to be by judgment.

We speak of a section of highway. Well what is a section of a highway? Nobody knows. It is just what the individual thinks it is. It can vary from a foot of a highway up to a hundred miles. It is a section of a route. So, when it is broken down to workable sections, inequality in sections and in conditions is created.

But if there was a bottleneck in Section C, along a generally adequate route from A to H, and traffic could not get through this restricted section, that should become a highly important section.

Those are the problems that we have to weigh. In other words, one of the factors involved in programing is what you might call continuity of development.

We come back to an objective. Where are we going? Now, if you have an objective, then every decision that you make must move toward that objective. And if it is this section, then that section has great value, maybe far out of proportion than could be calculated on a dollar and cents basis.

Livingston.—If you take the Congress Streets, expressways which have high rates of return, because of their high volumes, you have got to compare them, with the feeders that build those high volumes.

How do you, from a budget standpoint, figure out the balance between the high potential and the low potential feeder? Because if you put all of your high earnings roads under contract and build those and neglect these low earning roads, finally you will dissipate the high earnings of the main arterial, because it will not have anything feeding into it, and it will be completely obliterated. There has to be a balance between this low earning road that has actually been amortized by the earnings on the high volume road.

How do you get at this problem from a budgetary standpoint? This is in earning rate. You forget all the sociological advantages one way or another.

Winfrey.—That is a very important question. It is a question that the airlines, the railroads, and the telephone companies are faced with; because if the feeders do not exist in any of the communication systems, then the trunk line does not get any business. The feeders themselves may operate at a paper loss in the way that at least can be calculated.

In the highway field, we can do the same thing. We can calculate our traffic and reduce that traffic to revenue and expenses, that is, expenses in maintaining and constructing the highway, and revenue earned from the users.

Feeder routes exist in the highway system. They are routes in which the allocated tax earnings, fuel tax and license fees, do not equal the cost of keeping the highway in operation. But we cannot dispense with them. We have to keep them in our system. We have take care of them. And they are profitable.

There is some scheme that could be developed on an arithmetical or allocation basis to make an intelligent analysis of the feeder routes importance. We cannot

forget our so-called feeder systems. They are essential. They are profit-making in the end.

Granum.—At the highway cost committee meeting in January, several people made the point that one of the most severe problems confronting the state highway departments in the development of primary road systems was how to finance the local road systems, that is, the township roads, or the lowest volume routes in the rural areas; their point being that legislators are very conscious of the problems of these local roads and are frequently convinced of the importance and the profits that can be returned from the expenditure of state-collected revenue on local roads.

Part of the problem that is facing us generally is to develop techniques and procedures which will help define the desirable level of expenditures on local road systems as well as on others.

This may seem a far cry from formulating construction programs, particularly for a state highway system, but it is a beginning point, among others, where the legislature makes a determination of how much money they are going to make available for the development of any road system.

Burnes.—Legislators certainly set the amount of money available in some cases for secondary road improvement. They also set the number of miles of road which are included in a highway system. And perhaps that is one of the real problems in highway programing.

For example, out of a 12,000 mile system, you have traffic volumes ranging from 25 or 30 thousand cars a day on some roads to under 400 cars a day on others. That is quite a range of roads to consider for improvement. Every system is made up of earners and subsidy routes, and improvements must be balanced out.

Certainly we cannot completely disregard improvement of the so-called subsidy routes. And that is what makes it difficult in trying to sort out the benefits from the top to the bottom.

On the other hand, if the benefits are on the basis of systems, the answer might be easier to get at.

Swanson.—Sometimes we are inclined to think of highway benefits and forget about some of the broader benefits. The philosophy of broader benefits is particularly applicable where we get into our bigger urban areas, where not only the selection of a project but the method of design can result in increased or decreased benefits to the city.

We have a case right in our own area. Should we build an elevated road or a depressed road? The difference in cost is $12 million. To what extent can that additional expenditure of $12 million be justified on the basis of increased tax ratables over the year, or by increased city development? Certainly it is a factor, that has to be considered along with highway benefits.

Session Two

Monday, September 19, 1960, at 1:30 P.M.

INVESTMENT PLANNING

ROBERT E. LIVINGSTON, Presiding

Scheduling Capital Improvements

DONALD R. LANG

Programing capital improvements through our company's construction program activities of necessity is both technical and complicated. It would have been far more usual for me to discuss future developments in the art of telephony which carries with it the glamour of such things as the transistor, electronic switching, direct distance dialing, memory and logic devices, new types of telephone sets and now satellite communications. But all of these are or will be just a portion of our program of capital improvements on their way to becoming a part of the communications plant.

These expenditures for communications plant have many features similar to those to those of the highway systems that are your primary interest. First, it is not just a one-time job, but goes on year after year as people's wants and needs grow and as developments permit these wants and needs to be met in better and more economical ways — and this is true of highway capital improvements. Second, with only minor exceptions, every dollar spent is committed irretrievably because it is spent for things which are of no use to anybody but us and which, therefore, cannot be sold — a telephone central office or, in your case, a highway. Furthermore, surplus capacity in our central office and your highway cannot be diverted, if needed in other localities, as can such capacity in, say, a water source or an electric generating station. We have one last important factor, the need to earn on this investment. And how well we invest these dollars is the single biggest factor in how healthy our enterprise will be not only tomorrow but for many years into the future and, also, it controls how well we will be able to meet the communication needs of the public. This requires the investment of every dollar in the framework of long-range plans. That these plans will be subject to change is axiomatic in an industry where rapid change in science and technology and in people's wants and needs is a normal course of events. This means that there is a real premium on keeping these plans up to date. This type planning, I know, is an integral part of your operations.

This entire paper could be devoted to long-range planning because it is the path along which our business progresses. But let it suffice to say that this planning fixes in time, size, and dollars, major projects such as new central offices, extension of direct distance dialing, major cable extensions — in fact, projects for all major additions and changes. In addition, this planning serves as a guide for short-term operations. This latter is of extreme importance. Otherwise we could place millions of dollars worth of plant that would either inadequately or not at all meet long-term objectives.

In general, the scheduling of capital improvements deals with what we call short-term or near-future operations — a period of five years. For example, such a review for each of the years 1960 through 1964 has just been finished. We make such a review every quarter and it deals with dollars that range between $125 and $150 million a year for the Chesapeake and Potomac group of companies and between $2 and $3 billion

for the Bell System operating companies. Such a program is a detailed list of individual projects and involves additions to or changes in every type of plant. These projects are placed in the construction program only after detailed study and serious consideration by management of the company.

There are always numerous projects that it would be desirable to do, far more in fact than money, force and even time will permit. The best way I know to exercise the very necessary management vigilance is to make every job stand up against three age-old questions: Why do it at all? Why do it now? Why do it this way?

The last question carries with it the necessary engineering cost studies to assure that the plant is placed at a minimum cost and maximum service value during its life. Such studies would include year-by-year estimates of investment and expense for the several possible plans and, using a present worth of money approach, then a determination of the most economical plan. For example, as a part of a road improvement project the city of Westville plans to widen and resurface Main Street. Along this street we have a pole line carrying several cables that will have to be disposed of in some manner to clear the new and wider street. The "Why do it at all?" and "Why do it now?" are easily answered, but the "Why do it this way?" requires determination of "How soon will future growth require us to change from aerial to underground construction?" With this determined should we (a) Reroute over a different street? (b) Place underground conduit and cable in Main Street now? or (c) Move the present aerial line to provide street clearance and defer the reroute or underground construction? This is a matter of cost study determination with the final application of good engineering judgment.

CATEGORY BREAKDOWN OF CONSTRUCTION PROGRAM

Category	Explanation
Exchange Growth	- Projects required to care for extensions of local service This would include such items as additions to central offices and cable plant to meet increased customer demand
Exchange Mechanization	- The conversion of local manual to dial service
Toll Growth	- Similar to Exchange Growth, but applicable to Toll Service
Toll Mechanization	- The conversion of toll from a manual to a mechanical basis For example, Direct Distance Dialing
Stations	- The Telephones and Private Branch Exchange Equipments required by our customers
General Equipment	- Motor Vehicles, Office Furniture, Garage Equipment and similar items
Other	- Has several subcategories 1 Public Requirements 2 Dial-with-Dial Replacements 3 Maintenance Replacements 4 Non-Equipment Buildings such as Garages and Office Buildings

Figure 1.

CLASSES OF PLANT

Land and Buildings
Central Office Equipment (All Types)
Outside Plant (Poles, Cable, Wire, etc)
Station Equipment (Telephones, Private Branch Exchanges, etc)
General Equipment (Office Equipment, Furniture, Motor Vehicles, etc)

Figure 2.

As shown in Figure 1, each view of our construction program is first broken down into seven major categories. These are categories which permit a ready analysis of the proposed expenditures.

"Public Requirements" includes all of the projects caused by public road work and it is a substantial item totaling for the Chesapeake and Potomac group of companies

about $5 million a year. But above all, it is an item requiring a great deal of early coordination between those responsible for such road work and the affected utilities. This is essential to assure that the necessary work is performed economically and that these are adequate opportunity and time to budget the costs, engineer the projects, procure materials and supplies, and fit the work into operating schedules to meet the completion dates required. This is necessary without regard to any recompense for expenditures.

TYPICAL FLOW OF INFORMATION TO THE CONSTRUCTION PROGRAM ENGINEER

DEPARTMENT ENGINEERING	TYPE OF INFORMATION	ORIGINATOR	CONTRIBUTOR
	Land Projects	Staff Engr -Fund Plans	
	Building Projects	Staff Engr -Buildings	
	C.O.E Projects such as		
	a New Centers	Staff Engr -Fund Plans	Equip. & Bldgs Engr & Gen Traffic Engr.
	b Switching	Equip & Bldgs Engr	Gen Traffic Engr
	c Toll Terminal & Trunking	Trans & Out Plt Engr	Equip & Bldgs Engr & Gen Traffic Engr
	d Power Plants	Equip & Bldgs Engr	
	Large PBX Projects	Equip & Bldgs Engr	
	Radio - Video Projects	Trans & Out Plt Engr	Equip & Bldgs Engr
	Toll Out Plt Projects	Trans & Out Plt Engr	Gen Plant Engr
	Dial C.O.E Forecasts	Equip & Bldgs Engr	
	Carrier & Repeater	Trans & Out Plt Engr	Equip & Bldgs Engr
	Net Plant Req	Gen Staff Supvr	
PLANT	Exch Out Plt Projects	Dist Plant Engr	Gen Plant Engr
	Toll Out Plt Projects	Dist Plant Engr & Trans & Out Plt Engr.	Gen Plant Engr
	Motor Vehicles and Other Work Equip	Gen Bldgs Supplies & Motor Vehicle Supt	
	Routine PBX and Sta Equip. Expend	Gen Plant Supvr	
	TWX - Tel Set Req	Gen. Bldgs Supplies & Motor Vehicle Supt	
	Main Frame Fills	Gen. Plant Engr	
	Cable Requirements	Gen Plant Engr.	
COMMERCIAL	Ests of Demand, Gain Unfilled Orders, etc.	Gen Coml Engr	
	Party Line Fills	Gen Coml Engr	
TRAFFIC	Exch & Toll Switching	Gen Traffic Engr	Equip & Bldgs Engr.
	Aux Svcs & Positions	Gen Traffic Engr	Equip & Bldgs Engr
	Ests. of Message Volumes, Intertoll Trks , Speeds, etc	Gen Traffic Engr	
	Main Sta Capacity Data	Gen Traffic Engr	
ALL	Furn & Office Equip Projects	Equip & Bldgs Engr	
	Routine Furn & Office Equip	Gen Plant Supvr	

CONSTRUCTION PROGRAM STAFF ENGINEER

- Construction Program Summary
- Project Lists
- Material Forecasts
- Schedules
- Sequence Lists
- Various Other Reports

Figure 3.

There has been a substantial improvement in this early consideration within the last year or two, and Sam Houston of the company has worked actively in this field as a member of the American Right-of-Way Association, which in turn has worked cooperatively with the American Association of State Highway Officials. This problem is also recognized by the Policy and Procedure Memorandum 20-11.1, issued on this subject October 10, 1958 by the Bureau of Public Roads.

Having set up the broad categories as reviewed, a further breakdown is made into what are called "Classes of Plant" (Fig. 2). We then have the construction dollars by major reasons and by "Classes of Plant." Also included is a complete summary of all materials required.

In a construction program, we have first defined our responsibilities for all the information going into a program (Fig. 3).

It is obvious that each man listed must depend on others in his group for detailed data. For example, the district plant engineer has plant engineers and field engineers reporting to him and they do the detailed work. However, it is his responsibility to review all projects in his area and determine the need, size, cost and timing.

Figure 4 shows one page of the detailed projects. You will note at the top that it is Sheet 4 of 22 sheets and deals with central office equipment. At this stage these pro-

THE CHESAPEAKE AND POTOMAC TELEPHONE COMPANY OF MARYLAND — Sheet 4 of 22 Sheets

DATA FOR DEVELOPMENT OF 1957 CONSTRUCTION PROGRAM — Date December 1, 1957

Administrative Area

Central Office Equipment Project $50,000 & Over	Est or Proj No	Schedule * Work Start	Schedule * Work Compl	Gross Construction ($000) Total	Prior Years	This Year	This Year By Categories: Exch Growth	Exch Mech.	Toll Growth	Toll Mech.	Sta Equip.	Genl Equip.	Other	Held Orders: Beg of Year	Held Orders: End of Year	Material To Ship This Year: C. O. Equipment Type	C. O. Equipment Lines	C. O. Equipment Frames Shelves	Exch Type Cable M.C.F.
Arbutus - Dial Conv - C O E	1234	8-56	A-57	1544	1386	158		158											
- 1170 Line Addn.	1738	4-58	9-58	160		5	5												
Baltimore - AAA 3rd Addn & Conv	1445	6-57	1-59	360	34	500			500							AXB		93	
- AA 4th Addn	1761	10-58	4-59	92		1			1										
- Portable Micro T V Links	1325	Comp.		51	50	1							1						
- Bel Air - Edge, Carr	1424	11-56	11-57	210	83	127			127										
- Eastern Shore V F Carr	1496	4-57	10-57	61	3	58			58										
- Fork-Bain -Edge Carrier	1747	2-58	5-58	101		5			5										
- Ft. Meade - Wash. Carrier	1628	5-57	3-58	467		300			300										
- Elkton Carrier	1760	12-57	2-58	69		30			30										
- Wash Hi Carrier	1354	8-56	5-57	197	171	26			26										
- Green Clir Carrier	1523	5-57	6-58	62	5	52			52										
Boulevard - Line Addn. & Toll Disp.	1110	Comp		664	651	13	13												
- 1400 Ln. & Toll Disp.	1546	1-57	9-57	314	6	308	308									5XB	3400	58X	
- 1470 Line Addn.	1756	5-58	9-58	157		3	3												
Brooklyn - Dial Conv - C.O.E (Curtis)	1515	8-57	3-58	1670	11	1335		1335								(1XB 1XB 1XB	15680	30 2/3	
CAMA Equipment	1363	A-56	A-57	874	750	124				124						1XB		3	

* Underscore Accomplished Steps
# If Job Were Not Done
Σ Includes 10 frames for T.D

Figure 4.

jects have been reviewed in detail as to the three "why's." The time phasing, total dollars, dollars within the particular year, category, material requirements and other pertinent data are shown. The need for projects is in most cases the result of customer demand for service. We measure these causes as accomplishments — in other words what we get for our dollars.

Figure 5 shows these accomplishments in total. We have similar information for each central office and each outside plant project. Such items as gain in telephones, increase in subscriber lines, long distance message increase are a part of these accomplishments. Unit costs to gain our estimated accomplishments are shown. Here are just a few of the measurements we make on every program. At the top is a summary of the categories discussed previously. Here the total dollars in each year are summarized.

July 7, 1960

Table I
Company

CONSTRUCTION PROGRAM SUMMARY

				D. C.	1960	1961	1962
$ MILLIONS	CONST. EXPEND.	101	Total Construction Expenditures	1			
		102	Exchange Growth Projects	1			
		103	Exchange Mechanization Projects	1			
		104	Long Distance Growth Projects	1			
		105	Long Distance Mechanization Projects	1			
		106	Station Equipment	1			
		107	General Equipment	1			
		108	Other Projects	1			
		109	Net Additions	1			
		110	Net Plant Requirements	1			
EXCHANGE	DEMAND & GAIN (000)	111	Net New Demand Less Melt-Main Tels.	1			
		112	Gain - Main Telephones	1			
		113	Reserved for future use	1	-	-	-
		114	Gain - Total Telephones	1			
		115	Increase in P.B.X. Trunks	1			
		116	Reserved for future use	1	-	-	-
		117	Outward Movement - Total Telephones	1			
		118	Increase in Subscriber Lines	1			
		119	Total C.O. Cap. Added - Main Tels.	1			
		120	Total C.O. Equipped Lines Added	1			
		121	Increase in Subs. Pairs Term. - MDF	1			
		122	Increase in Subs. Pairs in Use	1			
	BACKLOG	123	Reserved for future use	1	-	-	-
		124	Unfilled Regrade Requests - Yr.End(000)	1			
	ACCOMP.	125	% Res.Ext.of Res.Main Tels.-Yr.End	1			
		126	% Dial of Total Telephones-Yr.End	1			
		127	% 4-Party Res. Main Tels.-Yr.End	1			
LONG DISTANCE		128	% Long Distance Message Increase *	1			
		129	% Incr.I.T.Trks. 25 Mi.or More-Yr.End	1			
		130	% Dial I.T.Trks. 25 Mi.or More-Yr.End	1			
UNIT COSTS CONST.EXP.		131	Exch. Gr. - $ Per Main Tel. L. & B.	0			
		132	Gained (Incl. P.B.X.Trks) C.O.E.	0			
		133	- $ Per Sub. Line Incr: O.P.	0			

* On 1-1-60 transfer base.

Figure 5.

July 7, 1960

Table IA
Company

CONSTRUCTION PROGRAM SUMMARY

				D. C.	1960	1961	1962
		151	Long Distance Message Increase-Millions*	1			
INTERTOLL TRUNKS 25 MILES OR MORE		152	Trunks Added During Year	0			
		153	Trunks Added by Busy Season	0			
		154	Dial Trunks Added During Year	0			
	IN SVC.-BUSY SEASON	155	Trks.Engd. by T Tables (Except Finals)	0			
		156	High Usage Trunks	0			
		157	Final Trunks	0			
		158	Reserved for Future Use	0	-	-	-
		159	Other Trks.Engd. by Probability Tables	0			
		160	Total	0			
		161	Busy Season-Busy Hour % NC Encountered	1			
		162	Reserved for Future Use	0	-	-	-
MISC. TEL. INFO.	(000)	163	1-Party Res. Main Tels. - Year End	1			
		164	2-Party Res. Main Tels. - Year End	1			
		165	4-Party Res. Main Tels. - Year End	1			
		166	Rural Main Tels. in Service - Year End	1			
		167	Res. Extension Tels. - Year End	1			
		168	Subscriber Line Incr. in Dial Offices	1			
		169	Main Telephone Incr. in Dial Offices	1			
		170	Total Dial Telephones - Year End	1			
		171	Dial C.O. Capacity Added-Main Tels.	1			
		172	Dial C.O. Equipped Lines Added	1			
FILL DATA		173	2-Party Line Fill-Res. Main-Year End	2			
		174	4-Party Line Fill-Res. Main-Year End	2			
		175	% Main Frame Fill-Subs. Cable-Year End	1			
		176	* On 1-1-60 transfer base. On this basis 1959 volume was	1			
			Intertoll Trunks over 25 Miles in Service 12-31-60 - Total Dial				

Figure 6.

Figure 6 shows the basic data for toll, telephone and outside plant used for other unit cost and efficiency of use measurements. Figure 7 is a summary of dollars by categories and classes of plant; Figure 8 is one part of a material summary; and Figure 9 is a comparison between previous and new views, which inevitably carries with it the need to explain the individual differences.

Although the steps in the preparation of our construction program have been shown,

_____ Company

CONSTRUCTION PROGRAM SUMMARY Sheet ___

19 Construction Expenditures

			Dollars - Millions						Plt. in Service 12-31
			Exchange		Long Distance				
		D. C.	Growth a	Mech. b	Growth c	Mech. d	Other e	Total f	g
201	Land and Bldgs.	1							
202	C.O. Eqpt.	1							
203	Res. for Fut. Use	1	-	-	-	-	-	-	-
204	Exch. Lines	1							
205	Toll Lines	1							
206	Subtotal	1							-
207	Station Eqpt.*	1	-	-	-	-	-		
208	General Eqpt.	1	-	-	-	-	-		
209	Total	1	-	-	-	-	-		

	Details of "Other"	D. C.	Dollars - Thousands L. & B. a	C.O. Eqpt. b	Exch Lines c	Toll Lines d	Total e
210	Non-Equipment Buildings	0					
211	Public Reqmts.(H'way Moves,etc.)	0					
212	Reserved for future use.	0	-	-	-	-	-
213	Replacement - Dial with Dial	0					
214	Misc. Replacements	0					
215	Extended Area Plans	0					
216	ZL-5N Numbering Plans	0					
217	Television	0					
218	Toll Dispersion & Def.(ex.SAGE)	0					
219	SAGE	0					
220	Other Identified Items	0					
221	Miscellaneous	0					
222	Total "Other"	0					

	Details of "General Equipment"		Dollars- Millions				
223	Furniture & Office Eqpt.	1					
224	Vehicles & Other Work Eqpt.	1					
225	Total "General Equipment"	1					
226	Repl.of Motor Veh.(Incl. in 224)	1					
227	Reserved for future use	1	-	-	-	-	-
228	Reserved for future use	1	-	-	-	-	-

* Plant Retired-Station Equipment ____

Figure 7.

_____ Company

ESTIMATED NEW MATERIAL SHIPMENTS

			D. C.	1960	1961	1962
CABLE	301	Exchange - M.C.F.	0			
	302	Toll - M.C.F.	0			
	303	Coaxial - Thousand Unit Feet	0			
CARRIER, REPEATERS AND MISCELLANEOUS	304	Broad Band Terminals - Total	0			
	305	Type N Terminals - 12-channel*	0			
	306	Type N Channel Terminal Units*	0			
	307	Type O Terminals - 4-channel	0			
	308	Type O Channel Terminal Units	0			
	309	Type P Channel Terminal Units	0			
	310	Type V Telephone Repeaters	0			
	311	Type 43A - Carrier Teleg. Chan. Terms.	0			
	312	Type E Telephone Repeaters (Other than E6)	0			
	313	Type E6 Telephone Repeaters	0			
	314	TD-2 Amplifier Bays	0			
	315	TJ Amplifier Bays	0			
	316	Manual Large Multiple Positions	0			
	317	Single Frequency Signalling Units-Type E	0			
	318	Reserved for Future Use	0	-	-	-
STATION EQUIPMENT	319	Telephone Sets - Total (000)	1			
	320	- Full Color (000)	1			
	321	701B P.B.X. - Lines	0			
	322	- Shelves	0			
	323	740-Type P.B.X. - Frames	0			
	324	756A P.B.X. Cabinets	0			
	325	No. 28 TTY Typing Units (incl. ASR's)	0			
	-	701A P.B.X. - Lines	0			
	-	- Shelves	0			
		*Exchange Use of Line 305 - Terminals	0			
		Line 306 - Chan. Terms.	0			

Figure 8.

there is associated with each step a review of the projects in the light of the three questions: Why do it at all? Why do it now? Why do it this way?

There is, of course, a broad review to assure that service to customers is maintained at a high level with a continuing modernization of this service, that the impact on force is a reasonable one in that work load does not fluctuate widely and require

		1960			1961		
		July	April	Diff.	July	April	Diff.
DOLLARS - MILLIONS	Construction Expenditures - Total						
	Exchange Growth Projects						
	Exchange Mechanization Projects						
	Long Distance Growth Projects						
	Long Distance Mechanization Projects						
	Station Equipment						
	General Equipment						
	Other Projects						
THOUSANDS	Net New Demand - Less Melt - Main Telephones						
	Gain - Main Telephones						
	- Total Telephones						
	Increase in Subscriber Lines						
	Total C.O. Capacity Added - Main Telephones						
	Total C.O. Equipped Lines Added						
	Unfilled Regrade Requests - Year End						
PER CENT	Res. Ext. of Res. Main Tels. - Year End						
	Dial of Total Telephones - Year End						
	4-Pty.of 1-,2- & 4-Pty.Res.Main Tels.-Year End						
	Long Distance Message Increase						
	I.T. Trunk Increase - 25 Miles or More-Year End						

Figure 9. Comparison of July 1960 and April 1960 views.

rapid expansion and contraction of the force, and that the total dollars required are at a reasonable level. This latter requires a broad appraisal of the three components that exist in all business — the interrelation of revenues, expenses and investment to assure that the over-all operations resulting from this program are in the best interests of the customer and the company.

That variations will occur in projects is inevitable, first, because the program is based on estimates of cost before engineering work is completed; and, second, because projects vary in size, when required, and unit costs with the rapid change in public needs and wants and developments in the industry. It is this variation that causes us to review our program on a quarterly basis.

Our level of approval for projects may be of interest. When construction expenditures for an individual project are $10,000 or more, final approval of the specific estimate for the project rests in the hands of the board of directors. For projects under $10,000 a quarterly routine estimate is approved by the board of directors and individual projects within this limit approved at first to fifth level of management, depending upon the dollars involved.

For each specific and routine estimate a final completion report showing differences between estimated and actual amounts and the reasons for these differences is required.

In all cases unit costs and variations between estimated and actual costs are analyzed in complete detail, not only to explain why but also as a guide for the future.

The few figures shown represent just nine pages of a two-volume edition of each quarterly program review, but I hope they have given you some insight into our capital improvement scheduling.

Discussion

Burnes. — Mr. Lang, who initiates the projects that finally wind up in the capital expenditure budget?

Lang. — Projects are initiated at different levels, depending upon the time. Generally, they start in our engineering groups.

For instance, the district plant engineers originate the projects that have to do with outside planning. Those that have to do with central office equipment originate in the traffic engineering department. But again, these projects all get brought into being well down the line in our organization. Generally it is either first or second level of supervision.

Livingston. — You said that those projects above $10,000 in total value required a specific estimate; those below did not. Is there a total amount in authorizations on those under $10,000 that may be approved prior to a subsequent meeting of the board of directors? In other words, do they give you a top figure of, say, $100,000?

Lang. — No, because we run into emergencies, just as you all have and will. We carry along with us what is called an advance approval. We have the right, within each of our companies, to write a letter saying that because of the urgency of this project there are certain work operations that must be performed before the board of directors' approval.

As an example, the Bureau of Public Roads was doing work here on Annapolis Boulevard. At that time I was in charge of operations. They suddenly decided to drop our conduit about 40 ft below its operating level. This had not been anticipated. The amount of dollars involved was critical. We had advance approval to go ahead with that project in about 15 minutes. It was well under way the next morning.

Granum. — Your company has a tentative pool of desirable projects to be developed. Assuming that you might make some savings in your estimates, is such advance approval given in case you are able to save funds?

Lang. — Yes, we surely do. We do our outside plant engineering on districts, and our central office engineering is done on a state basis. There are always backlogs of jobs that are desirable to do at both levels.

I have been working with construction programs since 1928. Since that time I can honestly say that I have seen no more than two or three that I would call bad jobs. There is bound to be one in a lifetime; but the rest of them are desirable to do. It is just a case of when do you do them?

Granum. — How many years ahead do you actually schedule in the detail that you showed here?

Lang. — Five years. We will take the jobs that are immediately desirable and prepare to do them in 1960. There are other jobs that we could do in either 1960 or 1961. There

are still others that there is no need to do until 1961.

For example, we would like to go ahead with direct distance dialing as fast as possible. It is categorized as an improvement. There is a limit to how much money you can put into improvements in any year. If there is an opportunity in 1961, for instance, to bring some projects on direct distance dialing forward, we will. It cannot be done this year because of the hurricane; and the dollars that were spent on the hurricane have caused us to push some jobs ahead into next year's program.

A construction program is fluid. It has to be. There is no other way you can operate it. It cannot be a rigid thing — and it has to be fluid, I believe, within the limits of long-range plans. If you do not stay within the limits of your long-range plans, you find you have put your dollars down a rat hole. It does not tie in with what you want in the future.

R. Johnson. — You mentioned your long-range programs as going up to 20 years. I am going to ask a question pertinent to what we perhaps should be doing in the highway industry. In your long-range programs, your 20 year programs, or even your 10 year programs, are you not interested in setting the broad objectives in terms of whole systems and whole plants, rather than trying to identify specific projects in that long period of time? And are the costs that you apply to these plants and systems that you were going to develop as objectives in this period statistical costs?

Lang. — I am going to simplify this. Let us assume that we have an area that we are studying, and that at the present time that area is served by a central office right here. We have cables that radiate from that central office.

We take a look at this 20 years in the futre. We go to our commercial people and say: "We want an estimate from you for this area for 20 years in the future."

Our commercial people can make a better estimate of what is going to happen 20 years from now than they can as to next year. They are frequently wrong on what is going to happen next year, but they can iron out the up's and down's when it comes to 20 years from now.

We make an assumption that we have no telephone plant at all in this area. And then we make a theoretical layout of the telephone plant in that area, using the very latest telephone plant, the very latest techniques, that we can use. We lay that out in the area, and perhaps it appears tha we need three offices in the area, on a theoretical basis.

That is a cross-section study, and the cross-section used is 20 years from now. Then we make what we call a program study, which is a year-by-year study.

In this year-by-year study, we in essence say, "Aren't we silly to assume that we don't have any telephone plant in that area?"

We start and assume that we do have this telephone plant, and tie in this one, right here. Then we make a year-by-year study to find out when office 1 proves in, when office 2 proves in, and when office 3 proves in.

That year-by-year study has to have in it some of the things you talk about. For instance, we are interested in differences between plants, we say, "We will compare this to continuing to serve it the way it is." Therefore, we are interested in incrementals. And because we are interested in incrementals, we are able to go to some broad estimating and we do not have to get this done on a really detailed basis for every piece of cable that goes into it.

We use, as we call them, broad gage costs.

R. Johnson. — This long-range process is more of a broad process, and when you get to specific identification and analysis, it is down in this five-year period.

Lang. — Here is where we get specific. In that first five-year approach, we do of necessity use broad estimates because the projects are not engineered. You have to use some broad gage unit costs to get over-all costs.

I have talked to our highway people, and they tell me they do much the same thing.

Role of the Legislature, Executive Branch, and Other Agencies in Highway Construction Programing

J.A. LEGARRA

The programing of highway construction in this era of change and rapid growth involves far more than the services of the professional engineer who is involved in the day-to-day, month-to-month, and year-to-year work of planning, designing, and building highways.

A sound, farseeing program must rely upon the fundamentals of governmental understanding, the necessary legislative framework, and broad direction. Government includes Federal, state, and local. This paper will be oriented to programing as related to state highways in California.

The people of California in 1902, by constitutional amendment, delegated to the legislature certain powers with regard to highways. These powers are broad, simple, and inclusive, as follows:

1. To establish a system of state highways; and
2. To pass all laws necessary or proper for highway construction or maintenance.

Under this authority, the legislature has caused to be created the complicated governmental structure which enables the engineers, the contractors, and the workmen to plan and build the highways.

It is important to note that within the limits of broad policy and certain specific directives, the legislature has delegated much of its authority to the executive arm of the state government and to the California Highway Commission. Despite this delegation of authority, the legislature is still the key to and the directing force in the highway program. It has exercised, particularly in recent years, a positive role in highway planning.

It became sharply evident as World War II ended that the highways were woefully inadequate to meet the traffic demand and totally incapable of caring for the needs which were developing and which could be foreseen. An avalance of people and motor vehicles was descending upon California.

Therefore, in 1946, the legislature initiated a deficiency study which developed a measure of what was required to correct the highway problem in California. The result was an act of the legislature (Collier-Burns) in 1947 which provided for an expanded program of street and highway improvement financed by increased highway-user taxes.

Because of necessary compromise, the 1947 legislation did not provide sufficient revenue to finance in a reasonable period all of the needed construction as revealed by the 1946 study. The inadequacy of the 1947 legislation was recognized and, on the basis of 1952 highway deficiency studies initiated by the legislature, user-taxes were again increased.

The present financing structure has met with general public acceptance. All indications are that it can support an adequate construction program that will, within a reasonable period of time, complete improvement of the entire present state highway master plan, including the 10½ billion dollar California Freeway and Expressway System.

This freeway and expressway system in its concept is a major accomplishment of the legislature and is a prime example of the legislature's contribution to, and initiation of, construction programing. It is the outgrowth of a study by the Division

of Highways, Department of Public Works, undertaken by direction of Senate Concurrent Resolution No. 26 of the 1957 legislature. The principal recommendations of this study were enacted into law (Senate Bill 480) in 1959, after numerous public hearings by a legislative interim committee.

This law created the 12,414-mile freeway and expressway system, which will eventually result in the linking of all cities of 5,000 or more population, and is expected to carry 59 percent of the total vehicle travel when completed.

The progressive action taken by the legislature in establishing a master plan of freeways and expressways has received nationwide recognition as a great achievement in the highway field. But it would be of little value had not it also laid the groundwork which makes it possible to carry out this program.

By statute, the legislature in 1939 established the freeway principle and authorized the Department of Public Works to construct any portion of the state highway system as a freeway, or to make any existing state highway a freeway. The law states "Freeway means a highway in respect to which the owners of abutting lands have no right or easement of access to or from their abutting lands or in respect to which such owners have only limited or restricted right of easement or access."

In 1952, the legislature took another farsighted action by creating a "Highway Right-of-Way Acquisiton Fund" for the purpose of protecting future highway rights-of-way from expensive developments. This fund totals $30,000,000 and is intended to act as a revolving fund, the money being returned from state highway funds at such time as construction begins. By reducing the ultimate cost of rights-of-way, this fund has the effect of providing more highway improvements for the money available. As an example, it is estimated that the use of this fund has, to date, saved the state about $215,000,000 which otherwise would have been needed to acquire improved instead of undeveloped properties.

Another assist to programing was given by the legislature in 1955 by enacting permissive legislation allowing the award of highway contracts after the first day of January preceding the beginning of the fiscal year (July 1) in which a project is budgeted. This enables the scheduling of contracts to take advantage of favorable weather conditions, and under certain circumstances may advance the completion of a project as much as a year.

Programing is dependent upon funds; and if the funds are uncertain, the programing is just as uncertain, if not more so. We must all look to the legislature for a firm financial foundation upon which we can base a sound highway construction program. California is fortunate in that the legislature has established a dependable source of financing for the improvement of highways, and programing can be based on estimates of funds for future years with reasonable assurance that these funds will be available at that time.

California state highways are financed by a family of taxes, consisting of taxes on motor fuels (both gasoline and diesel oil), annual registration fees applicable to all vehicles, driver's license fees, annual weight taxes on commercial vehicles graduated according to their empty weight, and a tax on the gross revenues of for-hire motor carriers. There are also, of course, Federal-aid funds that presently constitute a large portion of the construction budget in California. The funds from these sources are all used for highways and related purposes and are protected by an "anti-diversion" clause in the constitution which provides that "all moneys collected from any tax now or hereafter imposed by the state upon the manufacture, sale, distribution, or use of motor vehicle fuel for use in motor vehicles upon the public streets and highways over and above the costs of collection, and any refunds authorized by law, shall be used exclusively and directly for highway purposes."

For the purpose of controlling the distribution of construction funds, the legislature has divided the state into two parts, which are referred to as the northern county group (45 counties) and the southern county group (13 counties). The statutes require that the northern county group receive 45 percent of the total state highway construction funds available each year, and that the southern county group receive the remaining 55 percent. These percentages are based on consideration of the statewide transportation system approach, as well as the relative highway needs and vehicle registration.

In addition to the above north-south division of state highway construction funds, the legislature has included another statutory control referred to as the "Mayo Formula." This control has no effect on the division of funds between the northern and southern county groups. The "Mayo Formula" guarantees a specified minimum expenditure of construction funds in each county of the two sections of the state during specified periods. This guaranteed minimum expenditure is based only partially on the relative highway needs of the county and is actually the product of a compromise reached by the legislature.

To permit a certain amount of flexibility, the legislature made available a certain percentage of the total construction funds for budgeting by the California Highway Commission at its discretion. These funds have been referred to as "free money" and, with the exception of the north-south split, have no legislative control as to where on the state highway system they are to be expended.

Table 1 shows the percentages of "frozen" and "free" funds that were established by the legislature for the period since the Collier-Burns Act of 1947. The legislative controls shown in Table 1 will end on June 30, 1963. We are presently in the process of completing a cost estimate of the deficiencies on the entire state highway system. This information will be presented to the appropriate legislative committee for its deliberations on the establishment of future financial controls on the expenditure of highway construction funds.

TABLE 1

Period	Frozen	Free
July 1, 1947, to June 30, 1952	50%	50%
July 1, 1952, to June 30, 1955	60%	40%
July 1, 1955, to June 30, 1958	65%	35%
July 1, 1958, to June 30, 1963	65%	35%

It should be mentioned here that all Federal-aid highway funds available for the interstate, primary, urban, and secondary systems are subject to the same controls set up by the legislature for highway funds from other sources. Programing and budgeting must naturally still take into account Federal regulations and controls on the expenditure of Federal-aid funds.

The legislature has delegated to the California Highway Commission the authority and responsibility for carrying out its intentions in each annual budget. However, as with other major aspects of the state highway program, the legislature has laid down the necessary broad guide lines and made its general intent clear. Here is the most important section of the Streets and Highways Code in this regard: "It is hereby declared to be the policy of the legislature to provide for advance planning and continuity of fiscal policy in the construction and improvement of the state highway system, and in the administration of expenditures from the state highway fund. The commission is directed to follow such policy insofar as possible."

The legislature has thus made it quite clear to the California Highway Commission that it wants a highway program based on sound, long-range planning and, just as important, it wants continuity.

It is evident from the previous discussion that the legislature has a strong, indispensable role in highway construction programing. As is generally known, the Federal legislative branch has over the past few years played an increasingly important role in the highway field. The Federal-aid program is now a major part of the highway construction program in most states.

As stated previously, sound programing is dependent upon sound financing. This applies on the Federal level as much as on the state level. One of the most important roles that the Federal legislative branch could assume from the standpoint of planning and programing is to insure continued legislative action that would guarantee a stable

Federal-aid program for a number of years in the future. We are all aware of the havoc that was caused by the uncertainty of the status of the Federal-aid program a short while ago.

In order to hold spending within the limits of anticipated revenues and thereby keep the Federal Highway Trust Fund solvent, the Bureau of Public Roads has found it necessary to exercise strict control of obligations through "reimbursement planning." This is frequently referred to as "contract control." These controls tend to slow down highway construction programing to some degree; however, the Bureau has provided the states with some flexibility by allowing the award of approved contracts beyond the controls established with the understanding that the Federal reimbursement for these projects would be delayed. As of today, these Federal controls have not created any major problems in highway construction programing in California.

All states are confronted with highway program controls set up by at least two legislative branches — Federal and state. California has been fortunate in that the legislation of these two branches is compatible, at least for the present.

It is not difficult to visualize conflicting legislation that would make it difficult if not impossible to carry out a highway program. In these cases, it is the responsibility of the executive branch to advise the legislature of the conflict and to recommend corrective legislation.

The Department of Public Works has broad powers with relation to highways, set forth by law, including the following principal provisions:

1. The department shall have full possession and control of all state highways and all property and rights in property acquired for state highway purposes. The department is authorized and directed to lay out and construct all state highways between the termini designated by law and on the most direct and practicable locations as determined by the highway commission.
2. The department shall improve and maintain the state highways.
3. The department may do any act necessary, convenient or proper for the construction, improvement, maintenance or use of all highways which are under its jurisdiction, possession, or control.

Under these provisions the Director of Public Works lets contracts and acquires and conveys property on behalf of the state.

As an appointee of the Governor, the director carries out, within the provisions of law, the policy of the executive branch and reflects the thinking of the administration.

He is an important contact with the Governor, and with local jurisdictions and with civic leadership concerned with highway matters. He can interpret and perhaps influence the governmental climate, although, as we have seen, politics as such, does not enter into the carefully safeguarded area of highway planning, financing, and construction.

CALIFORNIA HIGHWAY COMMISSION

The California Highway Commission is a creature of the legislature to which have been delegated many powers.

It is a statutory body of seven members, including the Director of Public Works as chairman. The six others are appointed by the Governor, with consent of the Senate, for staggered four-year terms. The members usually come from different areas of the state; however, by law each member represents the state as a whole and not any particular area. Definite duties and definite responsibilities have been assigned to the commission.

The law prescribes seven principal functions of the commission as follows:

1. Adoption of routes.
2. Allocation of funds.
3. Declaration of routes as freeways.
4. Adoption of resolutions authorizing condemnation of rights-of-way.
5. Abandonment or relinquishment of rights-of-way.
6. Authorization for the Director of Public Works to execute deeds.
7. Approval of each county's system of primary county roads.

Some of these functions are technical, although highly necessary, grants of power. I would place the first three in the category of authority which affects programing. These matters also have great impact on the public and are of greatest import in the development of the highway system.

The various revenues apportioned for state highway purposes can be allocated for expenditure only by action of the highway commission. Staff work of the Division of Highways furnishes recommendations for these allocations, but they are recommendations only.

In practice the Division of Highways maintains an up-to-date planning program that is submitted annually to the commission for approval. This program is simply a time schedule listing specific projects and their estimated cost, and setting forth the year that construction is planned to begin, as well as the prior year or years over which the necessary rights-of-way are to be acquired. It is considered the backbone of the engineering phases of highway work, such as advance planning and design, and also acquisition of rights-of-way and construction. This planning program insures compliance with many of the Federal and state controls that have been established.

The Division of Highways operates on an annual (fiscal year) basis. The commission therefore adopts an annual highway budget based upon anticipated revenues for each fiscal year from July 1 through June 30 of the next. After adoption by the commission, this budget is submitted to the Governor for inclusion in the state's annual budget which is presented to the legislature.

In discussing the role of city and county governments in state highway construction programing, recognition must be given to the needs of city streets and county roads. In the case of freeways, this is theoretically taken care of in California by means of a freeway agreement executed between the state and the local governing body.

However, the legislature, through Senate Concurrent Resolution No. 62 (1959), requested the Department of Public Works to prepare a report which, among other things, would include an estimate of the deficiencies on every city street and county road in the entire state. This estimate was not only on present deficiencies but also included estimated deficiencies projected into the future as far as the year 1980. Although the report to the legislature was prepared by the Department of Public Works, the actual deficiency studies were made by the individual cities and counties with the guidance of an advisory committee, appointed by the legislature, and the technical assistance of the Division of Highways.

This report was submitted to the appropriate legislative committees last August 1 and will be the subject of several public hearings throughout the state.

Its main purpose was to provide the legislature with factual data that could be used as a basis for considering possible additional state financial assistance toward improvement of city streets and county roads. This study, however, combined with a review that is presently under way on the state highway system, will also result in a complete picture of the entire highway and local road and street system, and should be of considerable assistance to all levels of government in their transportation program.

The legislature has placed an important part of the freeway program in the hands of the city and county governments by requiring the execution of freeway agreements between the state and city councils or county boards of supervisors. These atreements govern the closing of streets or roads. The law specifies that "No city street or county highway shall be closed, either directly or indirectly, by the construction of a freeway except pursuant to such an agreement." As a matter of policy, the state, with some minor exceptions, does not even begin to acquire rights-of-way for a freeway project until a freeway agreement has been executed.

Accordingly, any freeway construction program is dependent not only on factors such as planning, design, and financing, but also on a mutual understanding between the local government and the state as expressed in the form of an executed freeway agreement. There are examples of freeway construction being delayed for several years due to the lack of such an agreement.

In the preparation of highway construction programing, it is necessary to recognize the need of coordination with the plans of many other agencies. The degree to which this coordination can be carried out depends upon many factors; however, it is

usually possible through some adjustment in the normal programing schedule to bring about the coordination that will result in an over-all benefit to the public.

An example would be a relocation of a deficient highway that is required by reservoir construction proposed by state or Federal agencies. In this case, the agency promoting the reservoir bears the cost of constructing the relocation to standards approximately equal to the existing highway. With some adjustment in the normal highway construction program, it is ordinarily possible to obtain additional state highway funds for the proposed relocation to supplement the amount that is the responsibility of the agency constructing the reservoir. This coordination will result in a highway relocation constructed to modern standards with a minimum expenditure of public funds and to the over-all advantage of the public.

Another example involves coordinated construction programing involving flood control projects, major local drainage and utility improvements, etc., that must be constructed considerably in advance of the highway project. By means of a cooperative agreement involving participation by the highway agency, it is possible to proceed with the needed local project considerably in advance of the future highway construction and at a considerable saving to the public.

Interested individuals may take a role in highway construction programing, other than through their elected representatives. In California, through active organizations, such as the chambers of commerce, individuals have been able to present definite and forceful recommendations on highway construction programing to both the Division of Highways and the California Highway Commission. These recommendations, through such an organization, represent the thinking of a broad cross-section of the state and are of considerable help in establishing a highway construction program.

Although this discussion may appear to segregate at least to some degree the role of the legislative and executive branches of government and the role of other agencies in highway construction programing, in actual practice they are closely interwoven and in the final analysis, inseparable.

Discussion

Livingston. — Those of us who live in the west and to some degree, those who come from the other parts of the country, have known for years that the California department and its public works and highway divisions have been in the vanguard of highway development. I believe they have been forced into it by the influx of people to that area.

It is appropriate, then, that Mr. Legarra has tried to tie together the various elements that necessitate cooperation during this kind of a program. His outline of the executive branch and the legislative branch is peculiar to California, but I am sure has significance to all of us.

W. Johnson. — I would like to ask a question about the advance right-of-way acquisition fund established in 1952. From what source were those funds derived, from ordinary highway user funds, or from some outside source?

Legarra. — I am not familiar with where it all came from, but it is my understanding that the funds are derived from highway-user sources.

W. Johnson. — In other words, they just set aside certain highway user funds to go into this $30 million advance acquisition fund?

Legarra. — Actually, that is the case.

W. Johnson. — Otherwise they would have been available for highway construction?

Legarra. — That is right. There has been quite a bit of talk here recently about extending this highway right-of-way acquisition fund program, to make it larger than it is, and the point you have made has come up. You can see the off-setting advantages of putting it into highway right-of-way acquisition.

W. Johnson. — But originally there was $30 million of construction that might have been started if the advance acquisition fund had not been created?

Legarra. — Essentially, yes.

Martin. — You spoke very little of the relationships in programing to the Governor, although you alluded to the question, to the local planning agency, the metropolitan planning agencies, and to the bureau staff. I wonder if you would comment on those relationships, briefly.

Legarra. — First of all, as I attempted to point out, the actual programing is done by the California Division of Highways and recommended to the California Highway Commission, and the commission is the only body by law that determines what the construction budget will be for the state highway program.

Now, as to the part that the cities and counties play in preparing this program, the answer is they play no direct part, but do make recommendations.

As far as the Bureau of Public Roads is concerned, I would say the same applies. So the full responsibility lies in the Division of Highways and the California Highway Commission.

Martin. — California has what is usually referred to as a "weak governor." I am not talking about the individual; I am talking about the position. Would you conceive that that same situation would exist in a state that has the strong-type governor?

Legarra. — In California, the budget is prepared by the California Highway Commission. That power has been given to them by the legislature. And this budget is turned over to the Governor, and it is included, in total, in the Governor's budget. I have never known of a case of any item being changed. Whether a strong-type Governor would change this is questionable.

Kimley. — I would like to ask a question about your statement that you have never experienced any loss of funds through advance acquisition of right-of-way. This seems to be a problem in North Carolina, where the Bureau of Public Roads has established a 7-year limitation.

In other words, my question has to do with the participation of the Bureau of Public Roads in the expenditures on the project, for right-of-way, preliminary engineering, etc.

Are you able to collect because California is building so fast that the limitation does not apply?

Legarra. — Actually, the right-of-way that is acquired by use of this highway right-of-way acquisition fund does not come under the Bureau regulation as to time limitation.

Kimley. — In other words, you do not get reimbursed for right-of-way acquired with those funds from the bureau?

Legarra. — I will put it this way. We can buy right-of-way from the highway acquisition fund ten years before we build the project, and it will still be eligible for Federal participation.

First of all, regular right-of-way funds are governed by this regulation of the Bureau, in regard to the 7-year period. There is no question about that.

However, in California the Bureau has agreed that the regulation does not apply to right-of-way acquired from the right-of-way acquisition fund.

Levin. — I just want to say the 7-year limitation applies only where Federal reimbursement is involved. They are not expecting any Federal reimbursement within the second period. They might thereafter; but within the 7-year period they are using their entire funds, and a special ruling has been made on this acquisition fund.

Legarra. — I think it should be clear that we are entitled to reimbursement.

Foster. — Ohio just got a new law that has been tested in the high court of Ohio, and it may provide impetus for the same thing California started some years ago. They are authorized to borrow from pension funds. They have a million dollars worth of

pension funds in Ohio. It is not under the control of the highway fund, of course. It is under the control of three or four state funds, social security, workmen's compensation, and one or two others. Under the law, the state highway department under proper agreements executed with these other state agencies can borrow up to 10 percent of this money.

In other words, as of now $100 million can on proper agreement be made available for advance acquisition of right-of-way in Ohio. You can see that every state has tremendous amounts of these public welfare funds, and they are actually laying idle.

One other inducement, as I understand it, is that a small premium, a quarter of one percent, can be paid to the social security agencies for the use of this fund, over and above what they are now getting. So it provides an incentive for them to contract with the highway people for this money.

Buswell. — On California's advance right-of-way fund, I presume there must be a substantial inventory of projects that are already surveyed, where right-of-way limits have been established? Otherwise you would not know what right-of-way was required.

Legarra. — I might add that the right-of-way acquisition fund is already depleted. What actually happens is this: As a construction project comes into being that requires right-of-way that was acquired under this right-of-way highway acquisition fund, a proper amount of money is turned back in to the highway right-of-way acquisiton fund. It is actually a revolving fund. So we can from time to time pick up money as construction projects go on.

Buswell. — It would be difficult for Montana to do that, because we just do not have a backlog of projects ready. You referred to the division of money between the northern and southern tiers of counties. Could you elaborate a little more on how you arrive at those percentages?

Legarra. — The legislature arrived at them. And they considered the relative deficiencies between the north and the south. As you can very well recognize, the north wanted more and the south wanted more, and there had to be an arrangement reached as to what the proper percentage was for the north and south. They went on the theory that the entire state highway network was a state transportation system, and consideration has been given to that, also. So some weight was placed on the matter of a system, and some weight was placed on the matter of deficiencies.

Buswell. — On the free and frozen funds, I understand that the highway commission can spend free fund money where it wants to?

Legarra. — Within that county group, yes.

Hall. — I wonder if you could comment on how city and state budgets and their programs can be coordinated.

Legarra. — First of all you would have to go back to the need of cooperation between the state and the cities in any freeway study.

You finally get to the point where you have a freeway located. You have to make a decision: Where will we put interchanges? Where will we put separation structures; which portion affects the transportation in the city itself, just on city streets? What are the effects of load from the freeway on to the city streets. During this freeway agreement stage is where all those determinations are made.

Now, as to the actual meshing of the improvements of the streets and the improvement of the state highways, naturally, no state highway would be improved with ramps unless the cities had an opportunity to improve some street that would be inadequate for the traffic that would be poured onto that street as soon as the freeway was opened. All I can say is that it just takes close coordination.

I do not know of any other answer, and it would have to be coordination on both sides, naturally. And certainly there is a flexibility in these freeway agreements. There is nothing firm about them. They can be changed by mutual agreement.

Bidell. — In what form do you present the legislature with your advance program, your request for approval for the necessary funds for the next five years, or whatever the

period is? Is it just a lump sum required per year, or do you go into much more detail in the presentation to the legislature?

Legarra. — I will divide it into two parts. One is the annual budget which the commission adopts. First of all, the Division of Highways recommends it to the commission. The commission adopts it, and it goes to the Governor. It is included in the Governor's budget to the legislature. And those are specific jobs. That is, they have the location between such-and-such a street and such-and-such a road, length, and cost. It is in quite complete detail. Second is the matter of programing (at the present time we are preparing one on a 7-year basis) and it is between the Division of Highways and the California Highway Commission and does not go to the legislature.

Bidell. — You mentioned before that you should have a knowledge of how much money is going to be coming in for the next seven years, in your particular case, so that you know where you are going insofar as your 7-year program is concerned. In what form do you present that, generally?

Legarra. — The legislature has set up definite monies for highway construction, or for the Department of Public Works, for highway purposes. And all we need to know is that this is a steady source of income to be used on highways. And then we can project that and use that for our planning program. We do not do any direct presentation to the legislature.

Granum. — Would you say that these legislative programs assist your programing procedure, that is, your selection of work to be done? Or would you say that it tends to handicap it to some extent?

Legarra. — First of all, insofar as the north-south split is concerned, it does not hurt us one bit, and it is perfectly all right. It is a legislative control that belongs in the legislature, and it does not harm the program.

Now, as far as the Mayo formula is concerned, at the present time it is out of balance because the relative deficiencies between the various counties has changed. There are counties that have just mushroomed, such as Santa Clara and Orange. Then there are other counties up in the mountains that have remained stable. The relative deficiencies between the two are out of balance. This means, for instance, that the legislature requires us to spend a certain amount of money in a mountain county. The money is not wasted. It is spent on needed deficiencies. But compared to the needs in the other counties, it does not measure up. So from that standpoint, there has to be a change made in the near future. The principle of the Mayo formula is all right. It is just that at present the percentages as set up are out of line.

Martin. — I would say that in some of the states, including Kentucky, legislative regulations such as you have outlined would be regarded as interjecting too much politics into the situation.

Livingston. — Actually, in trying to answer somewhat the problem you just posed, a well publicized program of the kind that they have in California, which the public acknowledges as being proper, will always find a vote-seeking legislature in difficulty if they try to change it.

Basic Information Needed for Sound Capital Investment Planning

PHILIP M. DONNELL

Investment in highways, very much as in any other investment, should be based upon past experience and the projection of existing conditions into the future. In great part, the present investment in highways was begun with enactment of the Federal-Aid Highway Act in 1918. This period of investment continued into the 1930's, and it is this investment that comprises a great part of the existing network. That it was a sound investment and that the returns have been good is beyond dispute. However, in the period since World War II there has been a substantial change in road usage, weight limits, land use and land development. The old values and projections no longer apply and new and more complex factors have appeared. The move to the suburbs, combined with the great use of automobiles in the place of mass transportation vehicles has loaded the streets and highways in a way not envisaged by early planners. Also, much of the freight formerly carried by rail now is trucked over roads and streets. With all these changes a more complex system of roads and streets has developed.

There has also developed an interdependence between component routes of the system. Thus, the improvement of one route, giving it greater capacity and facility of movement diverts traffic from other routes. Road and street improvements change the competitive position of producing, marketing and consuming centers and thus traffic patterns. The changing developments due to scientific research cause traffic generators to develop in new locations. The needs for defense transportation capabilities have increased tremendously. The current tendancy to industry dispersal causes the development of new sources of traffic generation and changes in the traffic pattern.

The wise investment of the highway dollar has become a complex task. The administrator, therefore, has turned more to the engineer for assistance in the development of sound highway construction planning.

In the development of bases for decision, the orderly application of engineering facts is considered the first step. Once the facts have been developed, a projection of future conditions, must be made, from which an estimate of needs for an investment period can be made.

The physical needs having been developed, the question of financing arises. How large a budget should be adopted? How is a just and equitable taxation policy to be devised, and how can it be assured that the most efficient road system is being purchased with the budget adopted? Cost-benefit studies are of assistance. The Bureau of Public Roads is now completing a study on incremental cost factors for the various highway elements. Economic studies by the states and cities furnish bases for revenue estimates.

When the budget has been determined, a method of orderly programing which assures the development of most urgent projects first must be devised. All of the foregoing require the assembly of large amounts of information on all phases and facets of road and street development.

An inventory of the existing plant is considered the first basic step in sound construction planning. The engineer must know in detail with what he is dealing. This inventory should be obtained by a careful inspection and recording of every roadway feature, located accurately by log mile.

All project beginnings and ends should be carefully established and the location of all county lines, city limits and urban boundaries carefully determined. Road plans, where available, should be used to establish curvature, structure data, surface and base descriptions, right-of-way widths, and other critical data. However, all plans

descriptions should be field checked to eliminate errors due to faulty research or subsequent construction for which records were not available. A special check should be made for overlapping or gaps between projects. Sections for which plans are not available must be completed by field measurements of all critical features. Other items required in the field inventory are the description of the terrain; the type of cultural development, rural, suburban, urban; the width of available right-of-way; and the available passing and stopping sight distance. On completion of the inventory, the maintenance personnel should be consulted and a condition rating established for the surface, base, subbase and drainage. Sections having excessive maintenance costs should be identified. An estimate of remaining surface life should also be made.

When all the inventory data have been obtained it should be assembled in a readily usable form. Some type of straight line diagram appears a logical method of data assembly. Tennessee uses a Kardex System, with all data for a 10-mile section of rural road, or a 1-mile section of urban road assembled on a single Kardex form.

The standard county and city maps prepared by the highway planning survey division from highway inventory data are invaluable for all highway planning purposes in Tennessee and are considered a basic requirement.

In conjunction with the road inventory operation, a study should be made of road life and road cost. This consists of recording each project built and still in use as part of the existing road network. The original grading and drainage project, the bridge projects, subsequent surfacing, resurfacing, widening and other betterment projects are shown in chronological order. Thus, it is possible to obtain from these records actual construction information showing materials underlying the existing surface. Costs are obtained and the amount invested in the section is shown. By a study of surfaces built and subsequently rebuilt or resurfaced, estimates of average surface life for various road surfaces are obtained. This also furnishes information for location of projects not available without extensive research.

Traffic volumes should be measured each year on each section of highway having appreciable variations in volume. These volumes, obtained by portable counters and adjusted to year-ground counts obtained at permanent representative counters furnish information as to the average daily traffic. Traffic counts are also used to establish the peak-hour volumes; classification counts show the type of road usage and the number and percentage of commercial vehicles using the road. Weighing stations are operated periodically to determine the axle loadings and gross weight of trucks on the various sections.

From this information a traffic flow map is prepared each year for the entire state highway system. This map is especially useful in that it readily shows the relative traffic volumes of the system and also the volumes at specific locations.

In Tennessee the traffic volume and the percent of commercial vehicles is also posted on the Kardex system each year for each section of road. Volumes for each intersecting road or street are also posted. Location and type of all traffic control devices must also be shown, and special traffic regulation measures noted.

Varying degrees of congestion and delay occur on highways. Some sections are so overloaded with vehicles that resulting delays approach intolerability. The establishment of a yardstick for measuring and comparing these delays has been aided by the publication of the Highway Capacity Manual. This manual gives basic data from which the capacity of highways and signalized intersections can be computed. Capacity tables have been prepared for varying conditions such as percent of available sight distance, design speed, percent of commercial vehicles, type of terrain, and operating speed for rural highways. Capacity tables for urban intersections may also be prepared for various signal timings, parking conditions, direction of flow and percent of commercial vehicles.

These capacities can be compared with existing traffic volumes to establish the amount of congestion existing on any section.

In Tennessee and a number of other states, these conditions affecting capacity have been further arrayed so as to show the effect in reduced operating speed which can be rated against the tolerable operating speed as a measure of road or street adequacy.

Another basic tool for sound planning is a road classification system. This system

classification does not refer to existing legal systems necessarily. This is for study purposes, to ascertain the general system to which the road should belong, as state trunkline, county or city arterial or feeder road.

State primary routes are routes that are of primary interest to the state as a whole. They connect the principal communities of the state and those of neighboring states. They are identified by the greater volume of traffic; by their superior service to natural resources, industry, agriculture and the national defense; and by the state's obligation to provide an interconnected system of highways to all sections of the state, while doing so with the least mileage which will achieve these objectives.

County arterials connect towns, communities, shipping points and markets within a county or adjacent counties; they provide access to schools and churches; they connect with state highways to form a complete network of main feeder roads; they carry appreciable volumes of traffic and act as collectors of traffic from several local roads.

City arterials are the streets that provide for the heavy traffic movements to and from the downtown business area as well as heavy traffic on crosstown routes; they include heavily traveled routes serving business or industrial areas.

Feeder roads, business or residential access streets serve relatively small local areas or provide adjacent land, residential or business access.

The requirements and standards generally vary for these systems. It is important that the approach in planning be based upon the type of use and the standards expected from these systems. System classification narrows the field in which each type of development must be studied and channels the appropriate type of improvement to its correct place.

When the foregoing data have been assembled the engineer is prepared to evaluate the existing highway system. He has the information on the existing investment and may now proceed to evaluate it and make preparations for the future.

In preparing for the future he must use any available data of past performance, present conditions, and anticipated trends. Using past and present experience as a guide and adjusting to foreseeable events, projections may be made. These projections should be tempered by comparisons with projections in other but comparable fields and a rational determination made for the future. In this way, sound forecasts may be made of numbers of vehicles, changes in traffic volume, estimates of revenue and other developments.

Having assembled all this information for inspection, the time has come to separate the good from the bad. To do this some standard of comparison is required. We must decide on the geometrics and quality in roads which will give the best and longest service for the investment. Therefore, standards must be established.

To be economically sound these standards should be based on the terrain where the road is located and on the traffic volume. Obviously it is not economically sound to attempt to build roads in mountainous terrain to the same design and operating speed standards as for flat terrain. By the same token, it is not justifiable or even desirable to build roads to the same standards for low volume roads as for high volume roads.

Two types of standards should be developed. For existing roads, there will be many roads that, although not quite up to the desired standards for new construction, do approach the new construction standards sufficiently so as not to justify rebuilding. To remedy this situation, a set of tolerable standards for judging existing roads should be developed.

The design standards for new construction should incorporate the best design features consistent with terrain type and traffic volume.

In judging tolerable and deficient sections of highway each section of road must be examined and compared with tolerability standards. Sections meeting tolerable design standards are judged presently adequate. These sections should also be judged for future inadequacies. Thus, a section that may meet all standards of tolerability at the present time might be expected to have an increase in traffic (from traffic projection) so as to become inadequate for traffic capacity at a future date. Sound planning would schedule improvement for that time. Estimates of remaining surface life might similarly show that a resurfacing or reconstruction project should be scheduled for the future.

In applying tolerability standards, examination should also be made of existing conditions to ascertain if some spot improvements might make the section tolerable. The addition of truck climbing lanes at certain points, for example, might remedy a capacity deficiency. At times one or more minor relocations to eliminate hazards may make a section tolerable. In cities, traffic remedies such as removal of parking, one-way street operation or other traffic control measures often furnish needed relief. These possibilities should be explored before declaring a section deficient.

Having examined each section and determined the deficient sections, a listing of deficient sections for each division or district of the Department should be made.

This listing, the maps, and the Kardex containing assembled data should be studied with design and location engineers of the field divisions and projects established and cost estimates made for each present or future deficient project. At this time, it may become apparent that field surveys, traffic studies, or the establishment of a transportation plan for an urban area are needed. Projects proposed should be the result of the application of sound engineering principles and investigation.

Origin and destination studies are of much help in planning, especially in determining justification for rerouting, new routes and bypasses and also the determination of the amount of relief which might be expected from such projects.

Each urban area should have an established transportation plan. The plan should be based on thorough traffic and engineering studies and provide for future growth. In this connection studies of future land use and projections of urban growth should be made. The best traffic engineering should be incorporated into the plan. It should be based on the thorough study of local conditions, be economically feasible and acceptable to the public. The transportation plan should be adopted as official and be used as a guide in issuing planning and zoning permits. Construction projects proposed in the area should be consistent with the official transportation plan.

When each deficient section has been established and the remedial projects and their cost developed, a highway needs study has been made. The projects may be divided into groups, such as, needed now; needed in 5 years; and needed in 10 years. Adding the cost for projects within the group, a total cost for each group may be obtained.

At this time, a study of fiscal capabilities is required. A study of past revenues and existing revenues can be made and these amounts projected to give estimates of future revenue available from present sources. These revenues compared with physical needs, over the study period will show if additional funds are needed. If there is a discrepancy, studies may be made of alternate methods of financing as by a 10-year catch-up program with funds augmented by bond issue to be paid from future revenues in various time periods, or new sources of revenue may be explored. Another and less desirable alternative is the construction of only those projects for which current revenues provide each year.

In embarking on any of these programs it is recognized that, even with a short catch-up period, a decision must be made as to which projects should be buit first. And certainly where revenues are insufficient to provide for needs, a method of equitable distribution of construction of the most urgent projects should be used.

Establishment of a system of priorities based on sound engineering principles is recommended. There are a number of methods in use, all of which have something to commend them. In Tennessee, we use an urgency rating based on structural condition, facility of movement and accident record, adjusted for traffic volume. Available funds are divided among field divisions on the basis of total needs of division against total needs of the state and by Federal-aid system. Then, priority arrays for the Federal-aid primary system, the Federal-aid urban system and the state system are used to establish a 5-year construction program for each system within the division. This 5-year program is used as a basis for surveys, design, right-of-way procurement and contract letting.

The adoption of some similar method is recommended for any department charged with the responsibility of sound investment of highway funds. A further note of caution is that the method adopted should assure that lower volume roads and remote areas will recieve attention in proportion to their needs. This can generally be accomplished by allocation of funds by Federal-aid systems to smaller department sub-divisions with the sub-division of funds based on the proportion of total needs.

The foregoing outlines the basic data we have found of use in capital investment planning in Tennessee. We have profited greatly by the assistance of the Automobile Safety Foundation in a highway needs study and also in a subsequent programing study. Other sources of information include published papers of the Highway Research Board and the manuals and publications of the American Association of State Highway Officials.

Discussion

Babcock. — If you find that your needs are greater than the probable revenues, do you change your tolerability standards?

Donnell. — No, when we build a road, we hope to build it to a standard.

Hall. — You referred to removal of parking and other measures. Sometimes it is much more costly to take the immediate action, the obvious palliative, than to carry out some major construction to eliminate the critical section.

Donnell. — We make a study of an urban area, and we usually resolve these problems with the city planning and engineering departments before making recommendations. These departments usually tell us what can and what cannot be done operationally. Unfortunately, we do not have an expert operational man, and often we depend on the city to advise us as to the possibility of one-way streets, removing parking, the operational plan, and if that is not feasible, we try to work out with them a by-pass or new route.

Hall. — It seems to me that in general, it will cost much less money in the long run to build the by-pass because the cost of rights-of-way, construction, and other developments are increasing.

Donnell. — If operational improvements would only add one year or two years to the existing street system, we would advise, "Go ahead with your by-pass." But if they think they can get ten years out of an operational plan without a major improvement, then we would not go into an expensive by-pass at the present time.

Hall. — You referred to a transportation plan, and I certainly concur that we must have transportation plans — except I do not know what a transportation plan is.

Donnell. — Currently plans are being made in Nashville and Chattanooga. Our idea of a transportation plan is the one that was recommended by the committee that worked for about two years on highway transportation plans for urban areas.

We hope, when we get through, to have a plan that shows what the state highway system should be, what the city arterial system should be, and what the county arterial system should be in the metropolitan area; also what each one of these systems will cost, what should be built, whether it should be built to two or four or six lanes, and an over-all plan agreed upon by the city, the county, and the state highway department. That is what we hope to have — a transportation plan.

And when we make our assignment of traffic, it is made to this arterial street system, county system, state system, as we hope it to be some 20 years hence.

Hall. — You have said that there are two elements, first of all a map of the whole state, city, or county, and second, standards to reconcile the various elements of the system. Would it include anything as to planning or programing the financial aspects?

Donnell. — No, the over-all transportation plan will not, as far as the published report. As far as the state highway system, or the state highway department, is concerned, we will make a 5-year construction program, and we are encouraging the city and county to do the same thing. But that is, of course, out of our jurisdiction, and we can only hope that they will cooperate.

They are in a position that they are going to have to do something, because the Interstate System is dumping tremendous loads of traffic on to streets that will not handle

the volume of traffic that they are going to receive. And we are recommending to them that they not wait until the Interstate System is completed, but start now acquiring and building those streets that need to be improved first, and thereby establish a construction program of five or ten years.

Swanson. — I think that we need a complete understanding, particularly in the northeastern part of the United States, of the mass transportation system and what is going to happen to it. Anything that occurs in mass transportation is going to influence the highway program. Therefore, it is necessary to make a complete study of mass transportation as part of these major transportation plans.

From a statewide viewpoint, it is necessary to study the state's economy, trends in state legislation, shifts in the type of industry, and movements from one state to another.

That kind of basic information is essential, if we are going to do the kind of a capital investment planning that needs to be done.

Donnell. — Of course, we are making a study of the transit system. In our area there has been decline for a number of years. However, Nashville is one of the cities that shows a profit in its mass transportation and has a good system.

Swanson. — Whether it goes up or down, it is certainly a factor to be considered.

Tacke. — You stated that transportation studies were being made in Nashville and Chattanooga. I presume these are being made by the state highway commission. If so, what portion of the cost of that study is being paid for by the two cities?

Donnell. — We set up an agreement with the city and county that if they would make all the correlated studies recommended for a highway urban transportation study, and would pay for them, that we and the Bureau of Public Roads would pay for the origin-destination and parking study. They would furnish the information to make the other reports.

This has not been reduced to a percentage. We are in full control of the origin-destination parking study. They make the correlated studies.

Walker. — Were there definite reasons why you did not make your 5-year program public?

Donnell. — Frankly, we do not want the state legislature to adopt it. That is the best reason I can think of for not making it public, that we do not want to be strait-jacketed that severely if we can help it.

There are problems. There are bridges knocked out. For one reason or another, things go all to pieces in a winter. This occurred last year in the mountains, and you just have to make repairs. That automatically drops some projects into the second year instead of the first year. And that is one of the main reasons why we do not have it approved by the legislature.

Martin. — We find that the development of the highway system tends to alter the economy, so that a projection of past trends simply will not work in some cases.

There are other factors. The development of secondary roads sometimes opens up new market areas that make a difference in the economy that affects traffic volume materially. Other things, for example state and Federal public works, alter the requirements for traffic. Does your plan take into account the changes that are brought about by such developments?

Donnell. — Yes, in our land-use studies, they have the benefit of the arterial system as planned.

Now, we know that you cannot always say that this area is going to develop and this one is not. We are going to have to take the land-use people's word for it. We get the best people to work on it that we can, and we try to get them to tell us their best forecast.

I believe they make a statement similar to the one that Mr. Lang made, that they cannot tell you what it is going to be next year, but they think they can do a fairly good job in telling you what it will be 20 years from now, because it goes up and down.

Morf. — You said you had this 5-year program which you did not publish. Do you have a 1-year program that you do publish?

Donnell. — No. We put it out in a 5-year program. We publish it, but we only give it to the staff engineers of the highway department. It is not given to the general public.

Morf. — My question relates to the amount of money that you have in your program. Let us assume that for a period of a year, or a period of five years, you can make a fair estimate of what your income is going to be. Do you have trouble determining how many jobs you are going to list against that income?

If you have $100 million, do you list $90 million worth of work against that, or do you list $110 million?

Donnell. — We started out listing $110 million. We found out that we got in trouble. So now we are listing about $90 million.

Morf. — I could see where if it is a restricted publication, this might not be too critical, because nobody sees it in total. You say that the people discuss it as individual improvements?

Donnell. — That is right. If a county man comes in, we show him anything that is in his county. We show a state legislator anything in his district.

Morf. — But no one has a chance to see the whole array that is in your five-year total?

Donnell. — That is right.

Morf. — We are in a different position, because our publication lists the money and the work. And we are torn between whether to list more jobs on the chance that all of the jobs listed will not come to the contract stage, or, on the other hand, less than we have, because we may have jobs that should be done, which could not have been foreseen at the time the program was compiled. I think that this is one of the real problems in making a program among those who have actually done it.

Donnell. — We ran into trouble with a 125 percent program, so now we make a 90 percent program of the money that we think will be available.

The first year is very secure. The second year is fairly secure. And if we get all projects in the first year program done, we just reach over in the second year for a contract and go ahead with it.

Our program is revamped every year. We make a new 5-year program every year. We get our money on a 2-year basis, and are fairly certain of what the money is going to be those first two years. Our bond issues have been set by the legislature. There is not going to be much change in the money.

But if the legislature, which meets next year, gives us an additional $15 million a year, then the 5-year program will reflect that for the period of time they set the bond issue up.

Babcock. — Who does your land development planning? Do you do it yourself, or do you have experts do it?

Donnell. — Nashville and Chattanooga both had land development programs, and they furnished that as part of their agreement.

Accounting and Budgeting Requirements for Advance Construction Programs

EUGENE C. HOLSHOUSER

The process of formulating and carrying out a highway construction program (construction budgeting) has received increased attention from State highway departments during the past four years. Such a trend is to be expected with the expansion of the highway modernization program and with the growing importance of advance planning. Some of the larger projects and various types of special projects may require five or six years or longer from the route planning stage to the final completion date. Careful planning is required to allow adequate time for the preconstruction activities (such as location, field survey, field design, working drawings and specifications and right-of-way acquisition) and to coordinate the many projects in process. It is being realized in some highway departments that the lack of a long-term construction budget makes it virtually impossible to secure an effective and adequate current operating budget.

Assuming, that the need for thorough planning, both technical and financial, is recognized, such planning must be accompanied by an administrative ability to implement the plan properly. A good plan, of course, is worth little unless it can be placed in operation. And it does not go into operation automatically.

Late in 1959 Kentucky Department of Highway officials tentatively decided to do two things: (a) to develop a reasonably firm, long-rang highway construction program and (b) to execute and control the program primarily through the use of electronic data processing equipment.

Most State highway departments acquired electronic computing equipment in the 1956-58 period. This equipment has been used mostly for engineering computations and routine accounting functions. At least two States have mechanized cash forecasting through the use of their electronic computer. However, a brief search indicated that no State highway department had developed anything resembling complete machine control of its construction program.

Budget administration in the Kentucky Department of Highways has been weak for many reasons. The managerial devices for budget control in such large, relatively uncoordinated organizations are rather cumbersome and complex, and before 1958 the department never had anything approaching a comprehensive construction budget. With the formulation of the construction program, involving thoughtful planning, some means of implementing and controlling the program was necessary. The development of management tools for this purpose was essential. The use of machine apparatus as one important control device appeared feasible and desirable. The fact that the computer was not being fully utilized was an added inducement.

Each official of an operating division concerned with construction-oriented activity needs to be aware of progress within his division and of forthcoming assignments. The large number of projects at various stages and the several phases required for a proposed project to become a finished highway give rise to a serious problem of control and reporting, as well as to other ensuing issues of a management character. The practice of occasionally taking inventory is not adequate, and, in the long run, it is expensive. The status of each project in terms of both money spent and technical progress achieved should be continuously known so that it can be compared with the budget. Only in this manner can effective control be realized. Executives responsible for the program should have timely and adequate information constantly available. Data gathering should not consume their time. C.R. Lockyer envisaged that the data processing center could provide the vast bulk of required information either by regular reports or "on inquiry." Savings in clerical and managerial manpower could be ac-

complished thereby and data superior to those obtained manually or from small machines could be produced.

The highway construction program that is now being formulated will probably extend through 1964 or 1965. The program requires a listing on the basis of urgency and of cost of all Federal-aid projects, by system, to be undertaken during the 4- or 5-year period. It includes a time schedule by phase of activity for each project. Projects included in the program will be justified on the basis of financial, administrative, economic, social, political and, of course, engineering considerations. It is contemplated that the whole program will be thoroughly reviewed at least annually, necessary revisions made, and the program extended for another year. Of course, some replanning may be necessary more often to correct for inaccurate estimates of revenues, construction costs, and technical progress. It is assumed that the program will be adopted, either officially or unofficially, by the major State policy makers. It is hoped that the construction program will be published and distributed widely. If the experience of the few States which have published their long-term construction budget can be used as a guide, publication tends to stabilize the program and contributes to fuller public understanding and support.

The proposal to produce machine control for construction budgeting was accepted in September 1959, and a committee of management personnel was appointed to assure suitable administrative arrangements and to guide the general development of the plan. The department decided to limit initially the program to Federal-aid projects which, of course, constitute the vast bulk of the construction program. The present plan is based on the assumption that all construction will eventually be programed and machine-controlled. In developing the plan, emphasis was placed on an analysis of the preconstruction activities, as relatively little modification of departmental administrative procedure would be required from the construction contract award stage onward.

The first major task was the preparation of a description and flow chart of all relevant procedures currently used for the preconstruction phase for Federal-aid projects. This task involved an analysis of work flow through the divisions of planning, design, right-of-way, accounts and administrative services (accounting and budgeting) and a staff attached to the chief engineer's office which serves as liaison between the department and the Bureau of Public Roads district office. This analysis pointed up various administrative and procedural changes required. It also uncovered shortcomings which would hinder the smooth development of a construction budget and a machine control scheme. Many of these drawbacks when clearly identified have been corrected with little difficulty. A list of some of the things which needed to be developed for proper administration might be helpful.

1. A firm, priority-based road-building program which would prevent such occurrences as the division of design beginning work on a project before the division of planning had received official approval from the Bureau of Public Roads, substantial delays due to the necessity of making last minute route studies and user benefit analyses, and non-Federal-aid projects being pressured for Federal participation;
2. Adequate coordination between the budget and schedules staff, which issues billings to the Federal government, and the divisions of design and of right-of-way to assure prompt reimbursement;
3. A standard for processing repayment checks from consultants and utility and railroad companies which were overpaid;
4. More careful encumbering and attention to details to preclude the delay of right-of-way vouchers for payment;
5. Accounting records of Federal aid at the various stages prior to contract encumbrance in order not to have to rely on Bureau of Public Roads district office records, which for highway department purposes are usually not up to date; and
6. A revision in the right-of-way division encumbering procedure to avert the unnecessary tying-up of thousands of dollars.

Thus, the analysis necessary for the inception of the machine control program contributed to more efficient and economical operation in several directions.

After the survey of present procedures dealing with departmental construction activities, an over-all flow chart was prepared. This chart provides the basis for establishing the work flow under a construction budget.

Next, the reporting stages required to obtain construction budget control were determined and a summary flow chart prepared showing the suggested method of obtaining such control. Then the following steps were taken:

1. The necessary procedural changes to receive the information required for the reports were made;
2. The card layout and key punch instructions were prepared and the machine program written; and
3. Instructions were written for data required for the projected program.

The data processing staff is now in a position to conduct a "trial run" using the Interstate construction program which has been prepared by the division of planning and the chief engineer's office. Shortly thereafter, the actual operation of the new system should begin. (As might be expected, one of the most important tasks of the persons formulating the machine control program has been that of "selling" the program to the entire highway department. The importance of task will scarcely diminish when the program is in operation.)

The plan calls for a construction program expediter in the office of the chief engineer who would be responsible for the execution of the program. Since this person would play a key role if the department is to achieve the planned program, he should be in a high-level position. Projects will be dealt with from the initial planning stage to final billing to the Bureau of Public Roads. The program expediter will for each project in the construction program assign and schedule the several phases to the various operating divisions. He must carefully scrutinize progress on the program and keep top management informed. It is apparent that the planned schedule cannot be maintained in all cases and that some cost and revenue estimates will be off considerably. Minimum revisions are a necessary part of the process. The program expediter will doubtless be an engineer as only an engineer is likely to be acquainted with the multitude of factors, knowledge of which is necessary for appropriate scheduling of the projects. The engineer, however, will probably need considerable collaboration with and continuing explanation from the financial experts if he is to do his job well.

Other probable duties of the expediter as recommended by E. B. Bond are:

1. Scheduling new projects into the projected highway construction program;
2. Authorizing and notifying, except for routine phases, each division when to begin its function;
3. Ascertaining from reports received from the data processing center the status of each project's position in the projected schedule and taking action accordingly;
4. Serving as the liaison between the department and the Bureau of Public Roads district office;
5. After receiving reports from the data processing center, explaining, both in writing and orally if necessary, the significance of the reports to the appropriate persons; and
6. The interpretation and explanation of the distinctly budgetary reports will continue to be made by the budget staff in the division of accounts and administrative services.

After the construction budget receives official approval, the data processing staff will record the engineering and financial estimates. This record will be maintained and compared with what actually occurs until the planned highways have been constructed. The projects will be in various stages, some will be initially inactive, some will be in the location process, some in engineering design, some in the right-of-way acquisition phase, and some will be under construction contract. As each progresses, the technical progress and the costs incurred will be posted to the project record. This information will be closely linked and appropriate reports will be prepared periodically (weekly or monthly). Undoubtedly special reports will be useful also.

These reports could indicate the status of each project for a designated system or

for all systems, the status of all projects in a particular phase (design, for example) or for all projects which have fallen behind, or on almost any other basis. The reports also could, simultaneously or separately, show every imaginable type of cost information, for example, total amount spent to date or the amount spent on each phase. Futhermore, they could avert, for instance, encumbering more than the project agreement amount or obligating for a designated system more than is reimbursable by the Federal government. The information, of course, could be used as a partial guide to future budgets. Once sufficient data have been accumulated, more accurate estimates of costs and of completion dates should be possible. Several of the engineering and accounting reports which are now prepared manually will be unnecessary duplication.

There will no doubt be problems of obtaining adequate reporting from the central office divisions and the field. For example, technical progress is ordinarily reported on the basis of the estimated percentage of work completed only. A better basis, perhaps, would be the percentage and also the estimated completion date with an appropriate explanation if it appeared that the scheduled completion date could not be met. Ninety-nine percent of the right-of-way work on a particular project may be completed in six months, yet the final 1 percent may require a year. To report that 99 percent had been completed without comment would obviously be misleading. A particular design job may be 75 percent complete one moment and 10 percent complete the next. This would probably indicate a fresh start had been made on the design. The estimated completion date would be more meaningful here also.

Accurate reporting is necessary if the machine apparatus is to be of maximum utility. Instilling this idea in the thinking of highway personnel is likely to be more difficult in the field than at the central office. As in many highway departments, there is considerable resistance to change. This is a problem that cannot be solved swiftly. However, over time it should be correctable by training programs, by top management insistence on careful reporting on a timely basis, and perhaps by granting the administrative areas more authority and responsibility. Some of the carelessness undoubtedly can be accounted for by the individual's lack of pride in his job and a feeling that what he does is of no consequence in the over-all highway department operation.

ACKNOWLEDGMENTS

The author wishes to thank E. B. Bond, C. L. Dawson, J. R. Harbison, and R. R. Shipley of the Kentucky Department of Highways, and especially Professor J. W. Martin, Director of the Bureau of Business Research, University of Kentucky, for reading an early draft of the paper and offering helpful suggestions.

Discussion

Hart. — Has Kentucky put this data processing in operation as far as their total program is concerned? Or has any department put it into operation?

Holshouser. — No, it is not in operation. The department now is in a position to undertake a trial run, so it should not be too long before it is in operation.

Granum. — How do you visualize this to be integrated, particularly on the fiscal side, with the regular accounting system; that is, the documents that produce the pay checks, etc.? Is this to be a self-contained separate reporting system, or is it to be tied in with the more routine and regular accounting operation?

Holshouser. — No. I think this will be an independent system. Some of the other things have already been mechanized and have been in operation for some time.

I do not know exactly what the situation will be. I think some experimentation is going to be necessary before we reach a final conclusion.

Babcock. — We are involved in this same thing. Have you worked up your machine programs on this?

Holshouser. — Yes.

Babcock. — And what do you envision? A print-out sheet on each program, that will give the status of the problem, with where it is in design, where it is in location, etc. on one such sheet?

Holshouser. — Yes. I believe this is the idea, one print-out sheet.

Walker. — I would be interested in getting any material you have on simplifying that. For one thing a manual reporting system takes a lot of time.

There are two things that we are up against. One is timeliness. By that I mean relying on the divisional reports to get current up to date information on every process, all phases. And the other is manual labor. In fact, that is what I was going to present in my paper. And we certainly have not developed it to the point we want, by any means.

Donnell. — How much of a time lag do you feel you want to have between machine input and what you are going to be able to furnish the administrator?

How up to date is your data going to be? For instance, you are reporting on a right-of-way project. You are going to report that 70 percent has been acquired. How up to date is that report when the chief engineer gets it? Is it two weeks old, or is it a week old?

Holshouser. — It will depend on how often these reports are published. I think this will be one of the advantages of the system. That is, you will be able to get the data currently. By mechanizing it, the process should be speeded up considerably, and there should not be much of a time lag.

Donnell. — We are also trying to set this up. You have a field division man who is going to have to make a report to the headquarters office, and before that can be punched and put on cards, there has to be a time lag. How often are you going to have him report? Weekly, or bimonthly?

Holshouser. — Probably weekly, possibly monthly.

Walker. — When we get down to 90 days before a letting, we supply management with a right-of-way situation weekly. We get them up-to-date weekly; prior to that — monthly.

Donnell. — On a sliding scale, the closer it is to the letting of the contract?

Walker. — Yes. And we get information from the field almost daily by teletype.

Kimley. — Taking our case in point, to program for two years, we have 60 to 70 projects going through the commission all the time. Just about what size or what capacity machine would be required in terms of the IBM to put all these cost analyses and the positioning of the particular projects within the departments, and the various sub-departments?

Holshouser. — The Kentucky projects will be done on the 650.

Bidell. — Is this type of reporting also going to include all the jobs that are up to date or on schedule, or is it just going to show those that are behind, or ahead, whatever the case may be?

From the point of view of management, after they have seen and approved the initial set-up, are they really interested in seeing those jobs which are on time?

Holshouser. — Well, of course, it will be much more important to get a list of those jobs that are behind schedule. As to those that are on schedule, it would be important to get them to prevent potential trouble, which might be detected in the reports.

Donnell. — Where are you going to pick up this project, if for example, you have a 5-year construction program? Are you going to pick up all the jobs in the first year construction program, or the first two years, or are you going to pick it up when it starts into location?

Holshouser. — The entire program will be recorded once it receives official approval. And some of the projects will be initially inactive. There may not be any work done on them at all for two or three years, but the whole program will be recorded initially.

Hart. — I presume that you would only put in your system the expected cash payments of right-of-way. Would you also do that for construction operations, rather than when you have an obligation to contract? When you have a contract, is this situation finished as soon as it is let to contract, or will it continue cash payments until the final close-out of the project?

Holshouser. — No, it will continue throughout until final billing to the Bureau of Public Roads.

McCaa. — How many IBM cards are necessary? With the data you have listed here, I can visualize that one project might require 12 to 20 IBM cards. Then in your print-out, data can be in various parts of those cards. In the manual for punching all of this information, how many cards do you anticipate?

Holshouser. — I do not have any idea how many there will be.

McCaa. — Do you carry all your financial data and various types of funds? That would consume a lot of space.

Holshouser. — It consumes a lot of space. No question about it.

The Case for Capital Budgeting in the State Highway Departments

EUGENE C. HOLSHOUSER

Many opportunities exist for obtaining better highway service from the funds available for this purpose, some of which are already widely adopted. One under-utilized means of insuring more economical use of highway money is capital budgeting. Although capital budgeting is recognized by administrative specialists in both business and government as a fundamental aid to effective management, it is neglected by many State highway departments. Basically, capital budgeting is valuable because it can, and should, contribute to more orderly, systematic, and efficient road building.

NATURE OF HIGHWAY CAPITAL BUDGETING

Capital budgeting has different meanings depending on whether it is applied in municipal and state government, national government, or private industry.[1] However, the fundamental objective—that of providing a systematic means of selecting among alternative fixed property investments and of properly implementing the decision—is the same. Highway departments are concerned with the optimum investment and use of tax funds entrusted to them.

Highway capital budgeting involves, in essence, selecting a priority-based list of construction projects, carefully linking the construction program with a formal financial scheme, and carrying out the entire plan through a definite work schedule. (For purposes of this paper, buildings, shops, and land not used for highway construction, per se, are omitted. In other words, the paper is largely confined to highway construction budgeting.) Thus, the projects comprising the program, the estimated expenditure requirements, and the anticipated budgetary resources (revenue) available are included. The latter may involve estimates of support to agencies providing services to the highway department, proceeds of loans, debt service, maintenance, and administration to determine the amount available for construction work. It is to be noted that capital budgeting embodies technical planning as well as financial planning; it includes executing or carrying out, as well as formulating, the plan.

If it is to be of maximum utility, (a) the financial plan and the construction plan must be closely integrated, (b) the technical progress and the financial outlays for each project and for the whole program must be continuously known, knit together, and compared with the plan, and (c) the execution process must be an extension of program formulation — that is, another step in the over-all process.

The highway capital budget may appropriately cover a period as long as 8 or 10 years. Theoretically, the period should be of sufficient length to include the most time-consuming project from initial planning to final inspection and settlement. Although the desirable length will vary from State to State and from system to system within a state, a period of about six years may be the optimum in many states. Some of the larger projects and various types of special projects may require this much time

---

[1]For illustrations of municipal, state, and national governmental capital budgeting see Jesse Burkhead, "Government Budgeting" (New York, John Wiley and Sons, Inc., 1956), pp. 182-211. The advantages of and problems resulting from capital budgeting in municipalities are examined in Lyle E. Schaller, "The Balance Sheet on Capital Budgeting," National Tax Journal, XIII, No. 2 (June 1960), 163-167. Capital budgeting in industry is described by Joel Dean, "Capital Budgeting" (New York, Columbia University Press, 1951).

or possibly more; for example, a 12-lane freeway being built through Seattle, Washington, will require an estimated nine years to complete.

To put highway capital budgeting in proper perspective, its relationship to the goals of highway building, needs studies, the annual operating budget, and the over-all highway management process is examined briefly.

It is often said that a highway department should secure the most highway service possible with the resources available or, alternatively stated, should attempt to maximize net social benefits. These general ideas are not very useful unless they are accompanied by more specific statements setting out the goals of highway building and alternative methods of accomplishing these goals. Such questions as these should be asked and thoroughly considered: How should the appropriate level of highway service be determined? Should additional emphasis be placed on opening up natural resource and recreational areas, or on reducing urban traffic congestion by building bypasses, or on providing better access to relatively isolated areas? In other words, goals more specific than "building and maintaining highways" are highly desirable. It is true that the specific goals of highway building must be established within the framework of the Federal-aid systems and Federal funds available for each class of highways. However, it is important for highway management to ask itself "What are we trying to do and how well are we accomplishing it?" A practical course needs to be charted in the capital budget looking toward achieving specific, agreed-on goals.

The capital budget should be buttressed by a long-range engineering and financial needs study, similar to the master transportation plan in municipalities, which seeks to look 15 or 20 years ahead and plot the highway improvement program in broad terms. This study, along with the explicit goals of highway building, establishes the guide posts for the capital budget.

Putting the capital budget into actual operation is a year-by-year process. "The capital budget can lay a course, but it is the annual budget which sails the ship." The first year of the capital budget — with projects in all phases, such as, in the location process, in engineering design, in right-of-way acquisiton, under construction contract — is integrated with and becomes a part of the annual operating budget. The general budgetary apparatus as well as project reports are essential to capital budget execution. These statements emphasize the close interrelationship of the annual operating budget and the capital budget and the dependence of the latter on the former. Capital budgeting cannot be done independent of the operating budgeting machinery. Without an adequate annual operating budget, capital budgeting will almost surely be ineffective.

The capital budget is the basic management means of formulating and executing the construction program. It is interwoven with and is a product of the entire management process. Without such a budget, or something approximating it, administrators have few guides with respect to many long-range decisions. Where appropriate use is made of the capital budget, its fundamental importance to management efficiency at all operating levels seems firmly established.

UTILITY AND LIMITATIONS

Governments in the United States spend close to $10 billion a year in building and maintaining roads and streets. Even this tremendous rate of expenditures does not nearly satisfy all needs for highway improvement. The amount of money involved and the fact that highway departments are faced with the problem of choice among alternatives make it imperative that the departments do their best to assure that highway dollars provide as much road service as possible. Often highway departments must proceed rapidly, as in 1958 when they were allowed only about eight months in which to obligate $400 million of additional ABC funds. The establishment of construction priorities is of profound importance. When alternative road or street improvements are considered, such information as cost estimates, adequacy ratings, and estimated potential benefits is essential to selecting the optimal projects. If effective use is to be made of available resources, thorough fiscal planning is required. The fact that Federal aid is ordinarily offered by system and can be switched to a limited extent

emphasizes the importance of this type of planning. Uneconomical use of scarce funds is almost certain to occur unless the highway department has carefully prepared, well-integrated technical and financial plans.

There are several specific advantages of highway construction budgeting, and the utility of such budgeting will be augmented if the program is carefully linked with other State and local planning and is published.

With the advent of the accelerated highway improvement program in 1956, the average lead time for preconstruction activities increased. It is obvious that advance decisions must be made regardless of whether there is a plan which can be used as a guide. Since advance decisions must be made it is only logical to plan in advance. The alternative is day-to-day decisions on a road-by-road basis which result in recurring changes and crises with repetition of mistakes and unnecessary waste of valuable top management time. The importance of capital budgeting is further pointed up by the fact that errors in planning a long-term program usually have more serious and more lasting consequences than errors in planning and annual program.

Adequate capital budgeting will permit employment of all personnel engaged in highway building, without either unmanageable peak loads or unduly light work loads. The budget schedule may indicate, for example, that design work in a certain district will taper off in about a year and, at the same time, design work in a nearby district will become heavier. With this knowledge, the appropriate management personnel can arrange for transfers from one district to the other or for enlarging the design staff in one district and allowing vacancies to remain unfilled in the other. Such budgeting will facilitate adjustments to seasonal requirements, such as the economical use of construction personnel during the winter season. The result should be increased productivity. Also, management of the department will be much simpler if, rather than switching from one thing to another at a moment's notice, the planned program is followed.

Along with facilitating effective employment of manpower, departmental road machinery and equipment can be utilized more effectively. This machinery and equipment, with proper planning, can be placed at the right location at the right time. More important, if contractors and their suppliers know what the future demands of the highway department will be in terms of manpower, equipment, and supplies they can avoid shortages and can save money by planning of their own based on the published program. These economies should result in lower bids.[2]

A given level of highway building several years in the future will have important implications for the administrative and maintenance staffs of the highway department. In forecasting revenue available for construction, the estimated level of maintenance and administrative expenditures is established. Construction progress, especially on the Interstate System, has considerable effect on the level of maintenance expenditures because no Federal aid is available for maintaining State highways. As another example, the personnel recruiting section can base its estimate of manpower needs on the long-term budget. If this section knows with reasonable certainty what the highway personnel needs will be five years hence, it can proceed more intelligently to assure that the appropriate personnel is secured.

Outside the highway department, local governmental units, particularly municipalities, and public utilities are vitally concerned with the road program. If cities are given five or six years advance notice of highway construction in the area, local officials will have an adequate opportunity in appropriate cases to aid in location study and in any case to plan for changes in growth, zoning, dislocation, and other changes which may occur during and after construction. Where a highway improvement is projected through or near an urban renewal project, early coordination is essential if conflicts and serious delays in highway construction are to be avoided. The problems are likely to be complex and time consuming, and an adequate solution may require

---

[2]See James W. Martin, "Programming Highway Construction," Proceedings of the Kentucky Highway Conference, March 12-13, 1958 (Lexington: College of Engineering, University of Kentucky, 1958).

prolonged discussion and planning with city officials and urban renewal specialists. This situation presents an opportunity for great mutual benefit to the city and the highway user. However, full advantage cannot be taken of the situation without long-range planning by the highway department.

If the completion dates desired by the highway department are to be met, the same type of advance notice is needed by public utility officials incident to utility relocation. The utility companies need adequate opportunity and time to provide for meeting the costs, to engineer the projects, to procure material and supplies, and to fit the work into its construction schedule.

In short, satisfactory capital budgeting allows organizations and groups, both inside and outside the highway department, which will be affected by the construction programs to plan ahead. The savings in time and money produced thereby are apparent.

The experience of the few state highway departments which have published their capital budget for highway development indicates that publication can contribute considerably to fuller public understanding and support. Because of the size and complexity of the operation, the average citizen knows little, and cannot be expected to know in detail, how the highway department operates. However, lack of knowledge may be due also to an air of secrecy surrounding the plans and work of the highway department and a failure to explain well what it does choose to make public. Almost complete lack of knowledge is likely to intensify anxieties and suspicions and to encourage local jealousies and rivalries. The highway department can limit political influence on project selection by publishing its capital budget. Wise policy dictates taking advantage of an opportunity to do so.

Capital budgeting makes it possible for a highway department to spend in an economical manner all the money that is available to it. A department with such a developed process can prevent the carrying forward of large balances at a time when critical needs are apparent. Obviously, such carrying forward entails uneconomical postponement of needed construction. With proper financial planning this practice need not occur.

It appears that solution of unique problems (right-of-way acquisition, for example) and the complexity of coordinating preconstruction activities render well-developed capital budgeting peculiarly appropriate in State highway departments. Important examples of the potential benefits of a soundly conceived and executed highway capital budget have been presented. Obviously, not all possible benefits have been discussed. In summary, it might be said that the fullest development of careful, comprehensive, and continuous capital budgeting is likely to produce far better results than sketchy, haphazard, inconsistent performance. Without such budgeting neither the long-term goals of planning nor the most efficient administration is likely to be achieved.

Appropriate budgeting cannot, of course, solve all the problems involved in directing and controlling a highway department. It is no substitute, for instance, for inefficient employees. It does not, per se, solve human relation problems. However, capital budgeting can contribute indirectly to problem-solving even in these areas. It cannot be expected to work miracles; but with concomitant changes, some of which the budgeting process is helpful in bringing about, it can be extremely valuable. The major drawback is not the lack of potential of the capital budget; it is rather that the full potential is not achieved in highway departments.

IMPEDIMENTS TO EFFECTIVE CAPITAL BUDGETING

Federal legislation in 1956 provided for a vastly expanded highway modernization program. Expenditures for highway purposes today amount to almost twice those of 1955. The tooling up required and the increase in the complexity of problems to be solved has permitted little time for the development of adequate budgeting in the highway departments. The concentration on operating problems has left little time for efforts at defining the aims or goals of highway building. The highway departments have operated with such haste that faulty decisions and faulty arithmetic almost inevitably occur.[3] However the lack of time and of well-developed, explicit goals are not

[3]Some sensational examples are presented in a rather misleading article by Karl Detzer, "Our Great Big Highway Bungle," Readers Digest, July 1960, pp. 45-51.

the most important impediments to effective capital budgeting. The major impediments appear to be (a) an inadequate concept of budgeting and (b) lack of a firm Federal-aid support policy. In order to shed light on the status of highway department capital budgeting practice, each of these obstacles will be examined in turn.

A radical and far-reaching change in budget concept occurred in the United States in the late 1930's and the 1940's. Until the early 1940's the prevailing view was that the primary function of the budget was to provide financial control — to restrict and to prevent financial irregularities. The expenditure side of the budget, although typically based on inadequate program planning, received undue attention; revenue estimating was largely ignored.

The emphasis with respect to budgeting was almost wholly negative. Budgeting was frequently considered to be the antithesis of planning. It was commonly identified with the economy movement. In its conception as an accounting or financial document, the budget was often a barrier to spending necessary amounts of money; that is, it tended to limit expenditures without consideration of the effect on work to be performed or services to be provided.[4] Thus, in general, budgeting was associated with niggardliness rather than with planning or management. With the negative flavor of budgeting, the budget staff was classified by the various functional agencies and departments as essentially a "snooper" organization.[5]

The old concept of budgeting is now outmoded. The modern concept is that the primary utility of budgeting lies in its potential for helping management at all levels to operate more efficiently. It can be used as an effective aid to planning, administration, and policy making. Instead of being undertaken for just a few months before official approval of the budget document, budgeting has become a continuous task — a year-round business that pervades the work of all units in a department or organization.

Where practice is well developed, budgeting has become an important element of management. Priority-based construction projects and the method of financing the projects are carefully fitted into a long-term program. The first year of this program is integrated with and becomes a part of the annual operating program. A definite scheme for periodic revision of the long-range (capital) budget is devised.

No longer is the planning process primarily a matter of costs; it has become basically a problem of functional programing and management. The budget itself is a comprehensive plan for a departmental or governmental work program and is both a vital aspect and an end product of the total planning process. Budgeting facilitates the decision-making process by providing a basis for a systematic comparison among alternatives. It encourages and provides some of the tools for an increasing degree of precision in the planning process.[6]

The budget staff in many organizations is closely associated with the chief executive officer. The staff may well be composed mainly of personnel with a broad, general management outlook. Increasingly, it is realized that the appropriate function of the budget staff is service — to interpret, to present alternatives, to help regular departmental personnel toward a better understanding of budgeting, and to provide advice, but not to make decisions. Stated alternatively, the primary function of a budget staff is to provide a better basis for decision-making by regular departmental personnel.

Effective budgeting today is interwoven with and is the product of the whole management or decison-making process. In 1954, the transition was described as follows:

> Any technique of management reaches maturity when, after its earlier mistakes have antagonized human beings sufficiently, it emerges with a new outlook and practice that is in harmony with the basic motivations of people. Budgeting now seems to be undergoing this metamorphosis. Out of the disturbance it has created is appearing a calmer, more orderly, more positive approach.[7]

4/ Homer D. Reed, "Budget Estimates and Justifications," Public Management, XLII, No. 4 (April 1960), 74.

5/ James W. Martin, "Patterns of State Budgeting," (Lexington: Bureau of Business Research, University of Kentucky, 1960).

6/ Frederick C. Mosher, "Program Budgeting: Theory and Practice." (Chicago: Public Administration Service, 1954), pp. 49-50.

7/ James L. Pierce, "The Budget Comes of Age," Harvard Business Review, XXXII (May-June 1954), 58.

The transition of budget concept is not complete and many of the vestiges of the old concept linger on. In recent years, especially since 1956, some of the narrowness of concept held by many State highway departments has vanished. However, it is still not well understood by the management of many highway departments that "To budget is to operate the total department function within and according to a plan"[8] or that a budget is a "comprehensive plan, expressed in financial terms, by which an operating program is effective for a given period of time."[9] Neither is it always understood that budgeting is a basic process of management and not just a "control device" or "financial gadget." Many directors of operating divisions in the highway department may be unable to visualize how such a process can aid them in their own work. The lack of a broad management concept of budgeting has had unfortunate repercussions in several directions. Only two types will be mentioned here.

The value of the services that can be rendered by budget staff personnel, both departmental and State agency, are often not appreciated. A typical illustration of this situation occurs when a nonmanagement-oriented engineer performs a task which needs the knowledge and skills of a professional management person. Wasted engineering talent and an inferior job are the usual results.

> ...engineers, in general, like many other classes of professional people, can lay no claim to management knowhow....The idea that personnel can specialize in the field of administration, just as in civil engineering, seems not to have entered the thinking of state highway department leadership in certain states.[10]

Many highway departments have no real budget staff — they have not acquired the appropriate personnel. Some highway departments have a reasonably good budget staff, but their talents are not properly exploited.

In most States, the notable exceptions being Delaware, New Jersey, New York, and Rhode Island, in which highways are supported wholly or primarily from the general fund, the State budget agency gives little attention to highway budgeting. There are many reasons for this: shortage of qualified personnel, lack of time, emphasis on general fund agencies, the tradition of failing to provide services for the highway department, lack of authority to do a proper job, and others. The one of most interest here is that many highway departments have not solicited state budget agency aid; in fact, many have resisted it. They have resisted it primarily because of (a) lack of appreciation for the service a qualified budget staff can render, (b) shortage of competent budget personnel, and (c) fear that some of their prerogatives will be usurped. To say that the fear of usurpation is groundless in all States would be to distort the facts. Some State budget office people are frustrated because they have no supervision over the highway department and seem willing to jump at any opportunity to get "a foot in the door." One budget officer, when asked the role of the State budget office in highway affairs, remarked, "We do nothing. We are waiting for the legislature to get fed up with the highway department, and it is getting more fed up every day." That the proper function of a budget staff is service seems to have escaped some State budget agency people. As indicated previously their proper function is to suggest, interpret, present alternatives, and advise in areas in which they have unusual competence, and to work jointly with the highway department budget staff. It is not to try to tell engineers, for example, how they should perform their assigned tasks. It is not to make decisions for highway department personnel. In order to gain prestige and the respect of the highway department, budget offices must perform excellent work of a service nature without creating human relations problems.

On the other hand, some highway departments have failed to take advantage of high caliber State budget staffs that fully realize their appropriate function. The former

---

8/ Charles R. Lockyer, "Project Statement: Machine Control of Construction Budgeting" (Unpublished memorandum, Kentucky Department of Highways, February 8, 1960).
9/ International City Managers' Association, "Municipal Finance Administration" (Ann Arbor, Michigan: Cushing-Malloy, Inc., 1955), p. 61.
10/ James W. Martin, "Administrative Dangers in the Enlarged Highway Program," Public Administration Review, XIX, No. 3 (Summer 1959), 166.

may, in an effort to keep the latter relatively ignorant of highway operations, withhold information or present superficial information which is largely meaningless or misleading.

The outmoded concept of budgeting has certainly contributed to the generally unhealthy relationship between highway departments and State budget agencies.

Another adverse effect of inadequate budget concept is the lack of attention to the execution phase of budgeting. The job has really only begun when the program is formulated. It requires considerable attention from management to translate construction plans into finished highways. A good plan is nearly worthless unless it can be placed in operation, and it does not go into operation automatically. It is wasteful to concoct elaborate plans if the plans do not include means of putting them into effect according to schedule. The proper execution of the budget is by no means simple. The complexity may be indicated by the fact that some departments develop reasonably good long-range plans which are revised so much they are unrecognizable when they are finally put into effect.

In some States, Federal aid amounts to almost one-half of all revenue available to the State for highway purposes. It is obviously important to efficient capital budgeting that the highway department officials know the approximate amount of Federal aid they can expect to receive in future years. Congressional action with respect to the trust fund, set up in 1956 to finance the newly accelerated highway program, makes this virtually impossible.

The Highway Revenue Act of 1956, which created the highway trust fund, was drafted with the clear knowledge that receipts of the fund would be insufficient to meet expenditures on a pay-as-you-go basis during the early 1960's. A provision was included which would authorize borrowing from the general fund to keep the program on the intended schedule. The final legislation, however, included the "Byrd amendment" which put the program on a pay-as-you-go basis and provided that if the trust fund receipts were not sufficient to meet the authorizations for the Interstate System, the apportionments would be reduced accordingly. The primary effects of this amendment were to relegate the Interstate System to the lowest financial priority, to allow erratic fluctuations in amounts of Federal funds available, and to make it impossible to proceed at the pace Congress apparently intended.

In the 1958 Federal Aid Act, additional (anti-recession) funds were authorized and the Byrd amendment was temporarily suspended. It became evident early in 1959 that revenues were not going to be sufficient to sustain the program at the planned level. As Congress searched for a solution, many States completely halted the advertising of major highway construction projects because of uncertainty regarding Federal financing. The Interstate authorization for fiscal 1961, which had been increased $300 million to $2.5 billion by the 1958 legislation, was reduced in the autumn to an actual apportionment of only $1.8 billion. Reimbursement planning set limits on the amount of the available apportionments a State could obligate and still obtain prompt Federal reimbursement. Generally, this planning called for low expenditures the first two quarters of fiscal 1960 and higher expenditures the last half of the year. States which completely suspended the advertising of major construction projects during the summer and fall of 1959 found they had considerable catching up to do in the spring of 1960. It was not until June 1960 that the Bureau of Public Roads announced what amounts could be obligated during the fiscal year starting July 1960.

The cut-back in Federal funds and the accelerating and decelerating of the highway construction program have thrown construction progress off schedule and have tended to destabilize the highway construction contracting industry which finds it cannot plan ahead. (The use of Federal-aid funds for highways as an anti-cyclical device may contribute to the stability of the over-all economy.) The situation has been particularly disheartening to States which had rather carefully prepared, long-range construction plans. In some highway departments it has undoubtedly contributed to a "what's the use" philosophy. A major deterrent to long-range construction planning would be removed if the States knew with reasonable certainty the approximate amount of Federal funds for highway construction they will receive for at least a 5- or 6-year period.

It is argued in some quarters that it is useless to plan ahead in detail for 5 or 6

years because of the possibility of changed legislative policy, unforeseen economic developments, higher or lower design standards, and similar factors. It must be admitted that such factors do derange well-formulated long-term plans. However, it is pertinent to observe that long-range decisions must be made – even management by crisis involves making some decisions several years in advance, regardless of whether planning is done. The odds are that those decisions based on detailed planning and study of the alternatives will result in more efficient road building. The possible upset due to various factors can probably be minimized by the use of alternative assumptions, by planning so that forecasts and assumptions can be easily adjusted, and by making a thorough examination of the capital budget and revising, if necessary.

HIGHWAY CAPITAL BUDGETING PRACTICE

It should be clear that one does not find highly-developed capital budgeting in State highway departments. It is true that some aspects are done well in some highway departments. Generally speaking, however, highway department practice compares unfavorably with capital budgeting in municipalities and in private business.

Most highway departments have something approximating a capital construction budget. However, as of January 1960, 18 highway departments established construction priorities on their Federal-aid primary system (not including the Interstate System) for no longer than two years. Only one-third have a construction program of at least 5 years in length. Only four States have published their long-term highway capital budgets on a project-by-project basis. In order to allow everyone concerned adequate time to make plans based on the construction program and to insure that projects are completed on schedule, a capital budget covering at least three or four years should be published. The published version, of course, need not be in as great detail as that used for internal departmental purposes.

There are vast differences among States in the quality of the planning and in the resulting program. In some States, priority lists have little significance. Also, the length of the construction program changes from year to year in some States. For example, a State with a 6-year program may allow the program to dwindle to only one year before it makes a recanvass and adds five additional years of program. Such a plan is unfortunate in that it is too rigid and does not provide for the continuous evaluation of the program needed in an ever-changing society. The capital budget cannot be formulated and then forgotten. A better arrangement calls for examining the budget annually in thoroughgoing fashion with a view toward appraising the progress of the program and making revisions which are absolutely essential. At this time, the program should be extended one year to maintain the original time span.

Only one specific example of poorly-developed capital budget practice, which seems to be widespread, will be singled out here.

If budgeting is to be effective there must be a close integration of technical and financial planning. In the highway departments, technical planning and fiscal planning are not regarded as two completely separate and distinct functions; but generally speaking, neither are they integrated as closely as they should be. Most of the long-range budget formulation job (frequently referred to as "preparation of the estimates") is ordinarily done by the planning and programing staffs. The finance or administrative division usually does the fiscal planning and presents the information to the construction planners. The planners base their long-term construction program, at least loosely, on the expected revenue for future years. If the estimates are to be entirely realistic, the planning personnel and the finance people should work together very closely in establishing the construction program.

Neatly fitting each major phase of each project into the construction schedule requires a careful professional job of detailed revenue estimating. In setting up the detailed program, the people concerned require many kinds of information on fiscal affairs, some of which can scarcely be shown here. They will need detailed knowledge concerning the timing of revenue collections, of bond funds, and of Federal-aid apportionments; the appropriate cash balances; the estimated budgetary resources, including year-end balances, which will become available; and other fiscal information.

The point is that the financial planners cannot present the financial status to the construction planners and let them "take it from there." There should be such interchange of ideas and explanations between the two groups that the tentative detailed program is a joint product.

It should not, of course, be inferred that the highway budget staff, or whoever does the financial planning, usurps the prerogatives of the construction planners. The proper function of the financial planners is to explain the financial situation and point out the implications. They can be much more helpful, however, if they are acquainted with the construction planning.

There are indications that, in many States, such cooperation is not the rule. Some construction planning personnel seem to assume that they can properly interpret financial information presented to them and work out the program themselves. There are probably some exceptions, but generally this is "doing it the hard way." In addition, the later tasks of the financial planners are more difficult if they have not participated freely in the formulation of the program.

The lack of integration of technical and financial aspects is even more apparent in the execution phase. It is important that the technical progress and financial outlay for each project be closely integrated and be continuously compared with the budget. Highway department project records and practice generally do not permit the accomplishment of this objective. Highway management needs these budgetary facts, properly interpreted, on a timely basis. It needs to know, for example, all projects which fall behind schedule so that appropriate action can be taken. It needs to know quickly that cost estimates were too high or too low, so that the construction schedule can be adjusted accordingly.

State highway departments are making some headway toward developing sound capital budgeting. A few examples follow.

Three years ago, the North Carolina State Highway Commission established an Advance Planning Department which is accountable only to the Director of Highways and the Commission. The advance planning staff, with collaboration, has recently made an analysis of long-range highway needs in North Carolina. (This is a needs, not a budget, document.) The analysis was based on an estimation of adequate levels of highway service as indicated by present and anticipated traffic; land development; and economic, social, and population trends. The analysis culminated in a suggested 15-year construction priority list by 5-year periods. The list serves as a guide to future highway improvement. The Advance Planning Department is charged with working cooperatively with municipalities in developing thoroughfare plans. A comprehensive land development and thoroughfare plan is a prerequisite for future highway improvement in urban areas. The advance planning staff includes transportation planners, regional planners, specialists in geography, and a statistician. With the many disciplines available, the staff can analyze proposed projects from the point of view of economic impact on the community as well as from a strictly engineering angle.

The California Division of Highways has had since 1952 a revolving fund of $30 million which is used for the advance acquisition of right-of-way. The purpose of the fund is to protect future highway right-of-way from expensive developments. By concentrating on parcels where building construction appears imminent, the cost of right-of-way has been reduced considerably. An estimated $215 million has been saved through this means. It is perhaps needless to add that without a long-term construction plan, right-of-way cannot be acquired very far in advance.

The Kentucky Department of Highways is developing machine control apparatus for budget execution purposes. According to the plan, as soon as the construction budget is approved, the basic information will be recorded by the electronic data processing staff. As each project moves forward both the technical progress and the financial outlays will be posted to the project record and both will be compared with the budget. Periodic or special reports could show almost every imaginable type of information on the progress of the program. Management will have timely information constantly available. The plan calls for a program expediter in the office of the chief engineer who will be responsible for keeping the program on schedule. After receiving reports from the data processing center, this person, with budget staff collaboration, will explain the significance of the reports to the appropriate persons.

In 1957, the Michigan State Highway Department published its 5-year trunkline construction program schedule. Each project is identified, the type of work indicated, and the estimated contract award date (by quarter) given. The department wisely cautioned that the schedule could be met only if the revenue estimates prove accurate, agreement is reached with municipalities, and no serious delays are encountered in acquiring right-of-way. A work schedule form was prepared for each project in the program, and target dates for the completion of each phase of work were plotted. A performance control form shows a comparison of target dates and actual completion dates and provides the basis for analyzing progress on the various projects.

ACKNOWLEDGMENTS

Much of the factual information presented was obtained from visits to nine of the better-managed state highway departments and from correspondence with most of the others.

This paper is based in part on the preliminary findings of a project on construction budgeting practice in the state highway departments being made for the Kentucky Department of Highways in cooperation with the Bureau of Public Roads. The author wishes to thank Professor James W. Martin, Director of the Bureau of Business Research, University of Kentucky — under whose general supervision the project is being conducted — for helpful criticisms and suggestions. The author is also indebted to his colleagues, R. H. Stroup and K. E. Cook, for their comments on an early draft of the paper.

Discussion

Livingston. — I have heard highway administrators often comment that you could spend your entire cash receipts for maintenance if you were so disposed.

This would indicate only that the size of capital improvement program is going to be the result of proposed or expected income less the fixed charges. If you tamper with the fixed charges, then you are going to give an untrue picture of the capital improvement program.

I think this is what Morf and Donnell meant when they were asking whether the capital improvement program they released for you to examine was 125 percent or 90 percent of the anticipated revenue.

Morf. — I am not sure that I know what Mr. Holshouser is speaking of when he speaks of this capital improvement program as distinguished from something that we have. He speaks of all the benefits that might flow from it, but he does not say what it is he is speaking of that we do not have.

Livingston. — I think he feels there is a certain lack somewhere in the budgetary process in the setting up of the capital improvement program.

Holshouser. — Many of the highway departments, of course, have capital budgets, or something approximating them. But I think they are all lacking to a certain extent with regard to integrating financial and construction planning and in the execution phase. In other words, they are not as comprehensive and as well planned as they might be. Many States do not have a capital budget or anything approximating one.

Morf. — I believe that no budget we have is perfect, and might be improved. I was wondering if you had anything other than that generalization to make for improvement.

Holshouser. — I was hoping to get suggestions, rather than to give them out.

Livingston. — You have investigated a number of State budgets, and they are lacking in certain respects. Is the lack in these budgets as construed in state highway departments something that results from a statutory limitation, or from an administrative limitation?

Holshouser. — I think there are many reasons for this, that is, why the States do not have comprehensive, well-planned construction budgets.

One thing is the lack of time and personnel, especially since 1956. The congressional policy with respect to Federal aid has certainly been a major concern, in that is has been used thus far as a counter-cyclical device, and plans cannot be depended upon. The States which are penalized most heavily are those which have done some advance planning. Those which have done no planning have not much difficulty in making the change.

Wilson. — How are you going to improve that? The budget will not change that.

Holshouser. — This is just something that has to be lived with. I do not know if we can expect anything different in future years or not. I think perhaps we have a public relations job, here. It seems that neither Congress nor the public generally is aware what damage this type of Federal-aid policy is doing.

Burnes. — What do you mean by a comprehensive capital budgeting plan, in terms of a 5- or 6-year rolling program versus a one-shot annual program?

Holshouser. — This is only part of it, a 5- or 6-year program which is revised at least annually and extended so that you always have the same number of years in your program. But it should be all you have. It should be prefaced by planning which takes into consideration the amount to be spent for maintenance and administration, other agencies which the highway supports, bond retirement, etc., because the funds spent for highway construction are usually considered a residual. So you have to study the entire picture before you come up with your estimate of how much will be available for highway construction during a 5- or 6-year period.

Burnes. — That is right. You get a priority of expenditures as you come down to get the amount you spend for construction.

Granum. — I subscribe to what Mr. Holshouser is attempting to do here. I think that investigation of a number of State budgets would prove his point rather conclusively. There are a number of States that have nothing resembling what we would call a capital or performance budget. They have budgets, to be sure. Many of them list items like so many dollars for labor, so much for equipment, so much for material, even, as in New Jersey, for example, down to a budget item for a new typewriter.

Now, if this is the type of budget which the highway administrators have to have by law, or the basis for the control of the functions they have to perform, then such a budget presumably is satisfactory. But I do not believe that is the kind of budget we are talking about.

Our principal job, in building highways, is to construct and to maintain them. And the performance budget is one which establishes the nature of the construction program that you desire to carry out on specific systems of roads, and a study of the available published budgets from a number of States will show that such budgets are rare.

And therefore, the control and execution of management policy remains very difficult. I would expect that your paper would elaborate in this area and try to develop, as you point out, the case for such capital performance budgets.

Holshouser. — I hope to do that, although I think it is important to keep in mind Mr. Martin's previous statement that some highway departments are just not ready for performance budgeting at this time, because they probably do not do a good job of object-type budgeting, which is much more simple. The change-over would be quite elaborate and would require a good many changes throughout the department.

Hart. — Am I to presume in this discussion that we should present to the legislature individual projects and so forth? I know that in Wisconsin, we do not like to present individual projects to the legislature. We think the administration of the money, the segregated fund, is an administrative function of the highway commission and not of the legislature. They get approval of the appropriations, but I do not think Wisconsin would go in for submitting to the legislature approval of an individual project as such.

Granum. — I did not necessarily indicate that it should be submitted to the legislature. We are talking about budgets as a working tool within the highway department, whether they are submitted or not.

Holshouser. — I think there are several lines of thought on this. Michigan, for example, publishes its 5-year budget, and this lists the various projects for the 5-year program on a project by project basis. Other States prefer not to make their program public.

Livingston. — The difficulty with this type of budget relates to projects which must be eliminated. We had a project included in a budget, the plans all developed, the right-of-way about 70 percent acquired at the time of the budgeting process, and we ran into absentee owners who were then in Europe. It was impossible to bring them to court to gain possession. At this point, in order to put the money to work, the project had to be removed from the program and another one substituted for it.

I think this is the reason that many of these men are skeptical about publishing for public distribution anything except a current year's budget.

Holshouser. — I think you have to clearly set out the bases of the program. That is, it is contingent on certain things. If these are clearly stated, as Michigan has done, you have no budget problem here.

Burnes. — You still have advantage of having it unpublished internally.

Livingston. — I am not naive enough to believe an unpublished budget does not become public knowledge.

Buswell. — We used to have a 5-year program established and published. We found out that certain promises that we had made could not be carried out because of a loss in State revenue and the fact that the price index had increased to the extent that some projects had to be dropped. People later came in and wondered why we cut out their project and not someone else's, and they gave us a great amount of trouble.

I think an unpublished budget for planning within the department is fine, but I hate to see a published budget within the department go out for 5 years in advance.

Johnson. — I am very much disturbed if our concepts of long-range programing would be limited to what has been discussed here today, because in actual fact we have not been discussing long-range programing. We have been discussing short-range programing, scheduling, and long-range budgeting. Long-range programing is a relative matter, and I have heard some States refer to their annual program as a long-range program, because they have been used to programing on a month-to-month basis.

But perhaps the answer to some of these questions that have been raised recently is the fact that this may not be the kind of a long-range program that you want to present to the public. What you want to present is perhaps some of these broader decisions in terms of routes and in terms of large sums of money to be expended to do a broad job, broken down by large areas.

Session Three

Monday, September 19, 1960, at 7:30 p.m.

PRIORITY ANALYSES—PROJECT SELECTION

HARRY C. SCHWENDER, Presiding

Physical and Economic Rating Methods for Priority Considerations

M. EARL CAMPBELL

Road rating procedure will have but little meaning unless it becomes one of a series of constituted steps in the total process of planning for highway improvement. Order is the foundation stone of science, and the goal of scientific programing. Rating procedure makes little sense unless placed in proper perspective and sequence in the assembly-line flow that unites all of the component parts into an approved annual program or so-called "capital budget,"—unless it helps to translate highway needs into a construction program.

To provide perspective for this discussion on rating methods for priority considerations a recapitulation of antecedent procedures is in order. It is assumed that now the purpose, goals and standards of achievement have been established. When the ends are set the means are polarized. In other words, we may now assume that (1) certain highways have been "justified", (2) these highways have been classified into systems, and (3) reasonable standards have been established in accordance with the economy.

As a prelude to rating it would also be helpful if certain related determinations have been accomplished in addition to the above three: (4) needs, (5) fiscal capability, and (6) resource allocation and fund apportionment formulas (Fig. 1).

Preliminary to rating, then, it would be desirable to have already created a long-range program with time periods set for the completion of its various increments.

As to needs, first there are the maintenance needs which should have first priority, after administrative needs and debt service have been satisfied. And maintenance needs are growing with increasing age of highway systems, with increasing traffic volumes and loads, with expansion and improvement of the systems, and with increasing demands for higher quality service; for example, in the increasing demands for snow and ice control.

Next, there is the contingency fund for emergencies and for flexibility. Whether spent by State forces or under contract, the contingency fund for work that results from crises and Acts of God, can hardly become a part of deliberate priority planning.

Then comes the construction needs. These can be broken down into (1) the current backlog of needs, (2) the future accruals from continuing functional and structural obsolescence, (3) the future accruals resulting from growth and shifts in economic activity, and (4) accruals from inflation.

It is the highway construction needs that this present conference is primarily concerned with as it considers the process of formulating highway construction programs (Fig. 2).

As usual in the planning process the first concern is to establish the goal in light of needs and fiscal capabilities and then to determine the norm and means of achievement, and finally to learn how to achieve the summum bonum by putting first things first.

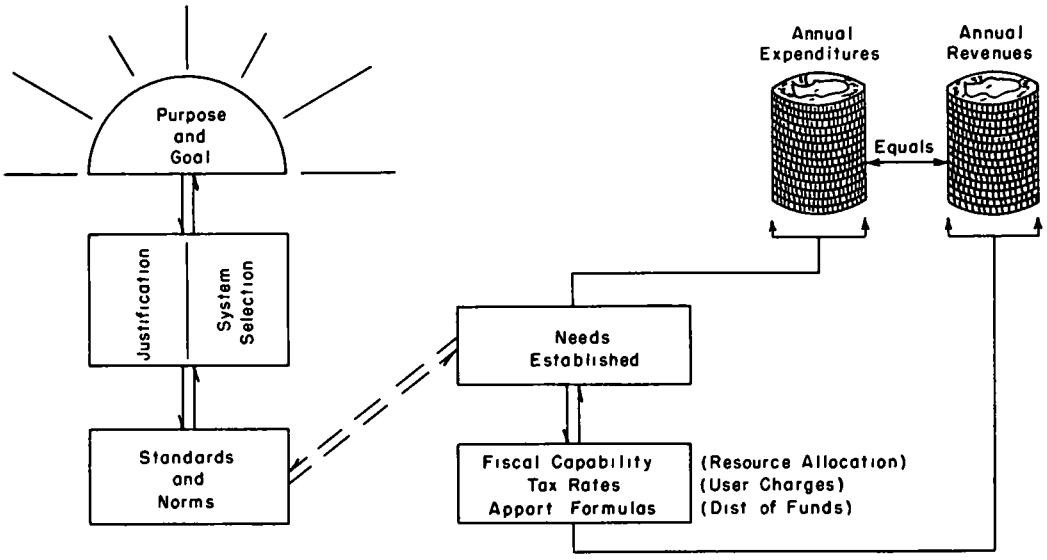


Figure 1. Desirable prelude to adequacy ratings.

To reiterate, it would be helpful if these preceding steps have been taken: the long-range plan created, its rate of achievement set by a satisfactory fiscal arrangement, the total plan divided into increments by time periods, by class of work, by systems, by funds and by other necessary categories (Fig. 3). Now, comes the initial planning pointed toward the ranking of sections of highway (or projects) for improvement with the objective of carrying out the master plan in intent and on time: to develop a dynamic, growing, unified, balanced, economic transportation system.

SCOPE

The challenge of a master plan is that of keeping the eyes upon the goal and of moving steadfastly toward the goal, in recognition that activities are aimless without a target.

This paper deals with a single step in this forward movement toward the objective. It deals with the subject of road rating and its role as one step toward priority ranking. This step follows after that of determining and categorizing needs and of securing means to fulfill the needs. While elementary in character the paper deals in fundamentals.

Physical and economic rating goes hand-in-hand with social and political and other evaluations. This paper treats only the physical and economic ratings—the assessment of the road, itself, and its environment for its relative adequacy in design and structural condition. The ratings are an expression of degree of adequacy in the existing circumstances and do not pretend to rank for priority.

A companion paper, by Arthur C. England will deal with social, political, administrative and other evaluations that must be weighed with the road adequacy ratings in listing and ranking priorities. The companion paper treats the difficult subject of merging values whose measurements are on a different scale. This is a vital part of the process of formulating the highway construction program.

Speaking in defense of this blending or merging action, it might be said that if the resulting decisions are within the framework of the master plan and provide an orderly and practicable succession of activities all oriented toward the goal, and which do not impede the progress of attainment, then the summum bonum can be achieved through this marriage: priorities composed of the best both in the economic and social order.

This paper deals only with the rating procedure. It starts after the creation of a general master plan and it is followed by a merging of economic and socio-political evaluations into a priority listing. The priority listing evolves into a program (or an

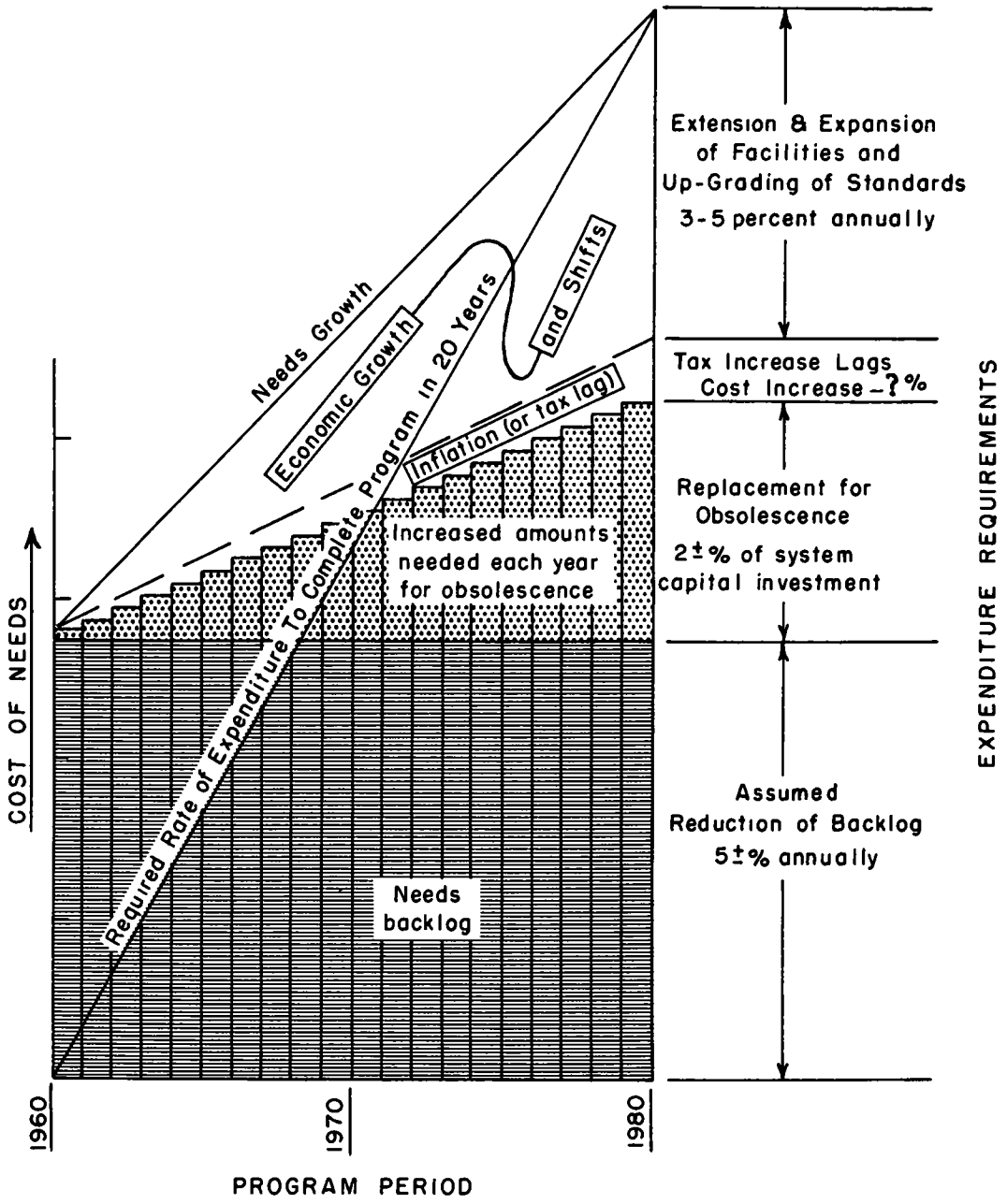


Figure 2. Schematic diagram of highway needs.

annual or biannial budget) as revenues are in sight, and thence into the scheduling of contracts in the fullness of time. This puts the steps into a broad perspective and spots the place of adequacy ratings.

It should be remembered that this paper deals with ratings for priority considerations and not with priority ratings, themselves. The distinction is significant. The several methods to be discussed rate adequacy, economy, solvency and related matters. The discussion will indicate the potentialities of ratings. It is not within the

province of this paper to detail all of the methods and techniques but rather to discuss their place, popularity, and plausibility in planning and in programing.

PURPOSE OF RATINGS

Discussing first the purpose of so-called "sufficiency", "deficiency", "adequacy" and other methods for rating the physical facility in terms of obsolescence or deterioration it is found that their intended purpose is as shown in Figure 4.

In connection with the first two items in Figure 4 it should be observed that the critical deficiency might be in safety, service, or structural condition of the highway, and in each of these possibilities the specific deficiency is isolated, thus suggesting the appropriate remedy.

Ratings are pointed toward the ultimate formulation of a short-term program, for example, five years, and finally to an annual or biennial capital budget, but it should

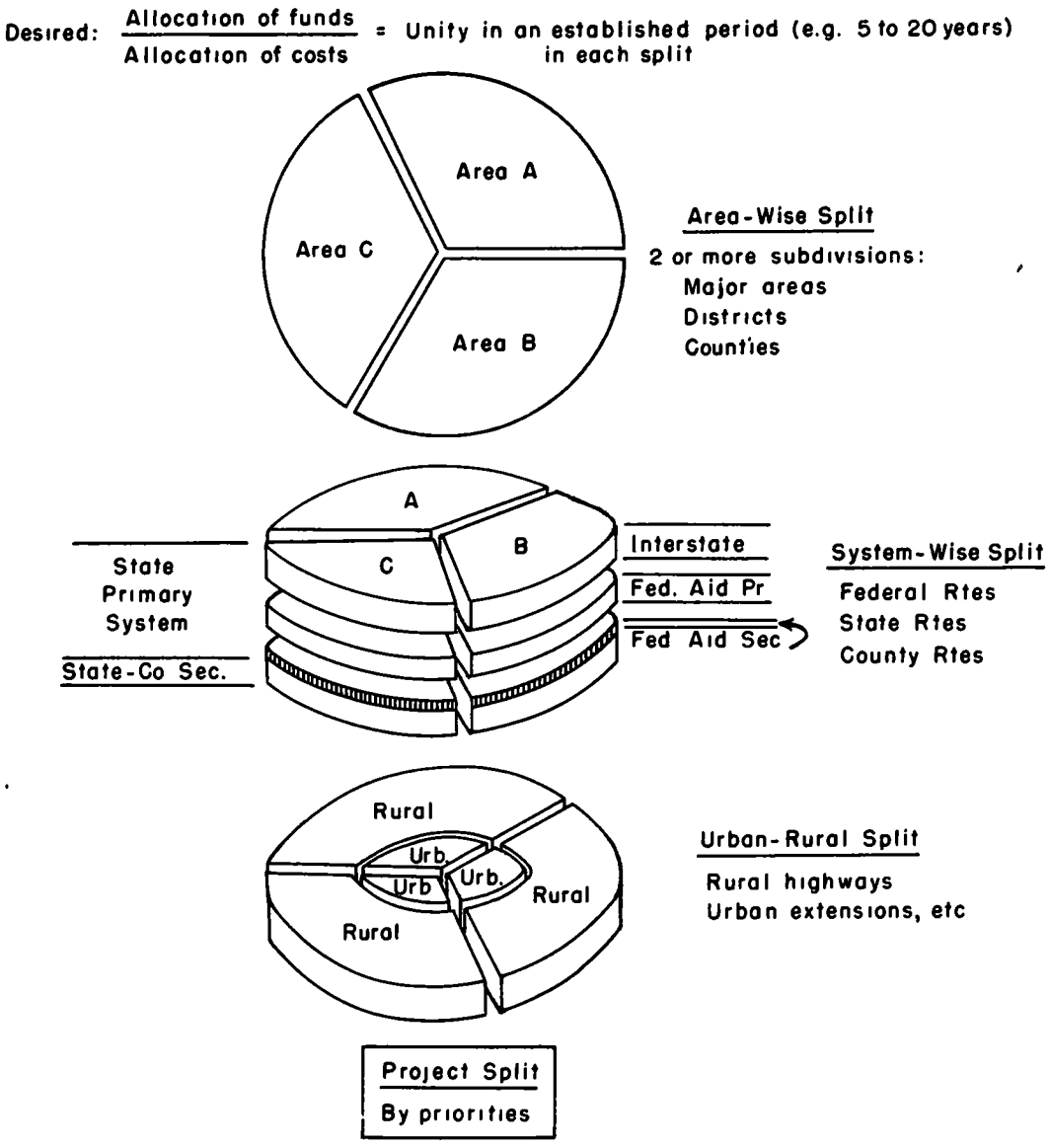


Figure 3. System and apportionment split for importance and spread.

be emphasized that they can serve importantly in long-range needs and fiscal studies for each of the several systems.

Other ratings, such as the benefit-cost ratio, rate of return on investment, and minimal transportation cost indicate how good an investment the project is from the user standpoint, while the solvency quotient indicates whether the project is self-liquidating from the user "earnings" produced within the limits of the project, or prorated thereto.

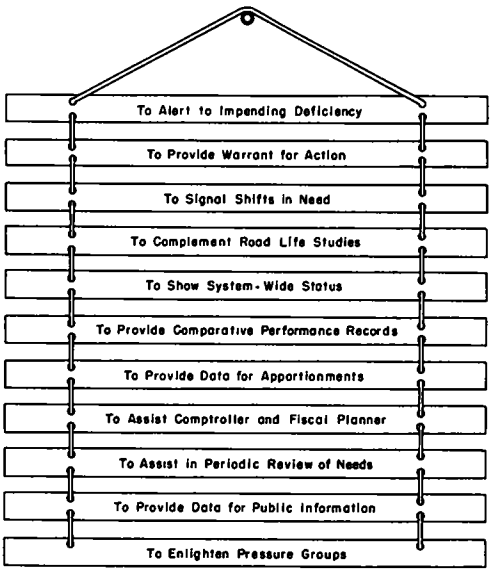


Figure 4. Intent of adequacy ratings.

PHILOSOPHY AND CONCEPT OF RATING

Imagination and practicality should conjoin in setting the goal and in creating the master plan. The evolution of a step-by-step method of reaching the goal requires the best thinking that administration, engineering, economics and other disciplines can give.

The critical job in programing is the ranking of needs. During the rest of this paper the implication will be economic need—not that other needs are not of equal importance, but because they are discussed in the companion paper. Specifically, the desired end in ranking is to make an unequivocal and valid determination, for example, that a certain bridge in one area is more needful now than a highway, or bypass, or expressway, or resource road in that same area, or in some other area.

This brings one face to face with ends, norms, means and performance standards in order to proceed in a systematic and straightforward manner. For continuity of purpose and plan, for a diminution of crash and crisis programing, for a means of holding the line against pressures when revenues are scarce, it would be desirable to develop a consistent, or reproducible adequacy rating—a rating that would measure a section in terms of a norm, or an established standard.

Such a rating to be reproducible by the same rater or different raters should have a minimum of subjective determinations; it should be a numerical rating with a convenient scale and the component parts to be scored should so far as possible be evaluated by a common yardstick.

Further, in order that the aims of the rating device be identical with and implement the aims of the needs study the same criteria used in determining standards for the needs study should, as far as possible, be carried over into the rating plan to determine the degree of a section's adequacy or deficiency, and serve as a measuring stick for determining its deviation from the standard or norm. And if the standards in the needs study are money based then we might say that the standards in adequacy ratings (the cut-off point for critical deficiency in an element, for example) are likewise dollar based. If the needs study has been realistic in allowance for growth then ratings can evaluate all but a minor part of roads required in the next two decades or so, for the existing system is the now dominant problem (Fig. 5).

In the final analysis the cut-off point for critical deficiency should bear the same reasonable relation to fiscal capability as the intolerable sections in the needs study do if the intent of the needs study is fulfilled in the warrants of the rating study. This does not imply that exigencies from local growths and shifts will not occur in a dynamic economy which will demand a modification in resource allocation, apportionment and standards. Continual review is part of a continuous "rolling" program.

Should we try to approach the ethical through an attempt to promote—in an economic

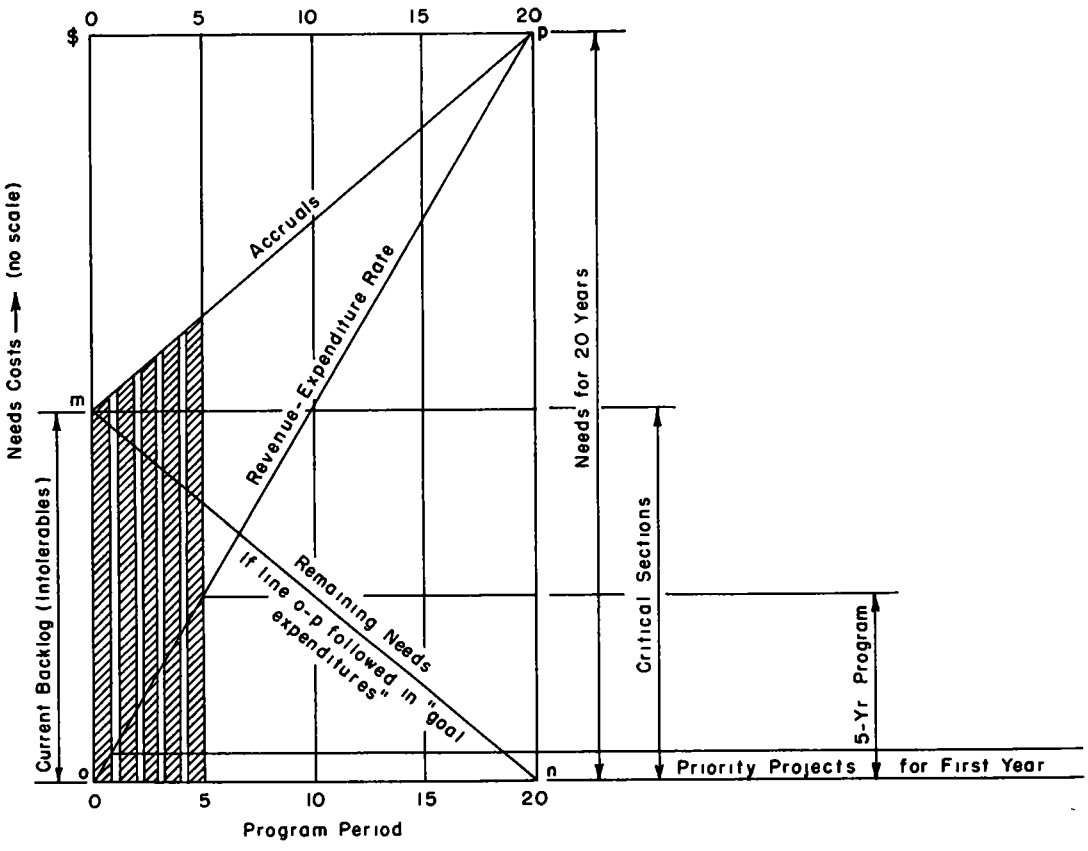


Figure 5. Mathematics of term program.

sequence—the economy of every part? If we follow this philosophy are we blind to the findings of sufficiency ratings? It is a hard fact that the sections with most critical deficiences do not always promise the greatest return on the investment for improvement—but it is a harder fact that if we do not abide by the critical deficiency ratings we can easily deviate from the path to the goal. However, there is usually such a big back log of critically deficient projects that we can for the time being select from them the emergency projects and then add the most economic from among the rest.

With the concept that critical deficiency is the major determinant we approach the development of rating method—a score card, so to speak. It was recognized from the start that rating methods would have a minimum of peripheral vision: they would see the need for more capacity, higher speed, fewer accidents and roadway betterment on a particular system, but they would not translate these findings automatically into a finding for a new system, nor an extension of the existing system. Such needs as an interstate system, or resource roads, or bypasses are by-products rather than end products of ratings. Informed judgment and complementary studies will find the by-products.

Any adequacy scoring is difficult to make whether for a section of highway 1,000 ft long or for a section 10 miles long. A recent analysis of elements rated by 36 State highway departments using some form of sufficiency rating showed some 30 elements scored among all these States, the average State scoring about 10 separate elements and no 2 States using identical score sheets, with the number of items ranging from 4 to 15. In addition to these 30 elements, if the items considered in other types of road ratings are added the total number of items to evaluate approaches 50. Naturally, some of these items overlap and it would be difficult to say without thorough empirical testing

how many of the 50 items are statistically significant. Nevertheless, the array of items to be judged and composed into an index value on any one project is formidable. We might inquire what human mind unaided by a check list or scoring sheet can scan so many component parts and assess its individual adequacy, and if done, can retain and compare these abstract values for several thousand control sections or projects? What measure of reproducibility would be obtained on a repetition? What commonness in agreement among districts or States?

Even with the most objective score cards covering all significant elements there is required an experiential knowledge of defects, their cause, prognosis, remedy and cost of correction. The team of highway diagnosticians must have a rich background in the recognition and rating of structural defects and geometric deficiencies. It has been stated that a clever planner can manipulate the weights of the several rated and thus "gerrymander" the program. Of course he can. But of all places to violate ethics this is the least likely.

Field checks of structural defects should be made periodically, and likewise a check made of those elements (such as traffic and land use) which change with time and season. Of course, only the geometric elements which have been changed need be rechecked. In field checks it appears that there is no consistent pattern among State highway departments in regard to who does this work. In some States the district engineer and/or a selected staff makes the check. The planning engineer and/or assistants may be responsible and the work done on a statewide basis. Sometimes the construction and maintenance engineers do the scoring. Although there is not conformity in method the States report high reproducibility in results within the State.

Eventually the whole office procedure may be handled by linear programing when we understand better the interrelations among the multiple components and how a change in value in any component affects the composite score. Then predesigned punched cards will rule out any vagaries of the mind in repetitive interpretations or reiterations.

Inasmuch as standards are economy based and vary among the several States (and even within the State) the rating methods also vary. A common method might be devised for each system, however, so that all States used the identical score cards but set different cut-off points for critical deficiency and for the norm. Such a method would allow a comparison of the adequacy of a particular system for capacity, safety, and structural condition, and would be a useful guide for determining status, trends, and needs.

Another argument that can be made for a uniform scoring is that suggestions and recommendations for road improvement come from many sources; such as, district engineers, State construction and maintenance engineers, State planning and traffic engineers, delegations, other State agencies, other governmental jurisdictions, and interested individuals. Each group can give reasons for its recommendation but few will have a thorough and comprehensive objective analysis.

> If all the people of the state and all areas are to be treated fairly, then there must be some long-term continuing plan for road renewal based on priorities determined in as objective a way as possible.
>
> Even an engineer may be influenced in his judgment of needs by his greater knowledge of certain routes than others within a system, unless he has an over-all, consistent, and impartial scaling of all sections of the system for comparison and guidance.
>
> There has never been, nor will there ever be, the utopian situation in which a state has sufficient funds, time, personnel, and equipment to attack simultaneously all the projects required to bring its roads up to standard. Choices must be made."—Hope Wiley.

DEGREES OF NEED AND URGENCY

If we could measure the relative urgency of needs a ranking of projects could be made. Need and urgency are relative in degree and a qualifying adjective is often used to attempt to show the relative need and urgency.

With respect to need we use such qualifying adjectives as vital, great, fair, casual, and very limited; with respect to urgency we use such words as immediate, critical, serious, moderate, and little.

None of these quantify, however, and we could as well rate need from A to E and urgency 1 to 5. Thence, A-1 would be of highest importance and greatest urgency, E-5 would be of no present concern. But how would A-5 or E-1 be interpreted? So a numerical scale to indicate the relative urgency of need was sought.

It was accepted that if a project was included in a justified system, then its own importance was "justified" and established. On the other hand, the measure of relative urgency has often been debated. In the needs studies it has been customary to set up a dividing line between the "tolerable" and "intolerable," the "intolerable" sections forming the current backlog of needs. The tolerable would gradually become intolerable with the passage of time, the State primary roads needing replacement or relocation at a rate of (roughly speaking) about 2 percent annually.

Considering the current backlog which might represent a substantial part of the existing system the total need may be so great that the projects included therein may have to be spread through several years of construction, and thence the individual projects rated for priority on a year-to-year basis. Thus, a still finer scale of values must be drawn within the intolerable or critical range.

Adequacy ratings measured on a scale from zero percent to 100 percent provide for a graduated numerical scoring for a distinction among the critically deficient sections as well as defining the cut-off or demarcation between the critical and non-critical. These ratings indicate the degree of urgency. These ratings may show that an area of a State with a greater need than another may have less urgency. Importance, we might say, relates to type and amount of service. An economic analysis furnishes a means of measuring importance, and that this importance can be determined in the measurement of relative loss in user benefits and also in the relative lack in fulfillment of economic (as well as social) activity in the area of influence, that is, the potential loss. The number of people served, together with the benefits and costs per person, are desirable bits of information.

By setting the sufficiency rating alongside of the importance rating a guide to ranking is provided in these measurements of remaining life and quality of service.

STANDARDS FOR RATING

As far as possible the same division point should be made between tolerable and intolerable in the needs studies as made between the noncritical and critical deficiencies in sufficiency ratings. Going on from there, of course, the measuring scale of adequacy ratings usually rates by point values all the degrees of adequacy to 100 in one direction and to zero in the other.

Structural Condition

As to structural condition, some States measure the deficiency in terms of maintenance costs as related to the norm and make no field inspection for rating purposes. If an acceptable adequate standard for maintenance could be established, and then an agreed point established for an indication of critical deficiency we might have a practicable standard which would obviate field rating. But caution is necessary because some roads receive little repair when reconstruction is anticipated, thus the maintenance cost records would belie the true condition. Much research needs to be done yet on maintenance standards, both to determine the proper round-the-year standard, and to determine the point of diminishing return as maintenance costs become excessive and hence indicative of more than routine maintenance. If not based on an optimum standard, allocations made for maintenance can perpetuate an uneconomic sub-standard

and a wasteful deluxe standard. At present, maintenance standards and expenditures vary not only among the States, but among the highway districts and counties within a State. Therefore, cost accounting is generally inadequate.

Safety

In regard to safety, the figures to be presented are nationwide averages. Each State can translate these figures into terms of its own local experience. The nationwide fatality rate for 1959 was 5.4 per 100 million vehicle miles (ranging from 2.5 to 9.6 among the 48 states), the injury rate about 200 per 100 million vehicle miles, and property damage accidents 1,500 per 100 million vehicle miles; and at a cost of about 1 cent per vehicle mile, and more than $2,000 per road mile (6.2 billion dollars for about 675 billion vehicle miles). It has some intolerable components. If the Interstate System had been completed before 1959 the rate for that year might have been 4.8. Beyond that what hope do we have in the immediate future? Of course, as congestion increases, fatalities decrease but total involvements swell. What ideal can be set in rural areas (with a 1958 fatality rate of 7.3) and in urban areas (with a 1958 fatality rate of 3.3)? What can we regard as intolerable? We have suggested that we must keep our standards money based. But here we have one cent per vehicle mile that we can nibble on, and by spending a fraction of a cent per vehicle mile for improvement of hazardous sections, who knows but what we might not reduce the accident bill more than we spend for betterment.

More research should be done with respect to geometry and speed-volume-accident relations and costs. Safety is one of the great historical challenges in highway research. The goal in aviation is to cut its accident record toll in half. Is such a goal feasible in the highway industry where we pay about twice as much accident tax per gallon (14 cents) as we pay in State road tax per gallon of gasoline?

Service

In the service function, or speed-volume relations in terms of capacity, where is the point of diminishing return in capacity and speed-volume relations? Certainly each road section has its own critical limits which can be determined by economic analysis. We know also that there are maximum possible capacities at speeds usually below the desirable.

Programing is a translation of needs into action. Needs studies can provide the basis for this translation and not serve simply as a means of convincing the legislature and the electorate that more money is needed.

Needs studies may use actuarial or road life tables to predict the future because these studies must serve for fiscal planning before the fact. Needs studies can well become a part of the programing process which "translates needs into action by way of the annual budget and in accordance with the flow of available revenue balanced with the flow of urgent projects." Needs studies can be projected into programing, serving as an effective guide all the way through. Actuarial tables from road life studies, used in a complementing trend analysis, will provide an illuminating beam to beacon the shallows and the safe channels. Actuarial tables show average life expectancies, whereas performance ratings pinpoint the remaining life expectancy in a specific project.

Needs, adequacy rating, and actuarial tables change with population growth and shifts, with changes in economic activity, and with changes in use of the motor vehicle. The goal of a needs study is a moving target. Ratings furnish guidance for required shifts in direction to keep focused on the moving target.

If standards are economy based, then priorities should also be rooted in economy, but in the over-all economy, not just in dollars for the user. And a growing economy brings pressure not only for an expansion of facilities but for an attendant upgrading of standards. These observations show that the hand of the comptroller and the hand of the engineer must always know what each is doing.

METHODS AND TECHNIQUES OF RATING

A canvass by the Highway Research Board in June 1960 showed that 38 States make adequacy ratings which are used in varying degrees and for a variety of purposes as previously discussed. Four States are now studying adequacy ratings for technique and feasibility.

Seven of these 38 States are required by law to rate their highways for adequacy. (I do not personally advocate the prescription of an inflexible rating technique nor its precise role in programing, for this would fetter the administrator in his more discriminating judgment and might inadvertently move the program off target. Nevertheless, it might help to have a declaration of intent by the legislature that adequacy ratings be used as a supplementary guide in long-range planning and programing.) In addition to the 7 States which have statutory enactments providing for the rating of highways, 11 states have administrative orders requiring such rating.

Principal rating methods reported in the canvass were:

Sufficiency rating (in various modifications)	32
Deficiency rating (in various modifications)	2
Service	1
Congestion warrant	1
Priority analysis	1
Adequacy rating	1

Methods now being studied include:

Sufficiency rating	2
Deficiency rating	1
Continuous programing	1

Complementing analyses of some type were made by nearly all of the 38 States making adequacy ratings. Among the types of correlative studies reported were capacity, maintenance cost, rate of return on investment, accidents, speed, structural performance, benefit-cost ratio, operating cost, integration, area growth, remaining life, economy, solvency quotient, objective and subjective factors, minimum transportation costs, and serviceability-performance.

Most of the techniques are a matter of record and are familiar to the analyst. The adequacy ratings are detailed in the manuals of the States which make these ratings. With the many types and techniques now in use it is seen that there is no tidy ranking formula.

Some discussion of the type of rating, and its potential role may provide perspective. The methods can be categorized into three groups:

1. Adequacy ratings, which rate safety, service and structural adequacy (included are design-performance ratings, condition ratings, serviceability-performance ratings, capacity and accident indexes);
2. Service indexes alone, which rate adequacy for traffic operations: the quality of traffic flow (included are congestion and capacity indexes, and travel time); and
3. Economic analyses, which rates economic consequences of improvement or non-improvement to user or non-user and reflects the consequences in solvency, insolvency and in the general economy (included are benefit-cost ratio, rate of return, minimum cost of transportation, solvency quotient).

Among the several methods listed some directly measure the characteristics of traffic flow and maintenance operations, while others measure the geometrical and physical attributes. Both types of analyses should be made translatable to the other, but much empirical data on interrelation of the various components are needed to make an accurate translation. More data on performance are needed, for example, to interpret the reading of the Benkelman beam, the profilometer and the roughometer in terms of critical deficiency.

Each index can furnish valuable information. Each index can play a significant part

in the making of decisions. But when comparisons are made by ranking projects in terms of sufficiency ratings, benefit-cost ratio, rate of return, minimum transportation cost, solvency quotient and by other ratings, the rankings do not correspond. It is questionable whether any individual rating method can serve as the sole criterion in decision making.

Why the difference? The answer is that adequacy ratings measure the urgency for action whereas the economic analyses measure the importance of the action. The adequacy rating is blind to absolute costs, it does not prescribe the solution, it simply says that the project is or is not adequate for the existing conditions, pointing out the deficiency. The economic analysis, while highlighting daily economic loss, might not score the adequacy nor show criticalness of condition, nor give an answer for the "poor earner" but critically deficient link. But each has its own purpose which it can serve well. It is suggested that only the critically deficient sections having a warrant for action need a supplementing economic analysis, since all sections have the assumption of justification.

ELEMENTAL AND COMPOSITE RATINGS

There has been considerable debate regarding the wisdom and unwisdom of combining the elemental ratings into composite ratings. There is in each a distinctive purpose and therefore a need for both the elemental and the composite.

The composite can be helpful in a long range appraisal of needs and accomplishments. Yet, in determining an individual project's needs, our Lord's perceptiveness can be applied. He said: "....broad is the way that leadeth to destruction and many there be which go in thereat..." (Matt. 7:13). In other words the road has adequate capacity, and the structural condition must be sound to attract so many, yet its fatality rate is 100 percent. How would you rate it? It just might score a passing mark in our composite index.

The retention of the identity of the individual element and its separate scoring assures notice of any critical deficiency warranting action. It also provides a separate comparability of the systems, counties and States for relative adequacy of safety, of service and of structural conditions.

ALERTING TO IMPENDING NEED

The inevitable critical deficiency of a project is approached with a telling sureness. The period of time from critical deficiency to emergency can be read in the declining periodic adequacy rating for the project. Life curves of the individual project may be platted from periodic ratings, even as the service-life curve of a particular type of pavement in a certain system can be plotted from annual retirement data.

By projecting the historical ratings, a date for an "alert" can be foretold. A study of trend in deviation from standard toward critical might be made for each component, and then an appropriate curvilinear projection would suggest the time for action. With a long lead time (5 or 6 years) required from preliminary survey to contract letting such an alert will allow the requisite time for reconnaissance, location and design before the critical date arrives.

The engineering department can be helped immeasurably in its planning if alerted to the approaching critical index rating when projects must be programed for surveys and plans.

After the alert is sounded it is almost a matter of calculated time until the date of critical deficiency arrives.

Periodic ratings will also bring to light any accelerating or retarding deviations that might eventuate in some switch in rank as time comes for budgeting. All of these procedures, including the calculated date for the alert and critical deficiency can be programed for the electronic computer.

The whole process of programing is ideally suited to Operations Research, to the teamwork of many disciplines moving toward a common objective. The result of rating is the measuring and projecting of trends, the alerting and the ranking, all at the same time. If the rating of any project indicates a marked deviation from the expected rate

of change normal for that kind of project, an alert is sounded for investigation to discover why it is so much better or so much worse than expected.

WARRANTS FOR ACTION

Warrants are determined by balancing the flow of available revenue with the flow of needs. Even as the orbital path of a satellite is determined by a balancing of the centripetal and centrifugal forces likewise the measure of critical deficiency is defined by the two flows of cash and needs, and though the orbit may be erratic, the warrants reflect the equilibrium—a balance determined by many component forces on each side.

I used the traffic signal warrant for several years, calling it an "engineering warrant" but wondering how it was determined. Then one day, the late Dr. Miller McClintock explained the basis for this warrant. He had made a survey of the intersection movements over a large area of Chicago in preparation for the installation of signals. He ranked the intersections in terms of traffic movement, then knowing that the city had allocated a certain sum of money for signalization which was not sufficient to purchase signals for all of the intersections surveyed, he setupon the fixing of a warrant for signalization. Matching signal with intersection volume by rankorder, he determined the traffic movement for the lowest ranking intersection for which a signal could be afforded. This pattern was adopted as the minimum warrant for traffic signal and became a national standard—a standard based on Chicago's economy rather than upon scientific measures of over-all economy of such a regulated traffic flow. Signal warrants have changed since that time, of course.

Warrants are based on standards and standards are based on the "hoped for" rate of meeting needs under the appraised fiscal capability of the taxed beneficiaries. The critical point might not be the same in different States.

The measure of a critical deficiency is a warrant for action. The rating does not specify the action. A "Remarks Column" records and quantifies the deficiency. It names the category and cause of deficiency. The engineer must weigh and choose appropriate action (betterment, reconstruction, relocation, etc.).

A listing of warrants is not a priority listing. A warrant shows only the need for action. If money based, the possibility of eventual action is assured. If not economy based the critical sections may proceed to a state which can only be tagged "emergency." Just how long a project can or should remain on the critical list is a moot question. Available funds over a five- or six-year period should fairly match the warrants for that period. Pyramiding the warrants is both futile and frustrating.

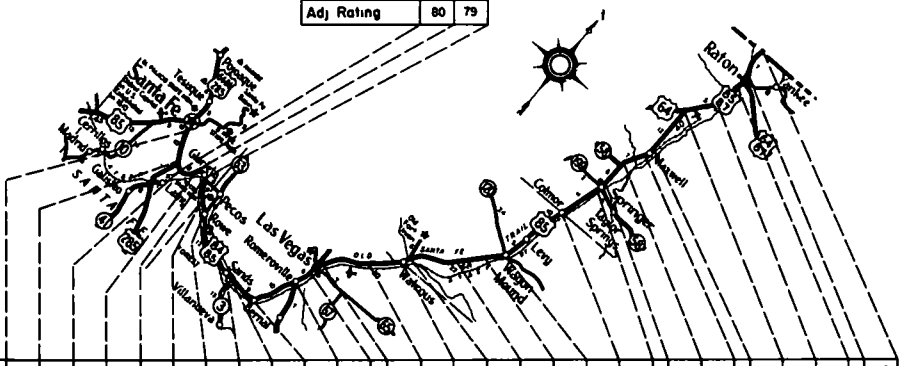
A modification of the classical sufficiency rating procedure was made recently in New Mexico. It provides an excellent means of isolating the critically deficient section—the one with a warrant for action. It also provides a composite index which aids in choosing among the many projects with warrants for action, and to provide trend studies for projects and for systems. The following excerpt is taken from the 1959 New Mexico Sufficiency Rating Report:

> It was decided, in setting out on a fresh approach to sufficiency ratings, that the method should provide as precisely as possible the information needed to determine which sections of highway were critically deficient, the reason or reasons for the deficiency, and indications of the corrective measure needed. (see Fig. 6.)
>
> Before selecting items for evaluation, the conditions obtaining for a highway of complete adequacy were determined. It was agreed that a highway section meriting a rating of 100 should have a thoroughly sound structure, be free from those hazards which can be obviated by road design, and have the capacity to handle satisfactorily the traffic generated by user demand.

N. M. STATE HIGHWAY DEPARTMENT
PLANNING DIVISION

SUFFICIENCY RATINGS ON PRIMARY SYSTEM 1959

Length	3 9	3.2
Surface & Shoulder Width	24 36	24 36
ADT 1958	1945	1910
Foundation & Suface	10 13	10 21
Safety	16	6
Capacity	30	30
Adj Rating	80	79



Length	7 4	2 0	3 9	3.2	3.2	5.1	12.9	2 4	9.0	7 8	4 3		10 0	6.8	2 1	9.0	7 2	5 8	14 6	10.4		6.1	6.0		11 8	6 9	4.9		6.5
Surface & Shoulder Width	22 40	22 36	24 36	24 36	24 36	22 30	24 36	24 28	24 28	24 28	24 32			24 32	24 28	24 26	24 32	24 32	24 32	24 32		24 36	24 36		24 36	24 36	24 36		36 38
ADT 1958	3200	1945	1945	1910	1577	1430	1477	1461	1488	1518	2600		2400	1210	1239	1109	1140	1153	1041	1042		1505	1152		1151	1672	1940		2573
Foundation & Suface	10 12	10 13	10 13	10 23	10 [illegible]	10 [illegible]	10 21	10 20	10 20	10 20	10 12	Urban	Under Constr	[illegible] [illegible]	10 11	10 23	[illegible] [illegible]	10 17	10 17	10 17	Urban	10 14	10 13	Urban	10 13	10 18	10 16	Urban	10 11
Safety	4	[illegible]	16	6	3	10	6	[illegible]	[illegible]	[illegible]	3			7	[illegible]	[illegible]	3	5	4	4		12	3		12	9	5		7
Capacity	?	22	30	30	30	30	29	27	23	23	25			30	30	30	30	30	30	30		30	30		30	30	30		27
Adj Rating	42	59	80	80	67	74	79	73	69	69	60			53	66	79	49	77	76	76		79	71		79	79	73		65

LEGEND
CRITICALLY DEFICIENT
* ADT REPRESENTS TRAFFIC IN BOTH DIRECTIONS ON DIVIDED HIGHWAY

FAP ROUTE 1
(INTERSTATE 25)

Figure 6.

It was concluded, furthermore, that the single figure of the adjusted rating fell far short of revealing all the information desired from the sufficiency rating of a section, and that the adjusted rating was an unreliable criterion in designating a critically deficient section. A plan was adopted whereby each section would be classified as critically deficient when a critical deficiency existed in any one of its major characteristics— structure, safety, or capacity. This approach to critical deficiency is one of the chief differences between the New Mexico method and that of other sufficiency-rating systems.

In many other systems a numerical dividing line such as 60, 65, or 70 is selected as the demarcation between adequate sections and those which are critically deficient. The adjusted rating automatically places a section in the adequate or critically deficient category. However, when priorities are assigned on the basis of adjusted ratings, it is found that certain sections rating below 60 or 70, or whatever the level, are actually adequate for the present because they have no critically deficient factors, while a section with an over-all rating above the required level in reality merits a high priority because of one decidedly critical factor. A re-evaluation is then necessary to identify these exceptions among all of the sections rates.

SYSTEM ADEQUACY REFLECTED IN RATINGS

"Are we making progress toward the goal for adequate highways and is our fiscal program adequate and economical?"

Trends in adequacy ratings provide a method of measuring and comparing the rate of actual progress with the rate of planned progress. The analysis can be made in terms of any of the major components or in terms of the composite. Comparisons can be made between systems, counties, regions or States to determine relative adequacy of any function, the relative need, and relative urgency for improvement, and thus aid in more equitable apportionments.

An economic analysis can also be made to compare the profitability of alternate investments, and the economic consequences of historic actions and of projected action. Although rate of return is not the sole criterion of highway improvement, an analysis of a whole system by rate of return device could provide fiscal illumination.

System solvency should also be analyzed periodically because if a system continues insolvent standards must eventually be lowered, work delayed, or revenue increased. (Here solvency is defined as the revenue "earned" or produced by or for a system.)

PRESENTING THE FINDINGS

If it is difficult to rate a project without a score card, and to sort ranking projects without a rating method, it is also difficult to visualize the findings without a pictorial presentation.

The 1959 New Mexico report observes: "In addition to being one of the useful tools in highway administration, the graphic presentation of sufficiency ratings gives interested citizens an opportunity to view the road conditions of an entire system at a glance, to identify the sections of greatest concern to them, and to compare the condition of these sections with that of others."

Many techniques are available and here the artist and the engineer can use imagination to achieve the most efficacious presentation. The following list of methods by no means exhausts the possibilities:

1. Pictorial, perspective, three dimensional
   (a) Relief, or isoline maps (a series of overlays: topographic, economic, etc.)
   (b) Colors and symbols
2. Functional maps
   (a) Capacity maps
   (b) Accident maps
   (c) Speed, and travel time maps
   (d) Volume, showing purposes, dollar value, etc.
3. Diagrams, charts, graphs (time series, comparisons, cause and effect)
   (a) Straightline logs
   (b) Costs (operating, maintenance, accident, etc.)
   (c) Flow diagrams of funds, programing procedures, etc.
   (d) Historical trends and projections, progress, adequacy, etc.

A colored motion picture with sound is of much more value than black and white still pictures. Psychologists tell us of the value of motion, color and sound to bring to life and attract and hold attention. The whole programing method can be an entertaining story by this method, and can be used for delegations, for training of employees and before legislative committees.

Mapped ratings helps the administrator to more easily select a well-balanced capital budget.

FISCAL PLANNING AND ROAD RATINGS

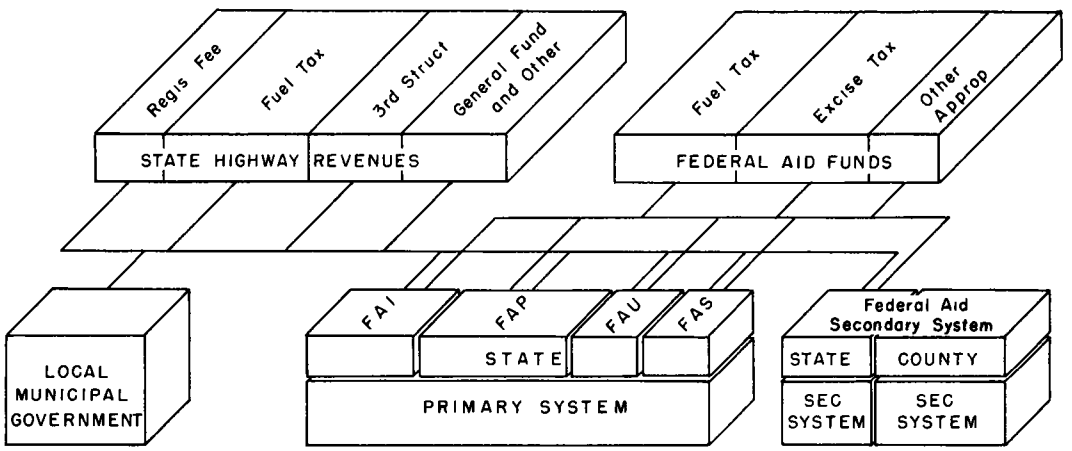
Road ratings focus the attention on the "rolling" 5-, 6- or 7-year advance programing plan rather than upon a 20- or 30-year plan. At this point the fiscal and priority planning must lock step. This re-emphasizes the need to use comparable score cards in rating intolerable sections in needs studies and critical deficiencies

in road ratings. For if the needs are to be translated into fulfillment in a stated period of time then the warrants must be compatible with the criteria for intolerability.

If the needs study projected investment depreciation along with desired upgrading, then there should be no imcompatibility between projected needs and year-by-year warrants. Some years will have more warrants than others and a backlog of unrequited warrants will at times be listed. Inasmuch as some previous years saw fluctuations in amount and kind of construction, so current years will show a fluctuation in amount of critical deficiencies. The differential traffic volumes among the routes, the changes in construction specifications and other changes will also result in fluctuations in annual warrants.

A good needs study supported by a road life analysis can forecast the fluctuations within a reasonable degree and show when backlogs of warrants beyond normal may be expected. But if a backlog of warrants increases consistently and continuously year after year without recession it shows that the needs study, the fiscal arrangements and possibly the criteria or warrants are not in harmony.

An analysis of the questionnaire returns regarding road ratings showed that six States apportioned money among two or three major regions of the State, that 23 States apportioned funds by districts, and 11 States apportioned funds to lesser jurisdictions. Of course, funds are also split among the several systems. This all adds up to the fact that apportionments provide for a spread of projects. This spread has not necessarily been made in accordance with relative need, or equity. Ratings and corollary economic analyses will help determine the relative importance and urgency. Systematic progress toward the goal and a balanced development is often hampered by apportionment formulas unrelated to need. Matched funds would be more realistic if they were allocated in accordance with relative highway need and urgency and fiscal capability of the matching political subdivision (Fig. 7).



Note This shows major revenue sources and major allocations of funds to systems Further distributions are made by: (a) major areas, (b) districts, (c) counties, (d) rural-urban; and (e) cities.

Figure 7. Flow diagram of revenues and expenditures for state highways.

ADEQUATE REVENUES FOR ADEQUATE ROADS

If any gain is to be made the revenues must be sufficient to provide for (a) an extinction of current deficiencies over the planned period, (b) meet continuing deficiencies, (c) plus an increase in need arising from increasing economic activity, and (d) plus anticipated inflation. The target is moving upward in some States faster than revenues.

ROLE OF RATINGS

One administrator said, "There is so much work of top priority to be done, and so little money to do it with that it doesn't make much difference where the work is done—it is worthwhile anywhere if it has a critical deficiency rating." If ethics are not violated in carrying out this philosophy, it might be practical. But the greater the dilemma, the more need there is for the best choice.

What is the role of ratings? As noted previously, they can reveal need for upgrading service function and structural betterment. They cannot reveal need for extension of service because they only rate an existing system. Origin and destination with land-use studies are needed for that determination. But the dominant problem is with the existing roads, and ratings of adequacy, supplemented with economic analyses, afford facts needed for these decisions. And all who are entrusted with responsibility of programing decisions are entitled to have all of the pertinent facts spread before them.

Even in "period programing" where the "Five Year Plan" is lifted out of needs study and budgeted, road ratings can be helpful in making a more precise selection of projects for the annual budget, because ratings will assist in the choice of projects of greatest urgency. In particular, ratings will signal the shifting and changing needs in a dynamic economy. A rating tells what is wrong. An economic analysis tells how to correct the deficiency. Priority ratings say when.

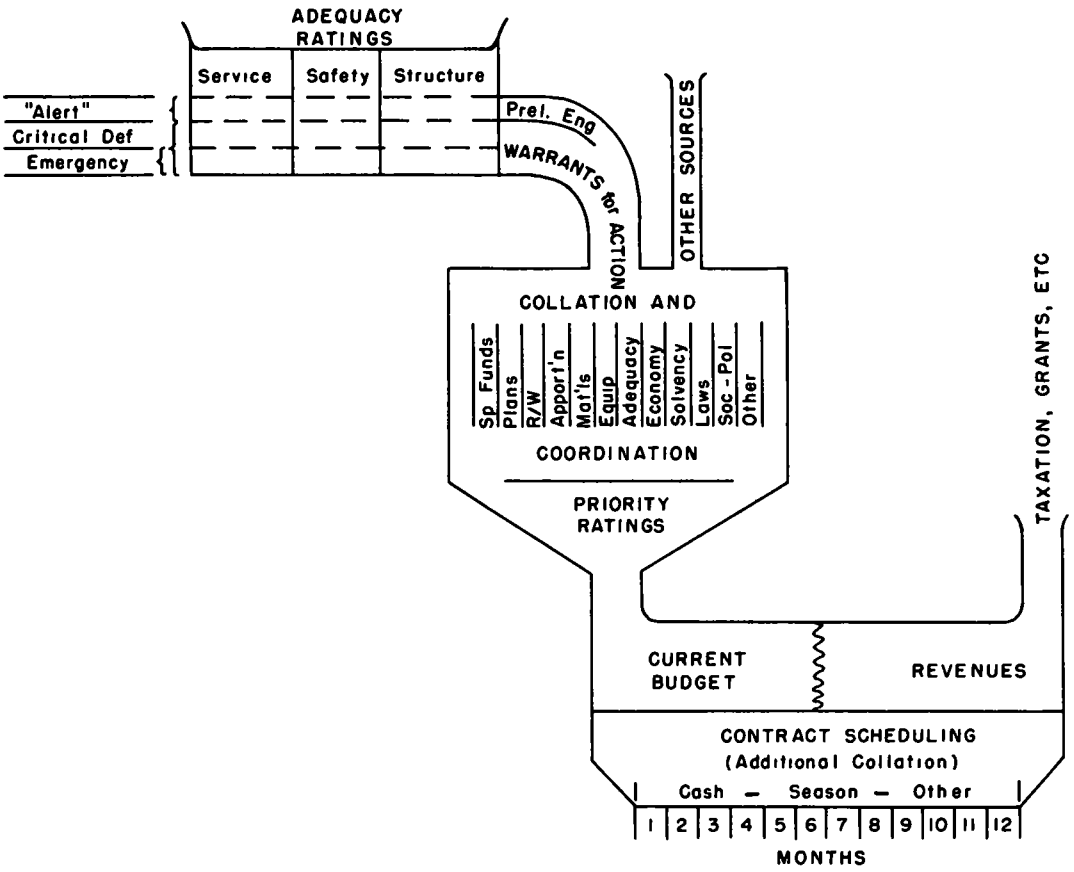


Figure 8. Adequacy ratings to priority ratings.

PRIORITY RANKING

If social consequences paralleled economic consequences, and if skilled men, highway revenue, and road material and equipment were in abundant supply, there might be less need for England's companion paper. But we come now to that point where ratings must be weighed with many practical considerations before priorities come to the top. This paper stops short of priority rating discussion because adequacy ratings are not priority ratings. They furnish one worthy procedure but only one in the total process. Now the ratings must be sorted in piles in light of area needs, availability of funds, plans, right-of-way, contractors and many other factors (Fig. 8). The companion paper tells how this is done.

RELATED RESEARCH NEEDED

Many problems need solution before linear programing methods can serve in highway construction programing. Many research problems will need a solution before the one step of rating is perfected. Needed rating research includes:

1. A polishing of the several methods of economic analysis.
2. Empirical values for weighting items in sufficiency ratings.
3. Comparative analysis of needs studies, road life and sufficiency rating for correlation.
4. Break-even or break-over point, or point of diminishing returns in costs of:
   (a) Maintenance vs betterment, reconstruction, etc.
   (b) Accident vs measures for reduction.
   (c) Volume-speed vs capacity.
   (d) Traffic control and highway improvement.
5. Type of accident by type of exposure.
6. Relation of accident involvement to exposure, by type.

ACKNOWLEDGMENTS

The ideas and material for this paper have come from discussions with highway engineers throughout the United States, and from special canvass. I have acknowledged sources in a few instances, but a listing of all the people to whom I am indebted would include one or more persons from nearly every state. I have drawn freely from these sources and now acknowledge my gratitude for the assistance.

REFERENCES

Highway Programing

Adams, R.W., "Economic Growth and the Highway Program." Proc. Amer. Assoc. of State Highway Officials, pp. 60-66 (1958).

American Telephone and Telegraph Co., Dept. of Operation and Engineering. "Engineering Economy." 195 Broadway, New York, N.Y.

Anderson, J.A., "Simple System of Determining Priorities of Improvement for Low-Type Roads." Proc., Northwest Conf. on Road Building, pp. 98-104 (1959).

Bhagat, D.G., "Adequacy Assessment of Highways." Jour. of Indian Roads Congress, 23:1, Paper No. 207, pp. 117-157 (Nov. 1958). Highway Research Abstracts, 29:3, pp. 6-7 (March 1959).

Carey, W.N., Jr. and Irick, P.E., "The Pavement Serviceability-Performance Concept." HRB Bull. 250, pp. 40-58 (1960).

Charlesworth, George and Paisley, J.L., "The Economic Assessment of Returns from Road Work." Proc., Inst. of Civil Engineers (London), Vol. 14, pp. 229-254, (November 1959.) Highway Research Abstracts, 30:2, pp. 16-17 (Feb. 1960).

Charlesworth, George, Reynolds, D.J. and Wardrop, J.G., "Road Improvements: Choosing Priorities by a New Formula." Engineering (London), 188:4873, pp. 185-188 (Sept. 11, 1959).

Clees, Elmer., "Factual Programming." Proc., Western Assoc. of State Highway Officials, pp. 23-27 (1958).

Donnell, P.M., "Tennessee's Programing Study: First Year's Experience and Techniques for Updating." HRB Bull. 194, pp. 49-60 (1958).

Donnell, P.M., and Tuttle, L.S., "Priorities Determination and Programming in Tennessee." HRB Bull. 158, pp. 63-77 (1957).

Grant, E.L. and Oglesby, C.H., "A Critique of Some Recent Economic Studies Comparing Alternate Highway Locations." HRB Proc. Vol. 39 (1960).

Granum, James O., "Highway Program Evaluations." HRB Bull. 158, pp. 126-131 (1957).

Highway Research Board., "Highway Needs and Programming Priorities." Bull. 249, 1960. 75 pp. Contains: Gardner, E.H., "The Congestion Approach to Rational Programming." Granum, J.O., and Burnes, C.H., "Advance Programming Methods for State Highway Systems."
Hummel, C.M., "A Criterion Designed to Aid Highway Expenditure Programming."
Covault, D.O. and Michael, H.L., "Estimation of County Primary Road Systems Needs by Sample Survey Methods."

Johnston, J.E., "Economic Costs of Traffic Accidents in Relation to Highway Planning." HRB Bull. 263 (1960).

Jorgensen, R.E., "Annual Inventories and Priorities for the Highway Program." Proc., Purdue Univ., 39th Annual Road School, pp. 52-63 (1953).

Jorgensen, R.E., "How Are We Doing? - Where Are We Going?" Paper presented at the Highway Engineering Conference, Univ. of Arizona, Tucson, Ariz., November 20, 1959. 13 pp. mimeo.

Kanwit, E.L., Steele, C.A., and Todd, T.R., "Need We Fail in Forecasting?" HRB Bull. 257 (1960).

Martin, James W., "Programming Highway Construction." Proc., Kentucky Highway Conference, pp. 11-15 (1958).

McMonagle, J. Carl., "A Comprehensive Method of Scientific Programming." HRB Proc., Vol. 35, pp. 33-37 (1956).

Nash, W.W., and Voss, J.R., "Analyzing the Socio-Economic Impacts of Urban Highways." HRB Bull. 268 (1960).

Newcomb, Robinson, "Financing a Highway Program." Traffic Quarterly, 13:4, pp. 504-525 (Oct. 1959).

Newcomb, Robinson, "Highway Planning for a Growing Economy." HRB Proc. Vol. 39 (1960).

Powills, M.A., Jr., "County Highways vs. County Highway Planning." Based on a study "Highway Planning for Hennepin County, Minnesota," published by George W. Barton and Assoc., Evanston, Ill. County Officer, 25:4, p. 115 (April 1960). Highway Research Abstracts, 30:6, pp. 18-19 (June 1960).

Renshaw, R.W., "Treatment of Deferred Costs in Economic Analysis." HRB Proc. Vol. 39 (1960).

Sargent, J.R., "Transportation Programming." Proc., Northwest Conf. on Traffic Engineering, pp. 15-18 (1951).

Steiner, P.O., "Choosing among Alternative Public Investments in the Water Resource Field." American Economic Review, 49:5, pp. 893-916 (Dec. 1959).

U.S. Dept. of Agriculture, Agricultural Research Service., "The Economic Impact of Highway Improvement." (3 parts). Washington 25, D.C.

U.S. Interagency River Basin Committee, Subcommittee on Benefits and Costs. "Proposed Practices for Economic Analysis of River Basin Projects." Revised by Subcommittee on Evaluation Standards. Washington, D.C., U.S. Gov. Print. Office, 1958. 56 pp.

U.S. Bureau of Public Roads. Circular Memorandum to Regional and Division Engineers; from G.M. Williams, Asst. Comm. Subject: Sufficiency Rating Plans in Use by 33 State Highway Departments and the Bur. of Public Roads.

U. S. Bureau of Public Roads. Circular Memorandum to Regional and Division Engineers; from M. B. Christiansen, Chief, Construction and Maintenance Division. Subject: Use of Numerical Ratings by State Highway Departments for Determining the Adequacy of Highway Sections.

Land Use as Related to Highway Development in Rural Areas

Johnson, A. E., "Impact of the Interstate Highway Program on Rural Areas," Proc., Southeastern Association of State Highway Officials, pp. 55-60 (1956).

Keller, W. J., "Land Use Planning in Relation to Highways," Public Roads, 23:1, pp. 5-13 (March 1942). (Delta County, Colorado study.)

Lambert, W. H., "County Road Planning in Relation to the Use Made of the Land." Proc., 23rd Annual Highway Conference, University of Colorado; University of Colorado, Engineering Experimental Station, Circular No. 23, pp. 90-96 (1950). (Discussion of Delta County study.)

Marschner, F. J., "Land Use and Its Patterns in the United States," U. S. Department of Agriculture, Agriculture Handbook Series No. 153, 1959. 277 pp.

Minnesota, University of, Department of Agricultural Economics, "Workshop on Rural Land Use Development," November 20, 1958, Summary of Discussion, 1 p. mimeo.

National Planning Association, "Rural Low-Income and Rural Development Programs in the South," 1959, 22 pp. mimeo.

North Carolina, University of, Institute for Research in Social Science, "In the Shadow of a Defense Plant: A Study of Urbanization in Rural South Carolina; A Final Report of the Savannah River Urbanization Study," (June 1954). 259 pp.

Stout, Samuel E., "The Influence of Current Mode of Transportation on a County," Proceedings, 42nd Annual Road School, Purdue University; Engineering Bulletin Series No. 90, pp. 134-139 (April 1956).

Thompson, Lorin A., and Madden, Carl H., "Socio-Economic Relationships of Highway Travel of Residents of a Rural Area," HRB Bull. 67, pp. 15-21 (1953).

Discussion

Hall.—Referring to Figure 6 from the New Mexico manual, I was interested in the absence of a rating on the urban areas. I wonder, particularly in view of what appears to be generally the high points in the profile, if there will be any comment as to the ratings given to the urban sections on this particular route.

Wiley.—I should answer that, since this chart came out of New Mexico. We do not rate the urban sections any more. We did a few years ago. We did not use quite the same system then, because we ran into different problems there. But the fact is that often we ran into other difficulties, such as routes that were incapable of improvement, right-of-way difficulties, and difficulties of agreement on location and timing, so we found that the ratings did not seem to serve the same purpose in urban areas as in rural ones. For this reason, we have not concentrated much on that since.

Hall.—How are the urban sections placed in competition for the funds with the rural sections?

Wiley.—To the extent that we have urban funds, those are earmarked. But we do spend a certain amount of primary money on primary extensions in urban areas, as well. This is simply done by a determination of the commission itself, depending on when the projects are ready. There is no formula for anything of this kind.

England.—Campbell mentioned the research in connection with geometry relative to accident frequency and the cost of the betterment. Has any research been undertaken in this country with respect to accident experience before and after improvements? I have heard there are some studies being conducted in England.

Campbell.—There has been a number of studies on route improvements and a great deal on spot improvements.

Granum.—You did a lot of work in Connecticut, years ago.

England.—It does not seem to work into this result though.

Morf.—This work is going on in Illinois, and in many other states there have been made before and after studies with freeway construction, and also detail studies of causes of accidents on freeways.

England.—How about on other sections, where there may be a betterment in alignment or a cross-section on a two-lane rural section?

Granum.—There has been quite a bit of work done in Oregon, New York, Texas, Vermont, and Louisiana, but not nearly enough.

Campbell.—Some of the investigations have shown that when you improve a road, you get more accidents. I would not say that that is the usual answer.

Livingston.—I would like to comment that it is not altogether a matter of before and after. It is the accident rate of a road with certain kinds of geometric characteristics, because the accident rate appertains to a certain type of facility, and you are not concerned with whether it was before or after, but just as it affects the road as it exists.

In other words, we take a freeway, compare it with an expressway and with a noncontrolled access highway having certain geometric characteristics. This is where the differences are really critical.

McWane.—There have been quite a few studies by a great many States on accidents occurring before and after improvements, which have provided rather differing results in different cases. In some cases the accident rate has actually gone up after improvement.

But I would like to comment on a study that has recently been initiated by the Automotive Safety Foundation and the Bureau of Public Roads, of searching the literature for investigations that have been made to determine the relationship between geometric features of the highway and accidents. If any of you know of such studies, it would be much appreciated if you would advise Cris of the Bureau of Public Roads, or Shoper of the Automotive Safety Foundation, or me. They are anxious to find all of these scattered studies they can, and by bringing them together think they may be able to get conclusions out of combinations that the individuals have not been able to get from isolated studies.

They also want to know of any extensive studies that have been documented, either published or unpublished.

Balancing of Physical and Economic Ratings With Other Considerations to Establish Project Priorities

ARTHUR C. ENGLAND

Balancing of a system of physical and economic ratings, such as sufficiency ratings, which may be expressed numerically with financial and other very important but in many instances controversial considerations, presents many difficulties. There are several factors which must be given consideration in the development of the over-all program for a given period whether it be for a year, biennium or decade.

Without endeavoring to indicate relative importance, the following are some of the factors which must be given consideration in developing construction priorities: availability of funds, distribution of funds by system or class of highway, statutory directives, financial requirements of activities other than highway construction, various programs within the over-all construction program, completion of usable segments and route improvements, ability to complete plans, ability to acquire necessary rights-of-way and coordination with community plans.

Sufficiency ratings, or other rating procedures, may be used to establish a relative need for improvement. If possible, such ratings should provide a statewide comparison. The analysis of these ratings would provide the administrator with a desirable basis for allocation of funds if other factors did not intervene. The physical ratings provide a guide which may be modified to develop a realistic program of construction. Subdivisions of the statewide ratings, either by systems or areas, provide guides in their respective fields for administrative decision along with financial, political and economic considerations.

AVAILABILITY OF FUNDS

Many governmental units, states, counties, cities and towns, have sources of funds specifically designated for highway purposes. In some areas, funds are provided by appropriation from total resources including general and highway users revenues. In other areas, there may be a combination of these sources.

It must be recognized that the establishment of priorities and the determination of funds for construction are, in many instances, interdependent. A system of priorities may be the basis for establishing the requested appropriation for highway construction. Conversely, the amount and manner in which funds are appropriated may affect the priority of construction.

For example, there are the procedures used in Connecticut to determine the amount available for appropriation for highway construction. By statute, certain revenues are made available to the highway commissioner for administration, maintenance and construction of highways within the state. These revenues are made available through legislative appropriation for various phases of the department's activities. Such appropriations are requested by the highway commissioner in his biennial budget. Within the limit of funds available, the commissioner must administer the activities of the department, adequately maintain the highway system, apportion funds to the 169 towns for maintenance and improvement of the network of highways maintained by the local governments, and maintain roads and drives under the jurisdiction of other state agencies. The available revenues, after allowance for the above-mentioned functions, are then appropriated for the "Construction and Reconstruction of Highways and Bridges". This amount is appropriated for construction projects, including engineering and

acquisition of rights-of-way as determined by the highway commissioner. The legislature usually does not appropriate for specific projects. Therefore, the commissioner has wide discretion in the selection of projects. Here then is the need for determining priorities of construction within the funds available.

STATUTORY DIRECTIVES

Perhaps the most commanding factor affecting priorities is that of statutory directive from the state legislature or assembly, depending upon the form of government. Such legislation may be mandatory or advisory that the indicated project be constructed in accordance with the statute. Many problems may arise from such legislative acts, either from the standpoint of location, traffic capacity, or other restrictive clauses which may not conform with the needs of the motorists nor be to the best advantage of the community or communities in the area of the project. Generally, it is better legislative procedure to have a project designated between or through one or more communities without defining the precise location, thereby allowing the planners and engineers to develop the location of greatest advantage to the one or more communities involved in the project by providing adequate traffic service and, at the same time, avoiding the disruption of the community, unnecessarily destroying taxable properties and disrupting or isolating segments of the community and also coordinating the project with the long range objectives of the community planners.

SYSTEMS PRIORITIES

The establishment of priorities by systems also presents a problem of prime consideration. Every state has its Federal-aid program. The distribution within each state of Federal-aid primary, secondary, urban and interstate apportionments together with the matching requirements and time limit on availability of Federal funds establishes a financial limitation on these portions of the over-all program.

Integration of projects on the Federal-aid systems and other classes of highways is also a prime consideration in order to provide a safe and economical transportation system.

If a large portion of the highway financing is undertaken on a 100 percent state basis this phase of establishing priorities is not of great importance. However, the program should assure that the state will be able to take advantage of any Federal apportionment available to it.

In other areas, the coordination of the Federal programs into the financial plan is dependent upon the classification of accounts or appropriation under which the funds are available for financing such projects. It is of interest that in some states specific amounts of money are appropriated for the construction of specific highway systems. There are generally the four categories of Federal aid available to the states plus the state monies which may be appropriated for highway construction purposes with or without regard to use of Federal aid and the accounts established under various bonding proposals. These latter monies may provide for the construction of special bridges, toll facilities or certain specific highway construction projects.

For example, in 1959, the Connecticut General Assembly authorized the sale of bonds to finance an accelerated program of construction on the Interstate and ABC systems provided the projects were eligible for Federal participation. This financial program revised radically the priorities of a great number of projects in the long-range program.

SUBSIDIARY PROGRAMS

There are also the subsidiary programs which must be developed and integrated into the annual construction program, such programs as bridge replacement, drainage betterments, minor sight line improvements and surface betterments. In addition to these programs, projects financed from special funds or accounts frequently require other construction to supplement and make more effective these special projects. Such additional projects invariably require adjustment of the priorities in the statewide construction program.

COORDINATION WITH ADJACENT STATES AND STATEWIDE DISTRIBUTION

Two other major considerations are the distribution of the highway construction program throughout the state and the coordination of proposed projects with contemplated improvements in adjoining states at their respective boundaries. It is recognized that people do not confine their trips to the relatively small area of the communities in which they live and work but have need for facilities throughout the state and the nation not only from the standpoint of personal transportation but from the standpoint of better transportation facilities for commerce and industry.

Projects distributed on a statewide basis may be scheduled to provide better transportation facilities between communities, to generate and to promote growth in areas of potential development, to distribute the work load of the highway department and that of the commercial producers and contractors located throughout the entire state. The distribution of the work load is desirable to maintain a uniform work force in the field or district offices.

URBAN ARTERIALS AND EXPRESSWAYS

The development of urban arterial and expressway systems are also prime considerations in the establishment of a program for highway construction. In the past the state highway departments aided and abetted by Federal statute constructed rural highways up to the political boundary of the city or incorporated village and deposited their vehicular load at the gateway to the town, leaving to the community the provision of streets through the residential and business area and to the motorists the determination of a way through the community or to their destination.

As a result of many urban studies it was noted that only approximately 10 percent of the traffic approaching an urban area of approximately 1 million can be bypassed around the area and that as much as 50 percent of the traffic approaching a community of approximately 50,000 wishes to enter the central area of the community. The development of the urban programs to provide arterial and expressway construction has provided traffic relief in many of the urban areas. Many more facilities of this type are needed. Consideration must be given to the location of these expressways and arterials to provide access to the heart of the urban areas. Such construction can be a benefit to the community inasmuch as motorists are attracted to a central area if they are able to readily reach the central business district to conduct their affairs. The construction of such highways without exception requires wider right-of-way than that provided by the usual city street. Undoubtedly, many objections will be raised by the owners of property within the required rights-of-way for these expressways. The determination of the location must take into consideration the factor of removal of buildings, small businesses or industry, and the relocation of those residing in the right-of-way of the expressway. Such removal may constitute a major disruption of the community activities.

The coordination of urban highway location and subsequent construction with redevelopment agency operations in older communities has become a contributing factor in establishing programs and priorities. By close cooperation with the redevelopment agency, a time table of operations can be developed benefiting both the highway department and the redevelopment agency so that each can obtain the benefit of the other's activities through the construction and development of traffic facilities located to serve the relocated traffic generators.

COMPLETION OF USABLE SEGMENTS AND PARTIALLY COMPLETED IMPROVEMENTS

A very important factor which influences the priorities of construction is the necessity of completing usable segments and partially completed route improvements. Planning studies may cover large route segments or entire routes recommending improvement and relocation. Most of these major projects can not be financed within a year or biennium. A section is selected for improvement and once such a start is made, it is almost mandatory that the route be progressively improved to completion. Recently,

an estimate was made of the cost of completing construction on Connecticut's major routes on which some expressway construction has been accomplished. This estimate indicated $238 million of added construction would be required. Improvements requiring this magnitude of work must be given great consideration in program development.

STATUS OF PLANS AND RIGHTS-OF-WAY

The status of the development of plans and specifications and the acquisition of rights-of-way will also affect the priority of projects in the construction program. This is particularly so under a program of accelerated construction. If plans can not be made available, if rights-of-way required can not be acquired for a project or group of projects for any of several reasons, that project or group must be deferred or, in other words, rerated at a lower priority.

Even a legislative directive, unless plans and funds are available to execute the directive, is not sufficient to give immediate top priority to such projects.

CONNECTICUT PROCEDURE

To illustrate some of the procedures to be used for establishment of a construction program, a review of the situation in Connecticut is presented.

Shortly after the biennial budget is submitted at about this time every other year, the department has available a list of projects which are believed feasible of accomplishment within the appropriation requested. This list is not intended as a program but may include minor project groupings which do not identify individual projects.

After review of all material available to it, the legislature appropriates from the revenues available to the highway commissioner the amounts required for the several activities of the department, including the construction account. With this latter appropriation and other legislation enacted, the department reviews the project listing to include legislative requirements. Then begins the establishment of project priorities.

Inasmuch as the appropriations are made for the fiscal year and not for the individual projects, the status of each project must be reviewed with an estimate made of whether all or part of each project can be included in the biennial program. Projects which it is anticipated can not be processed through the various engineering and acquisition of rights-of-way stages within the 1- and 2-year time limit are eliminated from the program of contract construction for that year or years but are still considered for engineering and rights-of-way priorities.

As previously indicated, this condition may apply to legislated projects if the scope of the project is such that considerable planning work is required before determination of the detailed route location prior to design.

Following the review of project status, simultaneous reviews are made of the project listings relative to several other factors which must be considered.

Using the sufficiency rating as guides, the projects are then analyzed with respect to location on the Federal-aid systems, eligibility for financing under the several classes of Federal aid and availability of funds in each of the several classes; taking into consideration the balances of the apportionments and the apportionments anticipated to be available during the period of the program.

At this time, consideration is also given to the availability of funds to provide the state's share of the cost of the selected projects.

Simultaneously, consideration is given to the inclusion of projects which will complete usable sections of highways and to close gaps in partially completed routes, construction on which was started under programs of previous periods. These projects, of course, fall into more than one of the Federal-aid categories and thus receive consideration under more than one phase of the priority analysis.

Similarly, a review is made of projects involving coordination of construction activities at the state boundaries. In recent years, this group of projects, although not large in number, has caused many revisions in the construction schedule in order to cooperate with our neighbor departments.

For some of the lesser programs, an arbitrary selection of a maximum annual ex-

penditure may be made and the most urgent projects in these categories are then designated for inclusion in the annual program up to the limit of funds assigned.

Conferences with local planning and/or redevelopment agencies may indicate the desirability of advancing or deferring projects in urban areas to coordinate the highway program with the program of the urban area.

Legislation enacted in 1959 authorized the 4-year bond financing of the state's share of the cost of Federal-aid projects on the primary and secondary systems and the state's matching share of the projects on the Interstate System, plus the Federal share of the cost of Interstate projects constructed in conformance with the Federal regulations and in anticipation of future Federal-aid apportionments.

The enactment of this legislation required a major revision of priorities of construction. The Interstate program in Connecticut calls for the construction of approximately 200 miles of expressway network connecting and passing through all of the major cities. The recently enacted legislation contemplates the construction of almost all of this highway system within a period of four years. This does not leave a great deal of discretion in selection of projects to be given a top priority in construction. A program of this nature requires that all of the mileage be initiated for engineering and design immediately if the program is to be consummated within the defined time. The integration of the program with the prior programs for construction, notably in the urban areas of Connecticut, has greatly affected the priority in which some of the urban projects are to be undertaken. The Interstate System, as located, passes through the major urban communities and, in effect, overlays many of the originally proposed expressway systems for these communities.

CONCLUSION

When consideration is given to these several factors, some affecting only a special group of highway projects, it is apparent that no firm rule can be given for establishment of priority.

One can not say that any one factor more than another, with the possible exception of funds to prepare plans and specifications, acquire rights-of-way and pay for the construction, controls the priority of construction but many interlocking factors must be recognized and the priorities retain a reasonable fluidity in order to accept the changes which occur in requirements, availability of plans and financial arrangements. Physical ratings are an important guide but must be coordinated with many other factors in the development of construction programs.

Discussion

Granum.—How many years ahead does New England program on a scheduled basis?

England.—We have set up a four-year program. That is the main basic program for our operation at this time.

Very general programing has gone as far as ten years, but not for specific projects.

Babcock.—You are going to do your Interstate highways in four years, I understand and you are going to put them through every major community in Connecticut.

I am asking if they are going to be putting expressways through all of those communities. Do you have adopted land development thoroughfare plans with the cities in each of these communities where you plan to put expressways?

England.—We do not have written agreements but understandings, with communities on practically all of the routes with the exception of the western circumferential route around the Hartford metropolitan area. Some of that has not been defined, and detailed public hearings have not been held. But on the rest of them the hearings have been held.

Babcock.—Generally have these towns and cities adopted land development thoroughfare plans?

England.—Some of them are in regional planning groups, but as for detailed plans, I would not say that most of them have.

McWane.—In order of ratings, if a project is passed up this year that has a high rating for improvement, then for some reason you reconsider it next year, and so on, where does it eventually get in programing?

England.—Some projects have come up year after year and been continually deferred. I can think of one such project. It has very poor alignment and a narrow roadway, in the western part of the state on which the traffic volume is very low. It is in an area containing fairly substantial estates. Although the sufficiency rating is very low (it would probably show it as one of the worst ratings) we have not given consideration to it in any of the programs. It has been put off because of other factors involved.

McWane.—What I had in mind was that one of the chief benefits of your sufficiency ratings is to flag those sections which have very high priority of improvement or low efficiency ratings. And then next year when the roads are rated again this particular section will also have a very poor rating.

Generally speaking, do those come up for discussion each year and are they considered each year, even though you do not include them in the program?

England.—That is correct.

Granum.—Could it be that this particular road should not even be a part of your State highway system?

England.—It could be. I see no possibility of releasing it to the town.

Campbell.—Have you made an economic analysis of it to determine what its importance is as well as its urgency?

England.—Not on that particular section.

Kimley.—Was it a study by the Bureau that prompted the floating of your bond issue?

England.—No, we do not sell them until tomorrow. We have not yet sold any. We have an authorization that these bonds may be issued, providing we conform with certain Federal aid and other conditions that are in the bond statute. It was brought before the legislature as part of an over-all improvement program for the State. It was pointed out that we all believed it would be of substantial benefit to the State economically if we could build the Interstate System in advance of the Federal program, even though we recognized that we would have to pay the interest on the money that we were borrowing.

Kimley.—You had a complete rating before you requested the bond issue, then, of all the roads in the State, and you knew where your deficiencies were?

England.—We had a sufficiency rating set up which goes back to about 1950—that we revise every two years. And the Interstate System with the Federal program seemed to be a place where we could take advantage of that program for the economic advantage of the State.

Kimley.—Your article stated that about a hundred percent of your staff and your funds were diverted to materializing this bond issue. Am I correct?

England.—I did not mean to imply that; but during the last year or so, that has been fairly generally true.

Kimley.—Has the work on the other highways in the State been more or less satisfied so you can work on the bonds?

England.—It may have to be. I will not say it has been, because we had some other monies available which supplemented the bond program. But during the current year, our non-bonded program will be very small. The bonded program will go into four categories of Federal-aid financing, which will include secondary roads.

Kimley.—Does your bond program take care of most of your inadequacies, so that you do not have to worry about too many being left over at the end, or are you getting behind?

England.—No. One of our primary needs studies indicated a need of $1,300,000,000. This bond issue will only cover some $410 million worth.

Kimley.—Does it cover most of your top priorities?

England.—It would cover the top priorities becuase it would get the top off both the Interstate and the primary and urban groups.

Swanson.—Your Federal, secondary, primary, and urban programs are going forward at the present rate. There has been no slow-down in them. And what has helped you is that you had the organization built up to carry through on the Connecticut Turnpike, and with that being completed, you could turn your efforts over to the completion of the remainder of the Interstate System in this four-year period. So you had a good

organization to carry on this expanded program of four years.

England.—That is right. In fact, the ABC program will be accelerated under this bond program, because we were not using the Federal-aid money up to the limit. We were beginning to accumulate a backlog. We will now be picking up that backlog as well as the current apportionment.

Granum.—I would like Campbell to elucidate on the suggestion in his paper that a parallel or companion analysis by economic rating would underscore the importance of the road sections under consideration, as well as the sufficiency rating underscoring the defects.

Campbell.—An economic analysis will point up the benefits which will accrue to the user by improving a system, and from that standpoint will show the importance to the user of improving that project.

At the present time it would be a potential loss until the improvement is effected. That would indicate to the user the importance of having the improvement made.

Then, if we go into the economic impact studies, which broaden out the base, showing the potential which may be expected to accrue to the abutting lands in use and value, that, also, will indicate the importance of the improvement to the general public and to the abutting property owner.

In other words, the economic analysis does establish the importance of improving a piece of highway from the standpoint of benefits. I do not know any other quantitative way to measure the importance.

On the other hand the adequacy rating, whether it be sufficiency or deficiency or any of the other adequacy ratings, tells when a road has deteriorated structurally or has become obsolescent to the point that it is in a critical condition and is not providing service that it should provide, or is costing more to maintain than it should. Of course, in constructive maintenance, we find another aspect of the importance of doing something, also; but I believe the adequacy rating speaks more about urgency, whereas economic analysis speaks more about importance.

Granum.—You visualize taking an entire road system under consideration, and making an economic rating mile by mile throughout the entire system?

Campbell.—No. The suggestion that I made was that the economic analyses be made only of those sections which were rated critically deficient; because I regarded urgency as the first thing to consider.

That may be the wrong philosophy. Maybe we should regard economic importance as first and make an economic analysis of every section of the whole system, but that would be a tremendous job. Perhaps that should not be the reason not to do it, but so far, most highway departments are not properly set up to do such a job. I think it would be well if it could be done.

Granum.—Would you intend the economic analysis to include intangibles?

Campbell.—Yes, so far as you can give some value to them, and we do give them value. I think most people rate the value of time at about $1.35 an hour for a passenger vehicle, which may be somewhere near right or may not be very near right. Then we also have a value given for comfort and convenience which may or may not be the proper value.

Some of these values might be determined by objective research. There is another area where we need more research.

For example, you can determine what people will pay for use of a toll road to avoid some of the discomforts and inconvenience of travel on existing routes without paying toll. And there are a number of measurements that can be made to determine the objective value of time, that is, the average value—even the range of values. There have been studies made of toll bridges and toll roads to determine the value of the time, and other intangibles, of those who preferred to use the toll facility and gain these benefits as against those who preferred to go around by a free bridge and lose these benefits.

Titus.—How, in the economic analysis, would you arrive at the estimated construction cost of the project?

Campbell.—I think we all take the estimated construction cost from the design engineers. Usually we go to the design department to get the cost, unless we have an estimator in the planning division.

Paterson.—I think you are implying that a need study changes conditions, but you do not use economic quantities to arrive at it. Growth and development of industries, changing structures and patterns within the different areas—these will help to indicate where roads perhaps should go if you are taking a long-range look at the program. But this does not affect the cost. This is done by design engineers.

Titus.—But one method of arriving at your program is to determine the rate of return on the cost. I am wondering in how much detail these cost estimates should be made.

Campbell.—In how much detail are the studies that are furnished for the proposed Interstate System? They contemplate projects which may not be built for 13 or 15 years.

Winfrey.—As another item on the program which fits into the present discussion, Wiley will discuss some work on sufficiency rating systems being done in New Mexico.

Wiley.—Referring to Figure 1, I am sure that we all would recognize that a highway section meriting a rating of 100 should have a thoroughly sound structure, be free from those hazards which can be obviated by road design, and have the capacity to handle satisfactorily the traffic generated by user demand.

In order to accomplish this kind of a rating, we divided our total points of 100, quite similarly to every other rating, into a number of items which are again very similar to what are used in most other ratings.

Structural adequacy is divided into two different items, a foundation rating of 10, and a surface rating of 30. I will explain why there is such a big rating on surface.

Ten points are given to drainage, 20 points to safety, and 30 points to capacity. This is capacity to carry volumes of traffic of the type that is using the highway.

The foundation rating (Fig. 2) is done simply by observation on the ground, by one single man who is trained to do this. He does the whole system, the secondary and primary system, each year. We may not always get everything perfect, but at least we are consistent, and we do not have a dozen people doing the same job.

So foundation is rated either as being satisfactory or critical. This is by observation of whether there are depressions or distortions or any kind of distress showing up through the pavement. If the foundation is not right, you practically have to tear up the surface to make repairs so the foundation will take a rating of either 10 or zero, satisfactory or unsatisfactory.

We allowed 30 points for surface because there is quite a range of varying conditions which we want to rate.

The point to remember is that a rating of 15, which is half the points off, would indicate a surface showing first signs of deterioration. Then all points above 15, from 15 to 30, are used to indicate increasing degrees of excellence. With a rating over 15, we still have a good pavement.

From 15 down to 10 indicates progressive deterioration, but that the surface is still usable. When the rating drops to 10, we consider the highway critical.

You could set these critical points at any figure you liked, depending on how you would decide to do it in your State. We used 10 to indicate the point at which we think

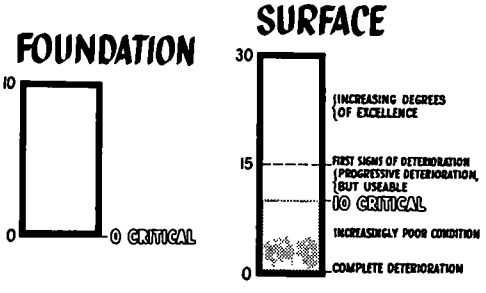
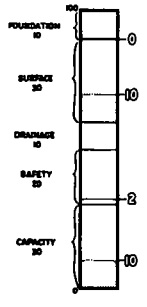


Figure 2.



A highway section meriting a rating of 100 should have a thoroughly sound structure, be free from those hazards which can be obviated by road design and have the capacity to handle satisfactorily the traffic generated by user demand.

Figure 1.

this surface has deteriorated to where something ought to be done about it. Ratings from 10 down to zero, which indicate complete deterioration, would show increasingly poor condition.

You will notice in Figure 3 that I bypassed drainage because we do not rate a highway critical on that basis. The drainage rating indicates only what work might have to be done.

Safety, however, is another item for which we would call a highway critical if we found certain conditions. We have not used accident records for this because our investigation of accident records would indicate that it seems as if most of the accidents are occurring on the best highways and under the best weather conditions.

What can be done to make a highway safer? Simply eliminate or remove all known hazardous conditions.

So we tally such items as stopping sight distances that are too short and horizontal curves too narrow for the designed speed of the roadway. For this we use assumed design criteria. We think a design should be good on a certain roadway for certain systems. Such things as a narrow roadway and dips can be removed by construction or improvement.

If we find no more than one in 10 miles, we will rate it at par, 20. You would not rate a 10-mile section critical because it had one hazardous condition. You would correct the spot, rather than rate the whole section critical. That is the way we would treat an isolated case. But when it gets to the situation where we find one or more of these critical conditions or hazardous conditions per mile, then the rating drops to two, and anything under two, of course, is critical.

There is a definite way of tallying by a formula that is simple arithmetic in determining that particular item.

For capacity (Fig. 3) we use 30 as par. This means capacity to carry

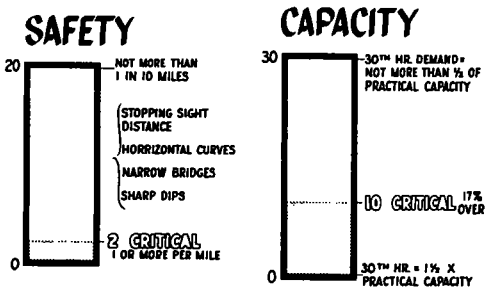


Figure 3.

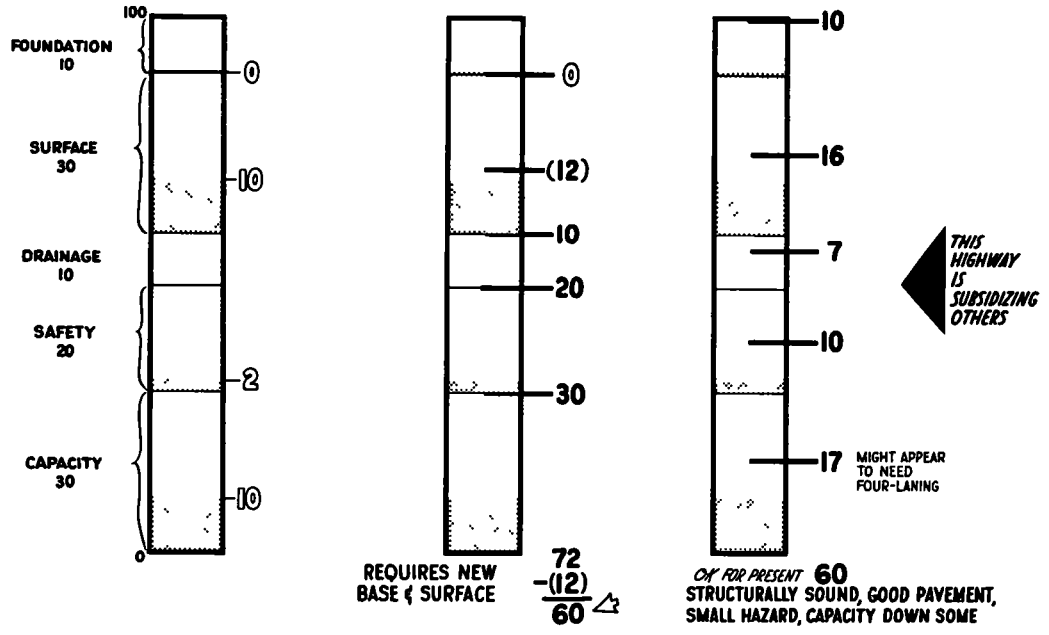


Figure 4.

vehicles under prevailing conditions and the types of vehicles that are using the highway.

If the 30th hour demand is not more than one-half of the practical capacity, the rating is 30 indicating no deficiency.

The rating goes down by use of a formula to the point where, when the 30th hour demand reaches 17 percent more than practical capacity, we rate it at 10, and it becomes a critical condition.

That 17 percent is not arbitrary; the 10 is and by coincidence came out 17 percent. That is getting to the point where some congestion begins.

Anything under 10, and down to zero at which point the 30th hour demand would be one and a half times the capacity, would indicate the point where the highway would really be choked up.

These are the points at which we would rate a highway critical. And if any one or more of these items show up as critical on a highway section, then it is rated as critical.

The bar on the right of Figure 4 is just a conventional one showing the critical points and what the items are. The hypothetical ratings are to explain certain points. I would like to explain how some of these things work.

The rating shown on the second column is for a highway on which the foundation is rated as being critical and the surface rated down to 12.

A rating of 15 is the point when distress begins. Twelve still indicates an acceptable surface. But we would reason from this that probably more money must be spent for maintenance on that highway than should be to keep it that good, under the condition that the foundation is not as satisfactory.

The drainage and safety ratings are satisfactory; capacity is up to par; but the highway is critical. When you add the ratings the total is 72.

I wanted to explain that, as in this case, if we have a foundation rating of zero, or a critical foundation rating, we do not add in the rating for the surface, because that surface can be no better than temporary, and it will be only a short time before it must be torn up, if it does not deteriorate by itself, in order to fix the foundation.

Therefore, from the rating of 72 we subtract the surface rating of 12 which leaves the total rating of 60 to show the critical section.

The next column shows simply that you can have the same rating, but on a highway that is not critical. In this case, the foundation is satisfactory, and there is an excellent surface with a rating of 16. The drainage rating is down a little. The safety rating is down to 10, which is not too good, but not critical. The capacity rating is down to 17.

A highway like this is the kind of which your commissioner will often say, "we ought to four-lane that highway right away. It is carrying a big load of traffic." It is, at least in the western region where we live, and it may be quite natural for them to think it requires four lanes.

But that is the very highway that should not make four lanes, because it is earning money which can be spent on another highway. It is one of the earners that helps to subsidize some of the roads that cannot support themselves.

It is a good highway with a good surface and it is not yet so over-crowded as to be deficient. We should leave it as it is and do nothing more to it until its capacity drops down below the critical point, and then make it four lanes.

The point is, of course, that both of those highways rated 60. One was critical, and the other was still a very good one.

The second bar of Figure 5 shows the rating on a portion of a highway that has a good foundation, but on which the surface is critical, deteriorated to the point that something should be done. The drainage rating is all right. The safety rating is down some. The capacity rating is up to par.

It might be inferred that this road needs to have something done to it, but probably we can get satisfactory service for a good many years, considering the capacity rating, if we should put a new surface on it, which is probably all it needs because it has a satisfactory foundation.

The next portion of a highway is rated 60. The foundation is all right. It has a good

surface. The drainage is all right and it is quite safe. There might be one or two hazardous conditions there that we should correct in spots but it is not critical.

But the capacity rating is critical. It is carrying too heavy a load of traffic, with too many vehicles trying to use it. So this road which is in very good condition otherwise, is the road that we need to make four lanes because of the need for more capacity.

The last bar (Fig. 5) is the rating on a section of highway which shows a critical foundation, a critical surface, drainage rating down some, and the safety rating is critical. The capacity rating is satisfactory, but there are so many things wrong with that road that really complete reconstruction is needed.

These illustrations show some of the things that can be deduced from this rating method. And as a matter of fact, I was difficult to convince on the merits of sufficiency ratings and did not think much of them for a long time, because they did not appear to do what we wanted a rating to do. Basically we wanted to know what sections were critical. We also wanted to have a good indication in detail of what was wrong with them, and something that would give us an approximate idea of what had to be done to correct that situation. Along with that we wanted a system that, like all of the other ratings, would give us an indication of the over-all progress on the system.

This rating is added to a basic rating, and then adjusted according to the deviation from the average traffic for the system, just as is done by almost all the other ratings (Fig. 6).

For our commissioners, it was important to be able to point out that if we had three highways, each with a basic rating of 60, and the average daily traffic on one was 400 and on another 1,400 and on a third 5,000, by this method of adjustment the rating of the one that carried the heavy volume of traffic was cut down, so that in the priority list it would be raised to 51, where the one that is on the average remains at 60 and the one with the lesser volume would be raised to 68; thus giving preference to the one where work does the most good for the most people.

Whether that is a sufficient adjustment for the purpose is debatable but at least it does give preference to the highway that serves the most people.

The reason we developed this method (Fig. 7) is that first we used to put out tables that listed all of the critical sections in ascending order of their adjusted rating forming

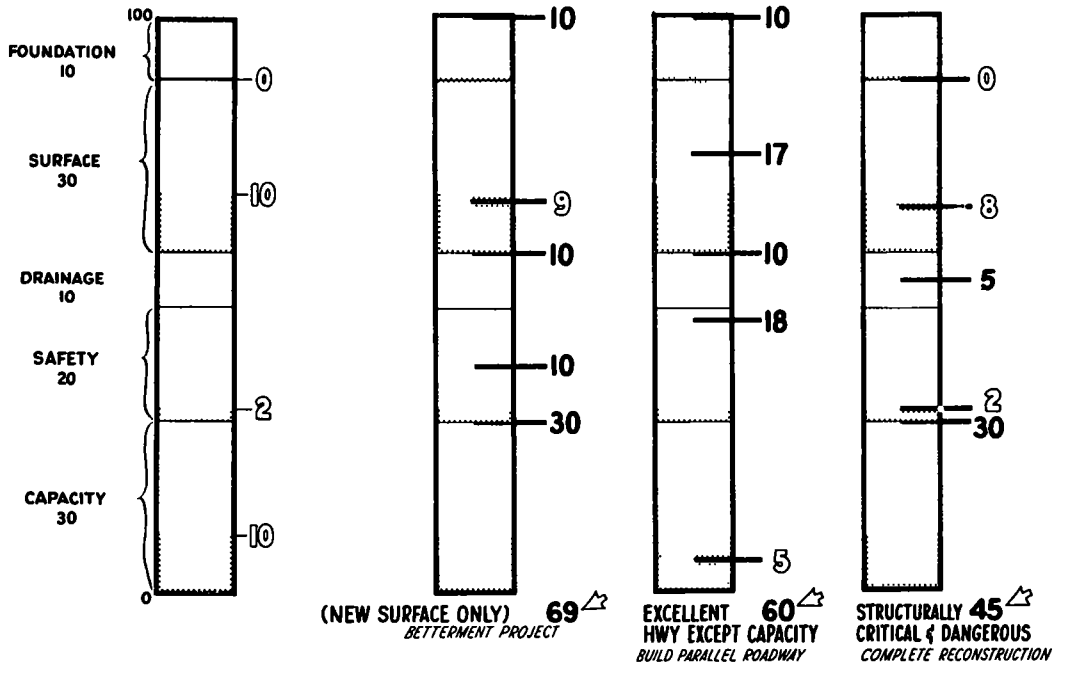
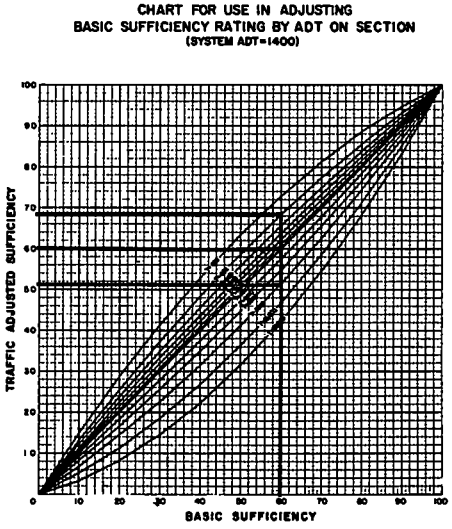


Figure 5.



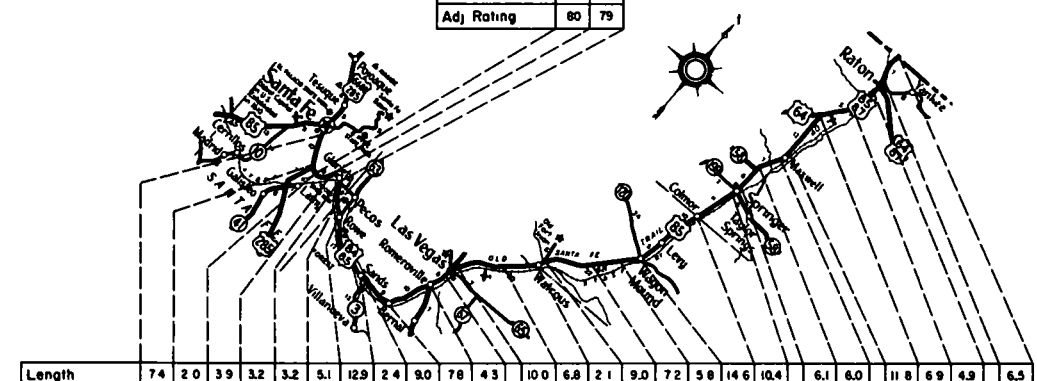
BASIC RATING	AVERAGE DAILY TRAFFIC	ADJUSTED RATING
60	400	68
60	1400	60
60	5000	51

Figure 6.

N M. STATE HIGHWAY DEPARTMENT
PLANNING DIVISION

SUFFICIENCY RATINGS ON PRIMARY SYSTEM 1959

Length	3.9	3.2
Surface & Shoulder Width	24 36	24 36
ADT 1958	1945	1910
Foundation & Suface	10 13	10 21
Safety	16	6
Capacity	30	30
Adj Rating	80	79



Length	7.4	2.0	3.9	3.2	3.2	5.1	12.9	2.4	9.0	7.8	4.3		10.0	6.8	2.1	9.0	7.2	5.8	14.6	10.4		6.1	6.0		11.8	6.9	4.9		6.5
Surface & Shoulder Width	22 40	22 36	24 36	24 36	24 36	22 30	24 36	24 28	24 28	24 28	24 32			24 32	24 28	24 26	24 32	24 32	24 32	24 32		24 36	24 36		24 36	24 36	24 36		36 38
ADT 1958	3200	1945	1945	1910	1577	1430	1477	1461	1486	1518	2600		2400	1210	1239	1109	1140	1153	1041	1042		1505	1152		1151	1672	1940		2573
Foundation & Suface	10 12	10 13	10 13	10 23	10 [illegible]	10 [illegible]	10 21	10 20	10 20	10 20	10 12	Urban	Under Constr.	9 [illegible]	10 11	10 23	9 [illegible]	10 17	10 17	10 17	Urban	10 14	10 13	Urban	10 13	10 18	10 16	Urban	10 11
Safety	4	[illegible]	16	6	3	10	6	[illegible]	[illegible]	[illegible]	3			7	[illegible]	[illegible]	3	5	4	4		12	3		12	9	5		7
Capacity	7	22	30	30	30	30	29	27	23	23	25			30	30	30	30	30	30	30		30	30		30	30	30		27
Adj Rating	42	59	80	80	67	74	79	73	69	69	60			53	66	79	49	77	76	76		79	71		79	79	73		65

LEGEND
. CRITICALLY DEFICIENT
* ADT REPRESENTS TRAFFIC IN BOTH DIRECTIONS ON DIVIDED HIGHWAY

FAP ROUTE 1
(INTERSTATE 25)

Figure 7.

not exactly a priority list, but a list from which a priority list can be made. The list does show the relative urgency of the various critical sections; but it is too difficult to find where these routes are. We also made a table that listed everything as it occurred chronologically along the route.

Figure 7 shows the length of the system, the surface width, the shoulder width, the ADT for the appropriate year, foundation service rating, safety rating, capacity, and adjusted rating. It shows in the shaded area which ones are critical and what about the section is critical, so that you get an idea of the continuity of the whole route.

The principal thing that we objected to about the use of some of the other rating methods was the idea of listing everything and then cutting it off at a certain level. Too

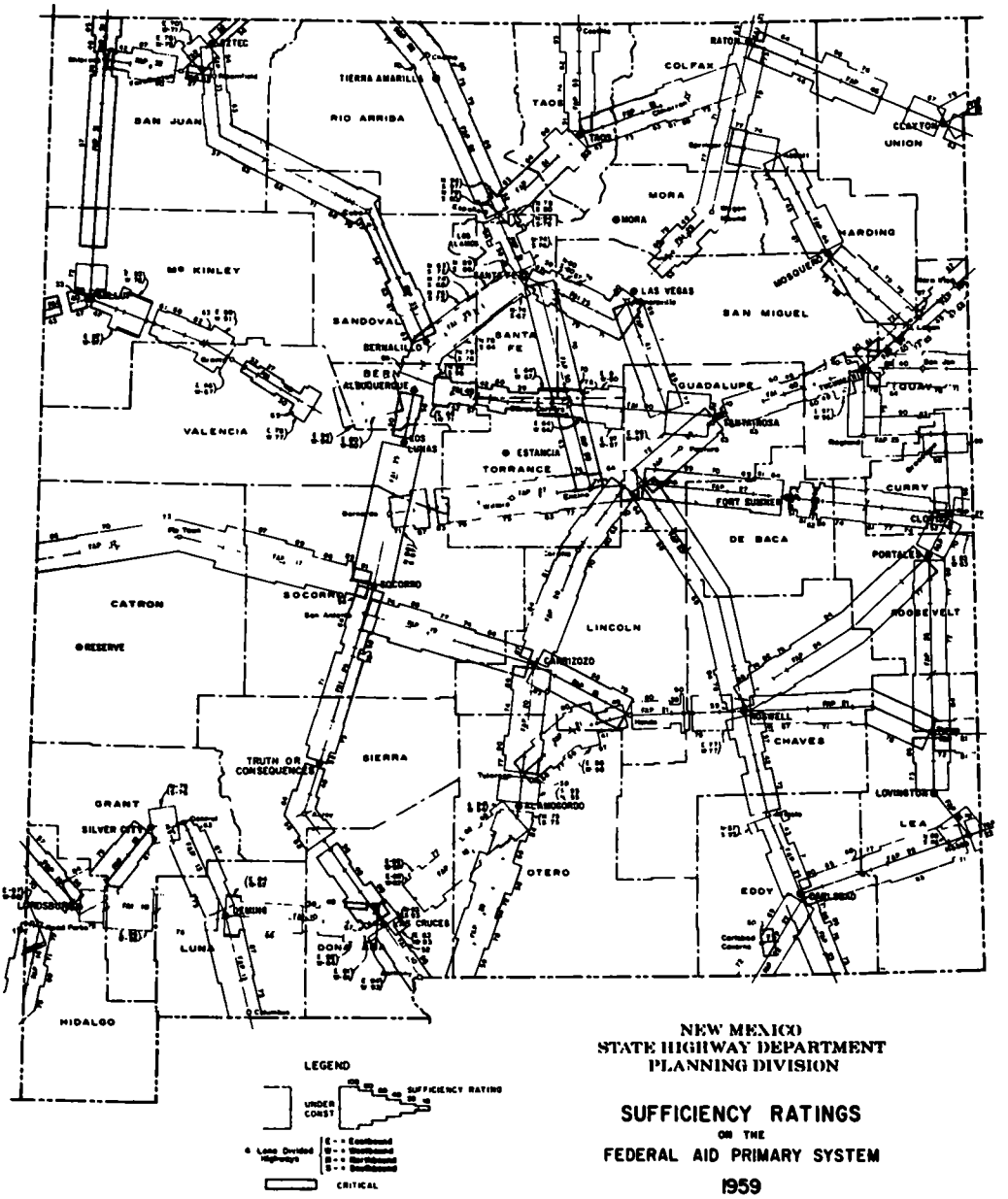


Figure 8.

many of the items that were listed under the cut-off line were tolerable and too many above the line actually had to have something done to them immediately.

So rather than put out a map (Fig. 8) that shows the ratings, Figure 7 actually shows the ratings in a shaded area for every section on the primary system that is critical. This gives us some idea of the continuity and what mileage of the various systems we still have to contend with. I believe what I have shown covers essentially what we are doing.

Babcock.—Do I understand that a road in perfect structural condition with a perfect surface, foundation, drainage, and everything else, because it was working at capacity all day long would have a rating of 70?

Wiley.—Yes.

Babcock.—It would be my impression that that ought to have a rating of zero.

Wiley.—No; because that is one of the things that would be wrong if we did it the other way; but that zero on capacity makes that road critical. The fact that the capacity rating is down to zero tells us that this is critical, and why.

Babcock.—But you also could have a section that would be critical because of its foundation.

Wiley.—That is true.

Babcock.—Which would be the more important of the two? A road with no traffic or a road that is operating at possible capacity?

Wiley.—If the road has no traffic, it is going to get quite an adjustment on the balloon chart.

Babcock.—I did not understand how you adjusted the road operating at practically full capacity for volume.

Wiley.—There is another point I wanted to make. The comparison of two different volumes is adjusted on a balloon chart. You asked which one is the most important. We would gauge that insofar as it had been measured by the rating, by the total adjusted rating.

In other words, a rating on one of them might be as low as 50, while the rating of another one might be around 60 to 70. And the one that has the lowest rating, of course, is the most important.

I am not so naive as to think that you can take such a rating and use it as a priority list; but it certainly gives you a lot of information to start with, and it helps in explaining to the public.

We have had people come in from over the State with questions as to why we do not do this on that road or another road. You can read right out of the rating tabulation to show exactly what condition that road is in. It amazes them that we know that much about the road.

Hall.—Do you use today's traffic for the design hour traffic, or forecasted traffic? And if so, why?

Wiley.—For the design hour traffic we are using today's, because we are using the traffic on the road as required for today. When we find it critical, and program it, then we project it to what we expect to have 20 years hence.

Kimley.—Can't your factors in safety be reflected in your capacity?

Wiley.—Well, of course, widths have something to do with capacity; but I think these hazardous conditions, such as vertical curves and too sharp horizontal curves, too narrow bridges, and dips, are not so much a capacity consideration as they are a safety consideration.

There is another thing we attempted to do. We tried to eliminate, as much as we could all those things that might be overlapping. You may be right to a certain extent. But some of the ratings that we studied seemed to have the same thing reflected in maybe three or four different items. We tried to eliminate that as much as we could.

I did not devise this; but I think it is good, and it has been useful to us.

Session Four

Tuesday, September 20, 1960, at 9:00 A.M.

SCHEDULING LETTING DATES FOR SPECIFIC PROJECTS

JAMES O. GRANUM, Presiding

Coordinating the Highway Construction Schedule With All Agencies Concerned

JOHN A. SWANSON

Rural highways were of primary importance in the first half of the 20th Century. Most highway projects were in relatively open and undeveloped areas involving only occasional conflicts with other agencies or interests. Only infrequently did instances arise that required coordination with outside groups.

Another characteristic of this period was that most highway improvements were on existing locations and consisted chiefly of widening, resurfacing, and straightening. Complete relocations were few and far between; the controlled-access highway was still a relatively new idea.

At the beginning of the 1950's, the principal change in the over-all highway program nationally was that attention began to shift from the country to the city. Also, with the passage of the 1956 Federal-Aid Highway Act the tempo of highway activity increased, with dramatic attention being given to construction on new locations and to controlled-access highways.

With these changes, most highway agencies found themselves confronted with tremendous problems of coordination. Conflicts with cities, with public utilities, and with home owners brought new and complex problems for the highway departments to solve. In many instances highway agencies were not too accustomed to working with cities and the utility companies. Furthermore, they did not fully appreciate each other's problems and methods of operation. The lack of mutual understanding coupled with imperfect machinery for coordination brought delay and, at times, complete halt to highway construction schedules.

The purpose of this paper is to describe the nature of some of these problems of coordination, and to discuss some ideas for their solution. Setting up advance contract letting schedules without regard to the coordination that needs to be achieved with all agencies concerned is like calculating the path of a projectile to the moon without considering the effects of air friction and the varying effects of gravity. It simply will not work.

COORDINATION WITH COUNTIES AND CITIES

Highway agencies have encountered considerable difficulty in the past decade in winning the support of counties and particularly local communities for expressway location, design, and construction. Here is where the old concept that a highway agency can complete its highway design before attempting coordination with other agencies must be completely abandoned. As a matter of fact, in the case of local communities, even the word

"coordination" is no longer appropriate. It is becoming clearer each day that community master plans and expressway plans are so interdependent that coordination in the form of only occasional contacts between the local city planners and the highway planners is inadequate to produce a master plan and a highway plan that are in harmony with each other. Instead of thinking in terms of "coordination," we should be thinking in terms of "integration."

This point may seem somewhat removed from the problem of formulating highway construction schedules. Yet is not this the root of many of our urban problems—construction schedules broken down through opposition from local officials and the community itself? This is no simple problem, and a great deal more know-how is needed before we have the tools we need to master fully this challenge. The point to be made, however, is that the local communities should be brought into construction scheduling and planning at earlier stages than they generally have in the past. It is in these early stages when neglect of the community or lack of full consideration for its legitimate concerns can plant the seeds for future problems that can tear any construction schedule to shreds.

The fact that practical difficulties of integrated planning in urban areas are numerous and complex should not divert us from recognizing that this integrated planning is the only fully satisfactory approach. Many highway departments and cities today are attacking the problem frontally and cooperatively by creating metropolitan area transportation committees in which all agencies concerned participate actively toward a common solution. Not only is the best over-all plan most likely to result, but the local support that comes from this approach creates a firm foundation for a dependable future construction schedule.

COORDINATION WITH URBAN RENEWAL

Another area where integrated planning with city officials is imperative occurs when proposed highway improvements run through or near urban renewal projects. It is here where perhaps the greatest benefits of all can be achieved through joint effort, both in terms of benefits to the city as well as to our highway interests. Surely, the outstanding success that has thus far been achieved in a number of cities through joint planning of urban renewal and highways will cause many more projects of this type to be undertaken in the future.

An urban renewal project capitalizes on the potential value created by a new expressway in the areas abutting the expressway. Such areas are redeveloped into higher and more attractive uses which bring important benefits to the city in place of formerly substandard areas. A renewal project also usually provides for parking areas near the expressway ramps as well as major physical street adjustments to tie in with the expressway. The long term benefits of such actions are great, both to the city and to drivers. In addition to this, the expressway—a major gateway into the city—will pass through a modern attractive area instead of slums and deteriorating commercial and industrial districts which may have existed before renewal.

In addition to the general benefits mentioned above, cooperative efforts of this type generally bring savings in rights-of-way costs both to the highway department and the urban renewal agency through the elimination of "partial takes." Also, joint effort in relocation of families and in public relation activities greatly simplifies these responsibilities for the highway department.

To achieve such benefits early coordination between the urban renewal and highway agencies must be established. Coordination must be achieved in the development of physical plans, in scheduling and timing all phases of both projects, and in field operating problems such as right-of-way acquisition and certain interlocking construction work.

Although the complexities and problems of coordination between urban renewal and new highways are not simple, the rewards are such that they deserve all the effort required to solve them. The primary requirement is for coordinated planning as much as three to four years in advance of the construction date. None of the problems are insurmountable, but, as in any coordinated project of such magnitude, there are numerous

complications which must be anticipated and provided for if the over-all schedule is to move according to plan.

COORDINATION WITH PUBLIC HEARINGS

The support of both the community and local officials that generally comes from integrated planning gives a highway agency a considerable advantage at public hearings. The Federal-Aid Highway Act specifies that a public hearing must be held and the economic effects of the proposal considered by the state highway department before any final decision as to the location is made and before any rights-of-way are acquired.

Many states differ as to the exact stage in the development of a project that a public hearing should be held. The time to hold the hearing is when the project is still flexible in order that adjustments can be made if information brought out at the hearing should justify.

The reaction to a project at the public hearing will generally affect the construction schedule in some way. Vigorous opposition may require the construction to be deferred. Conversely, enthusiastic support may permit early construction. It is helpful if a state can have some indication well in advance of the hearing concerning public reaction to a proposed project. With such advance information it is possible to meet legitimate criticisms before the hearing.

Close and continuous integrated planning with the community will go a long way in averting opposition. In addition, an alert public relations program from the earliest stages of the project can increase public support and hold misconceptions to a minimum. Particularly successful are meetings with small interested groups, such as chambers of commerce, civic clubs, and affected home owners, to explain the project in detail and provide a forum for amicable discussion. It is much easier to head off unfounded opposition before it becomes organized and committed rather than after it has gained momentum.

Another strong reason for early meetings with all interested groups prior to the public hearing is that the state itself may find it desirable to make adjustments which will result in greater benefit and service to the community without sacrifice to the highway project as such.

COORDINATION WITH RIGHTS-OF-WAY

Once the public hearing has been held and the state has considered the information presented at the hearing, the final highway location can be established and detailed design started. As soon as design has progressed to a point where it is possible to fix the approximate rights-of-way limits, the machinery leading to the acquisition of rights-of-way can be put into motion. A close working relationship between the design division and the rights-of-way division is essential to produce the maximum lead time for property acquisition.

Where a tight construction schedule exists, it is desirable to begin certain rights-of-way activities in the early design stages. Title searching can begin and taking maps prepared. The acquisition of "total takes" generally can also be started. The acquisition of "partial takes," on the other hand, must usually await completion of design since even minor design adjustments may affect the extent of the taking as well as the extent of damages.

The keys to successful rights-of-way acquisition are a close working relationship between the rights-of-way and design divisions, and an adequate lead time for acquisition.

If the completion of design, including all requisite approvals, is not kept to a fixed pre-determined schedule, the rights-of-way division can find itself in a "squeeze-play." That is, when the design plans are not completed on schedule, the rights-of-way division becomes sandwiched between a late starting date and a fixed contract advertising date. Since resistance is usually strong to changing a publicized advertising date, the rights-of-way division all too frequently become involved in a desperate race to meet that date. This not only tends to upset its other work schedules, it also interferes with the orderly procedures that are requisite to efficient operations and good public relations. A home owner should be given the maximum time possible to relocate. An over-pressured ac-

quisition schedule causes inconvenience and hardship to property owners, and creates bad feeling between the public and the highway agency.

COORDINATION WITH UTILITIES

Utility relocations represent another area which frequently disrupts construction schedules, particularly in recent years with the accelerated highway program and the increased work in built-up areas.

Inadequately coordinated utility relocations can easily delay an advertising schedule. They can also prevent the contractor from prosecuting his work with dispatch and add greatly to the cost of the project.

W. A. Bugge lists ("American Highways," July 1960) four important elements a utility must consider in setting up construction schedules: (a) Deployment of engineering manpower, (b) acquisition of right-of-way (utilities do not have the right of immediate possession), (c) need for special material which may require special ordering and (d) the problem of money. These elements must be recognized by a state highway department in coordinating construction schedules with a utility. Bugge then suggests that utilities could improve coordination with the state highway department by more thoroughly familiarizing themselves with legal requirements in each state and setting up a highway organization within their own administrative setup to work closely with the highway departments on highway development.

To date, many of the problems of coordinating utility relocations with highway construction have come from a lack of understanding of mutual problems by highway and utility agencies, and also from insufficient working liaison between the two.

In many states joint committees are being established comprised of representatives from the highway department, contractor associations, and the utilities. Such committees provide an excellent forum for the discussion of common problems and for the formulation of joint policies directed toward their solution.

There are a number of practices that have been found helpful in coordinating utility work and keeping the construction program on schedule. In some states the highway department in the early planning stages informs utility companies about the locations being considered and the tentative long-range schedule for the project. The utility company in turn apprises the highway agency of the effects of each of the alternate highway lines on its facilities or on its future plans for utility expansion.

In later stages, the highway agency sends the utility companies a map showing the approximate centerline and right-of-way limits as soon as a particular highway location becomes fixed. From this point onward a close liaison between the highway designers and utility engineers is established to permit consultation on mutual problems as the design progresses. During design consultation, arrangements can be made for the scheduling of utility relocation work to minimize interference with the highway work. In particular, arrangements should be made to complete all possible utility relocations in advance of the highway construction.

As soon as the contract is awarded, an on-site conference should be held with representatives from the contractor, the utility companies, and the highway agency to discuss scheduling of the utility work which must be done during the highway construction. At this time friendly liaison can be established between the field forces involved.

Another practice that has been found helpful is for both the highway agency and the utility companies to have a single individual in each agency to clear all highway-utility information and problems.

This will avoid the difficulty often encountered when engineers from either side must go from one office to another to find the right man to furnish them certain information or help with a problem. Many state highway departments have created the position of utilities engineer to serve this purpose. There are also many advantages in having a utilities engineer permanently assigned to each district. This is often the best way to create friendly working relationships with local utilities foremen that can aid appreciably in solving unanticipated problems.

These procedures will go a long way toward preventing many of the difficulties that have been encountered in coordinating utility and highway work. Vast strides are being

made in all the states in implementing utilities procedures. As a consequence, coordination of utility relocation with highway projects in the future should improve a great deal. This will mean not only better relations, but lower costs and less disruption of highway construction schedules.

COORDINATION WITH CONTRACTORS

The early planning that must be done by highway agencies, local governments, rights-of-way personnel, and utility companies in preparing to meet a highway construction schedule has been discussed. Too often it is assumed that the contractor may be excepted from this concept, that his interest begins only as the date of advertising approaches. Actually this is not the case. Early project information as well as a particular seasonal pattern of advertising can be most helpful to a contractor with beneficial results to the highway department.

A one-year advance advertising schedule will permit the contractor to select for bidding those jobs he can do most efficiently. It will also allow him to compete for a series of jobs that will make possible the most advantageous scheduling of his men and equipment over an extended period of time. This will encourage lower bidding as well as more efficient operations in meeting the construction schedule.

To serve a contractor advantageously, an advance advertising schedule must be dependable. If a contractor cannot rely on the sequence of advertising as shown on the advance schedule, he may be then forced to compete for remote jobs to insure keeping his forces employed. He will refrain from early and extensive searches for materials and supplies, and will be discouraged from advance equipment planning.

In addition to an advance one-year schedule, many contractors prefer that advertising be spread out over the entire year with peaks in the fall and early spring. When project advertising is spread out to some extent throughout the year a contractor is in a better position to give each job more careful analysis before preparing the bid. This might not be possible if a large number of projects had to be bid on at once. On the other hand, advertising peaks in the fall and early spring insure that in states with limited construction seasons the early part of the construction season will not be wasted. In the snow-belt, advertising should be minimized during the winter months when a blanket of snow can prevent a proper field inspection of the job.

An advertising schedule that gives consideration to contractors' problems will put contractors in the most favorable position to meet the construction schedule with the lowest cost to the public.

It has not been possible to include other agencies with whom coordination should also be achieved. These might include Federal agencies such as the Bureau of Public Roads and the Corps of Engineers, as well as other state agencies such as flood commissions, park commissions, and state development commissions. The primary focus here has been on outlining some of the chief problem areas that now exist.

In conclusion, regardless of the agency with which coordination must be achieved, the best solution is early planning. This means appraising the problems of the future and taking steps beforehand toward their solution. This can be achieved through better understanding of mutual problems by all agencies, and through the establishment of working relationships that lead to their solution.

Discussion

Houston.—Swanson has mentioned briefly coordination of highway problems with rights-of-way and the utilities. I think it is pertinent to "scheduling letting dates" because you have to consider all facets that feed into it.

In my spare time I have been National Chairman of the American Right-of-Way Association, which was originated by Frank Balfour 26 years ago in California.

We are interested in right-of-way matters, whether they are the concern of the highway department, utilities, (regulated or unregulated), pipeline companies, railroads, flood control projects, or water companies—both public and private: in other words,

right-of-way affairs in the whole gamut of public, quasi-public, and private organizations.

The Association is a non-political and educational organization. We are striving to do a good job in connection with the highway program, particularly the 1956 Federal-aid Highway Act.

Relocation of all kinds of utilities for highway work involved only one percent—a very small item—of the construction budget of the utilities prior to the 1956 Act. There are over 3.2 million miles of utility networks on, under and over the surface of the United States. The Interstate System alone, 41,000 miles, superimposed on that utility network, creates a potential conflict everywhere. I have found a lot of discussion that does not provide for good public relations between highways and utilities. I think, as Swanson pointed out, that there is a lot of misunderstanding, which we are seeking to eliminate.

In the fourth annual seminar of the American Right-of-Way Association, held in San Francisco, I moderated a panel entitled "The Advantages of Advance Planning, Cooperation, and Coordination Between Highways, Utilities, and Other Affected Agencies." On that panel were George Williams, Deputy Chief Engineer of the Bureau of Public Roads; A. E. Johnson, Executive Secretary of AASHO; Richard Taylor, Director of Right-of-Way and Real Estate for the Detroit Edison Company; Fred Crane, Superintendent of Right-of-Way for the Sinclair Pipeline Company; and a small independent telephone company man, Allen Stacy, with the Sunland-Tujunga Telephone Company in California.

The conclusion was that there was a definite need for coordination between highways and the utilities. For years everybody had been talking about it, but no one actually was doing anything on a concerted basis. We presented that situation to the 44th annual meeting of AASHO before the Legal Affairs and Right-of-way Committee, pleading, as a result of the resolution of the American Right-of-Way Association, that this was a desirable procedure, and that we would work with any like-minded organization to attempt to get the utilities and the highways together on this problem of coordination of planning.

Highway-related construction budgets for the utilities have increased. Lang told you yesterday that in three states and the District of Columbia the Chesapeake and Potomac Telephone Co. alone sets aside approximately $5 million annually. We do not know exactly how it is going to be spent, but it is the only way we could protect ourselves and try to keep in good faith with the highway departments when it was necessary to move our utilities.

I do not think that this is quite fair, because actually we do not have enough lead time to do the engineering or to get the material.

The particular subject in the past which has led to most misunderstanding was the justice or injustice of reimbursement. Now, we pitched that right out the window. I am no attorney, but I do not believe litigation makes you any friends at all.

All the American Right-of-Way Association is saying is: Let's let reimbursement stand aside, and let's discuss with you, if you will, through your organizations, advance planning, cooperation, and coordination. In our 33 chapters, covering all but four states in the United States, we have 300 men that have been appointed for the single purpose of liaison.

AASHO, in its December meeting, appointed DeWitt Greer with ten colleagues to formulate, encourage, and stimulate similar arrangements in the various highway departments of the United States. Greer sent a letter out on February 5, 1960.

On the utility side, we have a large problem. There are 50 of you people in the State organizations, plus one in the District of Columbia.

There are 30,000 utilities that we are trying to help in this program. Our means of communication with them has to be arranged through the national utility bodies, the American Gas Association, the American Petroleum Institute, the American Water Works Association, Edison Electrical Institute, The United States Independent Telephone Association.

There are 4,600 independent telephone companies in this United States. And there is the AT & T. We have contacted all of those organizations on this program, and they are helping us through their committees by having their associates in the States coordinate with us.

The machinery is set up. The American Right-of-Way Association does not ask any-

one to belong to it. All it asks for is workers who may join with our local chapter committees simply to coordinate with the State.

For example, in Maryland John Funk, Director of Highways, called a meeting of all the utilities. We brought the city engineers, the county engineers, and the utility engineers into that meeting. Now all 80 of them have written to Funk and have indicated to him what kind of advance procedures should be set up to coordinate problems with the State.

Funk is now analyzing those suggestions and they are going to set up procedures in Maryland to give at least six months' lead time—something we have not had in the past in Maryland. That is a good beginning. California has had liaison for years.

I am pressing this matter because it is going to help in your public relations, and in connection with your public hearings, because the utilities are serving the public.

We would appreciate it if you would remember that there is an agency, the American Right-of-Way Association, in your State that is ready to help, and the utility people are ready and willing to cooperate.

I am not saying everything is going to work smoothly, but we are learning.

Aitken.—I received a letter from the telephone company recently, asking me to give them more advice and more time lead on some of our major projects. Well, in the best of regulated families, you tell people to do things, but they do not do them. So I am taking Houston's suggestion. I think I am going to pin one man with the job of keeping in touch with the telephone company, because we have projects here where the company gets hit with a construction bill of half a million dollars or more. Moreover, they have the same problem that we do in terms of scheduling, in that they must maintain their telephone traffic, and we must maintain highway traffic.

Granum.—In two days, we are attempting to explore many problems concerning the formulation of construction programs, and certainly coordination of all agencies is an important problem. Threading through all of these discussions is the need for lead time—advance time.

Swanson emphasized, for example, that the contractors, as well as others, would like to have at least a one-year advance advertising schedule. I think the theme of his paper is teamwork, both inside the highway departments (State, county, and city) and with others that are concerned.

I think Swanson's paper emphasized the coordination necessary—once a decision had been made to proceed with something. In the early part of his paper, there is a fairly strong implication of the need for coordinated teamwork in reaching those decisions, too.

My question is: What do you see as necessary, among both public and private agencies, in order to arrive at the decision to proceed with a specific project? How far ahead do you think such a decision should be reached in order to allow lead time for carrying out all the coordinated activities essential to getting the project under way?

Swanson.—More specifically, I was thinking of the need for the State getting in at the early stages in cooperative planning and thinking with city and metropolitan area officials; because from the time a project is first conceived until it is finished can take many, many years. I think if we get in and work the way we should and cooperate and coordinate our work, we can cut that time down considerably.

In the New York Times yesterday there was an editorial referring to the Manhattan Island expressway. It was first approved by the city planning commission, as far as the major arterial plan was concerned, in 1941, and it was just last week that the board of estimate gave approval to that route.

Twenty years is a long time. I do not know if it could be cut down in New York City, particularly, but certainly in many urban areas, with good regional and city planning work between the cities and the State highway departments, we could cut down our planning schedules, and I am firmly convinced that a great deal needs to be done in that field.

Granum.—Would you say that there should be more initiation on the part of local agencies of government? In other words, should a city or a county precede the State and initiate some of these studies? I think this has been done generally in the New York City area.

Swanson.—We all subscribe to the principles set forth in the Sagamore Conference. It outlined six or seven things for the States to do, and four or five for the cities. If we accomplish those, I think that is the way it should be done.

Granum.—Hall, where do you think this initiative should arise basically?

Hall.—We are always biased by our own experiences. In San Diego, the city took the initiative to form a technical coordinating committee composed of the planners and engineers of all the cities in the metropolitan area, the county, the State Division of Highways, the San Diego transit private enterprise, urban renewal officials and traffic police, keeping in mind that after we get through building the facilities, somebody has to operate them, and it might be nice to have the police know the concepts of planning that went into the systems, both freeway and major street. We had legal personnel there, too, to keep us out of trouble and advise about problems such as Houston has discussed. This committee was organized in 1955 and met monthly until recently, and then it shifted to a bi-monthly schedule.

In connection with the California SCR 26 and SCR 62 studies, both of which John Legarra described, identical maps were submitted by each of the independent cities and counties to the local district office of the State Division of Highways. The Division accepted these as the area-wide plan.

In other words, we were all together. And it had been done by working together over a period of years.

In Phoenix, about four years ago, there was organized a Phoenix-Maricopa County Traffic Coordinating Committee, including the Bureau of Public Roads, Arizona Highway Department, County of Maricopa, and City of Phoenix. The initial purpose of that committee was to develop a general transportation plan. A private consulting firm was hired and on March 10, 1960, presented such a plan.

Last week, resolutions were drafted which, if adopted by the State Highway Commission, the County of Maricopa, and the City of Phoenix, will adopt legally the identical maps of a master highway plan for the area.

They have not yet, for some reason, invited in the other 13 cities in the metropolitan area. We are taking immediate action to extend that invitation to all of the cities to become a partner in this effort, because the system of highways and streets surely affects all cities.

I think these are two illustrations where the central city of an area has taken the initiative and the lead, in both cases with strong county and State support.

Granum.—Do the master plans, either in San Diego or in Phoenix, carry through to the development of a tentative construction schedule?

Hall.—In San Diego, the coordinating committee was a technical advisory group, non-policy making, because you cannot make decisions in committees of 20 or 30 people. But because the people were brought together, we had informal offshoots, where the State or the county or the city or little groups would get together and talk about these things; and then, of course, in the final decision-making, it gets down to the specific jurisdictions involved.

I think the coordinating committee idea provides a common meeting ground. In the San Diego operation, and I am sure it will be the same in Phoenix, you do not make detail programs. However, this leads to announcement of such things as joint city-county-State programs, such as were just written up in the California Highway Magazine, on the joint city-county-State projects on US 80, the Mission Valley Road, which is a rather tremendous coordinated effort. But the meeting ground is established, and people talk to each other. I think this is the clue. Communications are established.

Granum.—I have the impression that in North Carolina a different approach is being developed, through the Highway Department in terms of the State initiating planning and helping the cities.

Babcock.—Yes, the State Highway Department has quite a bit of responsibility in the cities. On the North Carolina State highway system we have the bulk of the major thoroughfares—roughly 25 percent of all the city streets.

The State enacted legislation in 1959 that says the basis for any highway improvement within an incorporated municipality shall be a mutually adopted thoroughfare plan, accepted both by the city and the State Highway Commission. This thoroughfare plan must be based upon a 20-year potential land development plan for the area. Once mutually adopted, the city and the State will jointly determine, on the basis of that thoroughfare plan, which streets are the State's responsibilities within the concept of the law, and which are the city's responsibilities. When we go from that, we have also adopted priorities in general, though this is not a commitment of the Commission.

Kimley has 55 such thoroughfare plans under way. In two years we have had about 20 adopted. They vary from cities of 5,000 to cities of 250,000.

The State has its own planning staff. In the smaller towns we do the work in cooperation with them. For larger towns, we will share 50-50 in land development plans, with the Federal Government paying part of this out of HPS funds, which is a help. Sometimes we use consultants. We use the land development plan as the strict basis for any urban highway improvement, which must be part of a well thought out master thoroughfare plan which, in turn, is part of an over-all master plan for a city.

We will not accept a schematic plan for highways which attempts to dictate what the over-all development of the cities shall be. It has to be within the framework of what we call an over-all master plan.

W. Johnson.—With respect to urban redevelopment plans, in three rather large urban areas in Kansas there are coordinating committees similar to those described by Hall.

Through the City of Topeka, the Interstate route is going through an urban redevelopment area. The county, contemplating the construction of a new court house, decided to locate that court house near the fairly new city auditorium and city building in developing a civic center. The county and city proposed to use some right-of-way the State had intended to use for the Interstate System.

Now it is working out, through cooperation between the city, county, State and the Bureau of Public Roads, that the city and county are going to acquire a portion of this right-of-way for the construction of a parking garage, and build a retaining wall adjacent to the Interstate construction; of course, no access to the Interstate System.

This is an example of cooperation that can be developed if everyone is interested.

Babcock.—Swanson, what is your experience as to the detail in public hearings that gives the best possible result? This is a very difficult question for all of us.

For example, you go to public hearings with an actual 200-ft scale topographic map, in which the details of all the interchanges are shown. Would that be conducive to good results in congested areas in the northeast?

Swanson.—We have had better luck when interchanges are shown just as circles on the map, rather than getting down to specifics. If you show details, immediately you are accused of having a preconceived idea of what you want to do, and are not subject to change. But if you go in with the kind of route location reports a consulting engineer generally provides for preliminary study, then you certainly are not guilty of that charge. Generally, we have gone into public hearings with route locations, rather than very detailed studies.

Referring to improving understanding between the Bureau of Public Roads and the State highway departments, I think Connecticut has done a very fine thing. They have a weekly staff meeting which the BPR division engineer has been invited to attend. They discuss, for example: Why is BPR holding up this or that? The BPR division engineer may say: "Well, such-and-such a person in your department is not giving me the information I need." Such meetings expedite the whole planning operation, eliminate misunderstandings and make the program move.

Aitken.—If any of you want to follow a project through a difficult course in terms of broad and more specific planning, and finally see it carried through to construction, come around. I will show you a maze that will shock you.

The District of Columbia is fortunate in that some years ago the Congress established the National Capital Planning Commission. Anything we do in Washington must be done correctly, because it is the nation's capital, and I think it cannot be done too well.

We have had some differences because of the old business of, "Where does planning end, and where does design begin?", but we have maintained contact, despite difficulties.

We are also fortunate that during the last four or five years a study has been under way and was completed last year for a proposed metropolitan area transportation system here in Washington. The study includes a combination of freeways, normal streets, and some subways. During the past session of Congress, legislation was enacted to create a transportation agency, which is supposed to develop a total transport program.

Now, again, it is a play on words as to what is meant between planning and programing. And perhaps there may be a question as to what this agency is to do in its final terms.

Then, after all the planning agencies and the District highway department agree on something that can be done, we go to the Fine Arts Commission. Although the general transportation plan that came out last year was adopted by everyone, because all the agencies had participants, the Fine Arts Commission has never adopted the plan, because they are against the idea of freeways in Washington. Therefore, when we take our plans to the Fine Arts Commission for comment and advice, we get advice on esthetics and then condemnation because we even think about freeways in Washington.

So it is a lot of fun. But once in a while we get a project advertised.

The Role of Time and Money as Related to Construction Schedules

WILLIAM B. BIDELL

Many highway and road building jurisdictions, not many years ago, would award a contract on relatively short notice without having prepared all the necessary pre-contract engineering requirements which would insure reasonable bids and a proper job. Indeed in some cases the line was being set and right-of-way cleared literally just ahead of the contractor. Operations of this nature made it extremely difficult to exercise any reasonable control over expenditures or to forecast funds that would be required. With the advent of needs studies and the recognition of the tremendous task ahead, it was quickly realized that a more orderly and logical approach to what contracts were to be awarded, and when, was required if the needs were to be met systematically and at the least possible cost.

LEAD TIME

Today, before a letting date for a contract can be determined there are many functions that must be performed, such as advance planning, preparation of detailed design and specifications, and acquisition of right-of-way. Sufficient time must be allowed for advance planning, which does not include program planning, but the group of more general and preliminary studies that precedes the detailed design stage of a specific project. In many cases origin-destination surveys must be carried out together with cost-benefit analyses to determine the general location of a new route. In other cases, studies on a regional basis must be initiated and completed to ascertain the impact on the entire region of a new highway. Functional plans must then be developed, which involves aerial surveys, determination of more detailed location, and preparation of functional drawings. Frequently, intensive liaison is required with other road jurisdictions and municipalities which the proposal will seriously affect to finalize all functional aspects of the project. It may also become necessary to hold public meetings in order to explain the reasons and benefits of the project proposed. If controlled-access highways are involved most likely road closings will be required entailing time consuming preparations for board hearings. Occasionally in the preparation of the functional aspects of a project it is learned that a railway is about to be abandoned, which may delay the completion of functional designs until the necessary procedures that the railway company must carry out in abandoning the line are carried out.

At least two years should be allowed for the advance planning process. It is true that many projects will not be as involved as indicated, thus not requiring as much time. However, much of this apparent surplus time is consumed by unforeseen problems uncovered by preliminary soil, bridge and property investigations being carried out during the preparation of functional design which frequently necessitates revisions of a significant nature.

Sufficient time must also be allowed for the preparation of detailed design and specifications together with a final estimate of cost of a project. This involves field investigations and data requirements, detailed soil surveys, analysis and reports, and structure design. Very frequently discussions must be held with municipal officials and agreements signed with respect to cost sharing, drainage requirements and utility problems. At times detailed soil investigations will uncover problems which were not evident following preliminary studies and which may drastically change location resulting in a substantial delay. At least 9 months to one year should be allowed for the preparation of detailed plans.

Advance acquisition of right-of-way involves two distinct functions of pre-appraisal and negotiation. Pre-appraisal consists of establishing ownership interests and property boundaries, gathering and assessing data regarding the general area and finally, estimating the compensation due to each property owner. The negotiation function is not a standardized procedure and it is difficult to estimate accurately the time likely to be required to complete. It is therefore necessary to recognize this fact, and to allow sufficient time to take care of all delays and unforeseen difficulties.

The ideal situation would be to allow a period of at least two years between the issuance of a property request and the commencement of construction. Such an extended period of time would allow for public meetings if required; it would tend to eliminate land grabbing and the resultant increases in land values; it would avoid possible construction delays and the resultant hurried buying at the last moment; it would provide ample time to relocate buildings and to allow owners to re-establish themselves without undue hardships; and it would allow time to consult with municipalities and to make the necessary arrangements for utility moving.

Therefore, the time involved beginning with advance planning may vary from three years to four years, depending on the complexity of the problem. If approximate letting dates for projects could be established for three years in advance this would provide enough time for the required functions to be carried out, irrespective of the degree of difficulty of the problem. It would not be important to establish letting dates beyond that time, other than the year itself in which a project is programed.

There is, however, a significant weakness in this and that is the acquisition of right-of-way would be completed immediately before the advertisement for tenders. In the case of rehabilitation projects, this does not give any time for utilities or buildings to be moved before the contractor is ready to begin; this in many cases forms the basis for claims. It would be much more desirable to have the utilities moved and possibly the necessary clearing and fencing done a year or so in advance of the award of a contract so that a contractor will not encounter any obstacles or delay. This would also give the utility companies a better opportunity to plan their work.

The implication here is to have approximate letting dates planned for four years in advance, and also that in any one year the program would consist of contract awards for those projects scheduled for that year plus right-of-way acquisition, utility moving, clearing and fencing for those projects slated for contract awards the following year.

FLOW OF CASH

In scheduling letting dates so far in advance it is essential that it is known, to a reasonable degree of accuracy, what funds will be available at any time in that period, and how and at what rate they will be expended. To illustrate one major difficulty with respect to the availability of funds at any time in the four year period, in Ontario it is not known for certain what capital funds will be at the disposal of the highway department for any one fiscal year until four or five months prior to the beginning of that year, as the appropriation or vote of the legislature is not passed until that time. This is quite an unstable position as it involves assumptions beyond the first year in the four year period being considered based on guess work as to the funds that may be available. This obviously seriously affects the scheduling of the letting of future contracts.

Where the inflow of cash is based on appropriations from the legislature, it would be highly desirable to have funds voted for at least three, and preferably four, years in advance, so as to be able properly to plan advance programs and schedules.

With respect to the outflow of cash, one of the formidable problems of scheduling future letting dates, is the one of estimating contract costs and construction progress. Detailed estimates are only available for those projects to be proceeded with in the year immediately following, or at the most an additional year, while for those in the following years no detailed estimates are available. One must rely on past experience on past contracts of a similar nature. This may lead to underestimating significant proportions. Furthermore, it could be said that the longer it takes to prepare detailed design the more likely more work will be added to the project as time goes on, which again increases the cost. It would be prudent therefore, when arriving at a preliminary

cost estimate for a project to apply a factor of perhaps 1.10 to 1.15 to take care of these possibilities. In addition rising construction costs and inflationary tendencies must be taken into account.

It is also important to maintain a reserve of funds for each of the fiscal years to accommodate emergency contracts which have not been included in the advance planning of the letting schedule. For example, an extremely wet fall followed by a severe winter will deteriorate some road surfaces to a point beyond repair. The reserve will also serve to accommodate project additions to the schedule, which sometimes occur and are beyond the control of those planning the work. Allowance in the reserve should also be made for unforeseen overruns in contracts under way, which can amount up to 2 to 3 percent of the award value. A relatively recent development in highway contracts which has aided the control of flow of money immeasurably was the introduction of the concept of prequalification of contractors and the insertion of a liquidated damages clause in the contract. Previously, many contracts were not being completed within the time limits specified. This was due to the fact that some contractors were awarded a greater number of contracts than their financial resources and equipment could handle. Consequently, the completion of many projects consumed a great deal more time than originally anticipated which made it extremely difficult to estimate construction time and expenditures in advance. With the implementation of prequalification and liquidated damages much more accurate forecasts of expenditures can now be made.

PRESENT SCHEDULING METHODS IN ONTARIO

Inflow of Cash

In Ontario highways are financed by appropriations of the legislature from the consolidated revenue fund, which includes receipts from nearly all tax sources and special fees. Theoretically then, there is no direct connection between budgeted appropriations or expenditures and highway-user tax receipts. Practically, the legislature tends to appropriate funds somewhat in proportion to the funds received from special highway taxes, such as on gasoline and motor vehicles. What has actually happened over the years, is that there have been notable exceptions when appropriations were much less than the special revenues, and conversely, when annual highway budgets exceeded special highway tax revenues. However, in total, expenditures up until 1955 have equaled roughly the total revenue in that period. During the past five years expenditures have risen considerably in excess of revenues. This development was a direct result of the highway needs study which clearly showed that if the backlog were to be eliminated within a reasonable length of time, a sharp rise in expenditures was necessary. This is being accomplished by the concept that credit financing plus higher revenues from highway users will provide sufficient funds to allow acceleration of the highway construction program to take place, and also that the benefits derived from such a program will offset much of the cost involved. Once the funds are appropriated by the legislature for the one year ahead, the objective is of course to schedule construction so that expenditures on highway construction do not exceed that amount.

Outflow of Cash

Figure 1 shows a typical statement of capital expenditures for one fiscal year. The first item that must be taken care of is the commitments or "carry-over" from the preceeding year or years. The amount shown represents the difference between the contract award values and the payments already made to the beginning of the year under consideration. It should be noted that a 100 percent expenditure of the carry-over is not expected during that year.

The next expenditure is that to be expected on new contracts to be awarded during the year. With the construction season from May to November, an expenditure of from 35 to 40 percent of the total value of awards during the year is generally expected. More specifically the expenditure shown is arrived at by the use of expenditure charts (Figs. 10-18) which will be discussed subsequently.

The bulk of work shown under miscellaneous construction is for projects to be done in cities and towns. This is work carried out under construction agreements on exist-

CAPITAL PROGRAM 1960-1961

FINANCIAL SUMMARY

	Estimated Total Value	Proposed Expenditure
ROAD CONSTRUCTION		
CARRY-OVER WORK		
Construction Division Capital Contracts	65,573,000	55,900,000
Maintenance Division Capital Projects	827,000	827,000
Sub-Total	66,400,000	56,727,000
PROPOSED NEW WORK		
Construction Division Capital Projects	104,243,000	35,585,000
Maintenance Division Capital Projects	4,800,000	4,200,000
Sub-Total	109,043,000	39,785,000
MISCELLANEOUS CONSTRUCTION		
CARRY-OVER WORK		
Construction Agreements (Normal)	1,764,000	1,764,000
Construction Agreements (Special)	2,000,000	2,000,000
Contract Post-Award Revisions	3,500,000	3,500,000
Preliminary Project Work	4,441,000	2,000,000
Miscellaneous Construction Division Projects	422,000	422,000
Sub-Total	12,127,000	9,686,000
PROPOSED NEW WORK		
Construction Agreements (Normal)	4,000,000	2,000,000
Construction Agreements (Special)	4,676,000	2,535,000
Contract Post-Award Revisions	2,000,000	1,500,000
Construction Overhead	1,271,000	1,271,000
Railway Grade-Crossing Protection	50,000	50,000
Municipal and Award Drains	100,000	100,000
Invitation Bids	500,000	500,000
Sub-Total	12,597,000	7,956,000
ENGINEERING (HEAD OFFICE)		
Planning & Design, Audit, Checking, Materials & Research Section (All Proposed New Work)	9,500,000	9,500,000
SERVICES		
Land Surveys, Property Purchase, Buildings, Bridge & Steel Stockpile (All Proposed New Work)	16,665,000	16,665,000
TOTAL	226,332,000	140,319,000
REVIEW		
CARRY-OVER WORK	78,527,000	66,413,000
PROPOSED NEW WORK	121,640,000	47,741,000
ENGINEERING & SERVICES	26,165,000	26,165,000
TOTAL	226,332,000	140,319,000

Figure 1.

ing streets or new routes designated as connecting routes of King's Highways, whereby the municipality carries out the work and the department contributes 50 to 100 percent of the cost.

Contract post-award revisions are necessitated by unforeseen developments in the course of construction. This item is in effect a contingency allowance based on experience. Preliminary project work consists of the moving of utilities and ordering of reinforcing and structural steel which must be carried out in advance of the contractor's operations. Construction overhead consists of salaries of certain regional and district personnel (engineering supervisors and staff) whose general services cannot readily be assessed against the particular projects that they deal with.

Engineering (head office) consists of planning investigations, engineering surveys, designing, estimating, checking and auditing.

Services consist of land-surveying acquisition of right-of-way, stock piling of reinforcing steel and emergency bridge parts such as bailey panels and construction of district buildings.

Insofar as the flow of money to finance this program is concerned the monthly pattern of expenditures can be readily seen (Fig. 2). For example, for the month of September approximately 12 percent of the year's total will be spent during that month and also that by the end of September roughly one-half of the year's total will have been expended from the beginning of the fiscal year. This information is submitted to the Treasury Department in advance so that those responsible know approximately what to expect from month to month.

Lead Time

Pre-contract engineering consists of six individual sections preparing their part of the data based on information received. Each section receives data from the preceding section, adds its findings and forwards the more complete data to the next section.

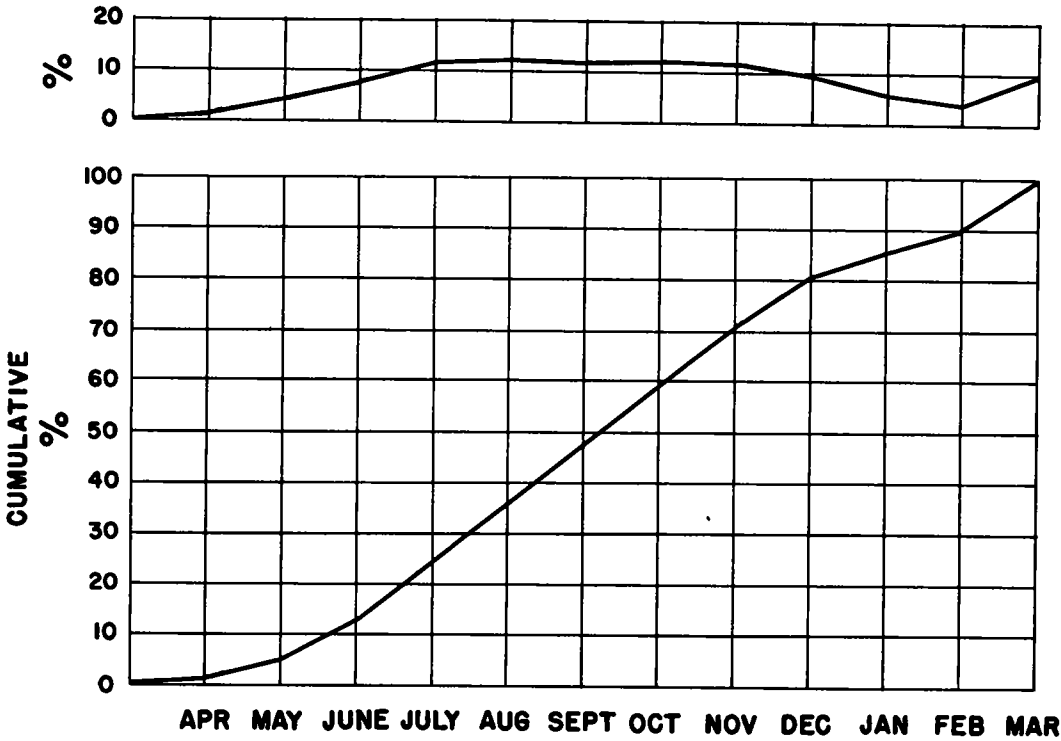


Figure 2. Typical construction expenditures.

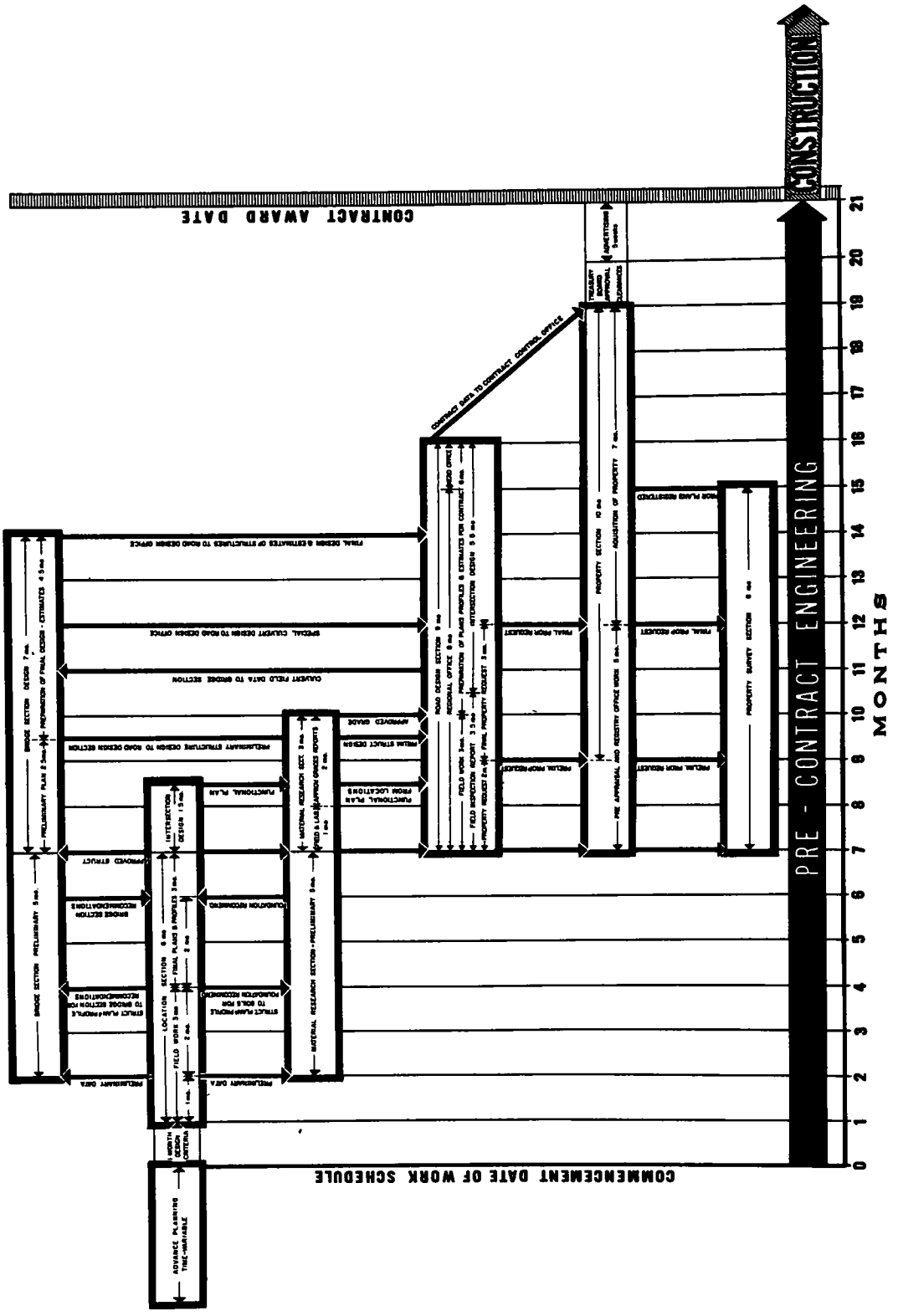


Figure 3. Work-time chart.

APPROVED PRE-CONTRACT ENGINEERING SCHEDULE

WORK SCHEDULE No. 21

REVISIONS
January 20, 1960.

W P	Dist	HWY No	Type of Work	Name and Location	Final Design Criteria	Location Section	Final Bridge Design	Material and Research Section	R D O.
41-59	8	401	Struct.	New Hwy. 38 Interch	Mar 4/59	Sept 2/9	Nov 18/9	Mar 23/60	June 8/60
67-58	10	62	Struct	Bonnechere Ri Tramore	"	"	"	"	"
188-59	6	2	GDGB Pav.	Pickering to Metro East Limits 5 5 miles	"	"	"	N A	"
35-56 112-58	3	8 CAH	GD & S	Freeport Div and Lake Erie and Northern Rwy Structures	"	"	"	Mar 23/60	"
221-59	11	60	Struct.	Smoke Crk. (20 mi. E. of Jct. of Hwy 35 and 60)	"	"	"	"	"
102-A-58	11	60	GB Pav.	Algonquin Park W Gate E. to Smoke Cr 7 0 mi	"	"	"	N A	"
247-59	5	92	Struct	Nottawasaga Ri. (Wasaga Beach)	"	Oct 14/9	"	Mar 23/60	"

Figure 4.

or sections. The function of the work schedule is to coordinate efficiently this flow of work by developing and controlling a schedule of dates as to when the information must be completed and forwarded to the respective sections. Figures 3 through 5 show the point of beginning and completion of each phase of the work and how the work of the various sections dovetails.

Advance Planning. —Prior to the preparation of location and functional plans, a preliminary design criteria sheet is issued by the program section suggesting the general design requirements, which is sent to the various sections heads and appropriate district engineer for their criticisms or approval, and comments. Based on the information received, final design criteria are produced in one month from the time this "reaction" is received. This procedure works out quite well if the project under consideration consists primarily of rehabilitation of an existing road. However, if multi-lane requirements or a new location are required which may involve the necessity of carrying out detailed studies, origin-destination surveys, and area studies, then the system breaks down and the project must be delayed to provide time to carry out these studies. The problem is not due to the scheduling procedure but to the fact that the future program is not available for more than two years in advance. However, by the end of this year a 3-year advance program will be available which will provide approximately one year for these studies to be carried out if necessary.

Location Section. —One month after the final design criteria have been issued this section forwards preliminary functional plans, consisting primarily of line and grade, to the bridge and materials and research sections for their consideration. The purpose of this is to advise the location section of any serious difficulties which may be encountered with respect to suggested bridge locations and soils problems. This move, in many instances, cuts down waste effort on the part of the location section. In the case of grading projects, six months after receipt of the final design criteria this section must produce complete functional plans for distribution to the other sections.

In the case of structure projects, three months after receipt of the final design criteria, the suggested alignment is forwarded to the bridge section for their recommendations. At the same time plans are forwarded to the materials and research section for recommendation as to location and for a foundations report. If it is anticipated that serious problems will be encountered with respect to property acquisition, these plans are also sent to the property section for study and suggestions.

Recommendations are received from these sections within two months. At this time

if the structure under consideration involves a railway crossing, a plan is forwarded to the railway company for their present and future requirements. One month later a final site plan is issued to the bridge section.

Bridge Section. —Although the actual design does not start until the approved site plan is received, considerable preparatory work can be accomplished in the five months between receiving the preliminary plans and profiles. The site plan field inspection

REVISION March 1, 1960

TENTATIVE SCHEDULE OF PRE-CONTRACT ENGINEERING

WORK SCHEDULE NO. 21

FOR ROAD DESIGN SECTION

1 Design Criteria	- Mar. 4 /59	9. R.D.O. to E.C.C.	-Dec. 30/59
2. Location	- Sept. 2 /59	10. E.C.C. Complete	-Jan. 13/60
3. Channelization	- Oct. 14 /59	11. Clvt. Data to Bridge	-Jan. 13/60
4. Prelim. Property	- Nov. 4 /59	12. Property Req. (Final)	-Jan. 20/60
5. Bridge (Prelim)	- Nov. 11 /59	13. Splining Group	-Mar. 30/60
6. Soils	- Nov. 18 /59	14. Bridge (Final)	-Mar. 23/60
7. Field Staff	- Nov. 25 /59	15. R.R. Board Estimate	-Mar. 30/60
8. Field Insp. Report	- Dec. 16 /59	16 Regional Office	-May 4 /60

17. R.D.O. June 8/60

W.P. No.	Dist.	Hwy.	Work of	Location
41-59	8	401	Struct.	New Hwy. 38 Interch.
67-58	10	62	Struct.	Bonnechere Ri. Tramore.
188-59	6	2	GDGB Pav.	Pickering to Metro East Limits 5.5 mi.
35-56 112-58	3	8 CAH	GD & S	Freeport Div. and Lake Erie and Northern Rwy. Structs.
221-59	11	60	Struct.	Smoke Crk. (20 mi. E. of Jct. of Hwy. 35 and 60).
102A-58	11	60	GB Pav.	Algonquin Park W. Gate E. to Smoke Cr. 7.0 mi.
247-59	5	92	Struct.	Nottawasaga Ri. (Wasaga Beach).

Figure 5.

Scheduling Section,
Date July 29/60.

MEMORANDUM TO·

Mr. T. C. Muir,
Contract Control Engineer,
Room 2630.

RE· ADVANCE NOTICE FOR CALLING TENDERS

Cont. No. 60-192 W P. No. 112-58 35-56 Dist No. 3

Hwy. No. 8 C. A. H. Type of Work Grading Culverts & Structure

Location Freeport Diversion and L. E. N. Diversion 2. 5 miles.

Total Estimated Cost $ 650,000

Information Date Aug. 24/60.
Advertising Date Sept. 7/60.
Tender Closing Date Oct. 12/60. For Tender Opening No. 28

SCHEDULING SUPERVISOR

Copies To·

Road Design Section
Material Laboratory
District Engineer
Construction Engineer
Property Section
Bridge Section
Reproduction Section
Trans Canada Section
Special Liaison Section

THIS FORM TO BE RETAINED BY SECTION.

Figure 6.

would be included in this work to determine if the site is suitable, type and span of the proposed structure, costs, etc., all of which will be used in making up the recommendations to the location section. Any recommendations for change of alignment can be made early enough so that the location section will not be late in issuing the site plan. This time is also used to determine if the stream is navigable and if so to prepare all data required for agreement under the National Navigable Waters Act.

Seven months is allowed for the design of a structure. Two and a half months after receiving the site plan, the bridge section forwards a preliminary design to the road design section and in four and a half months the final design.

MEMORANDUM TO:

Scheduling Section
Date July 29/60

Mr. R. Strain,
Scheduling Supervisor,
Parliament Buildings.

RE: CLEARANCE NOTICE

Cont. No. 60-192 W.P. No. 35-58 112-58

Dist. No. 3 Hwy. 8 CA Type Grading Drainage and Structure

Location Freeport Diversion and L.E.N. Rly.

From the attached "Advance Notice" I have noted that the above Contract has been scheduled to be called for Tender as indicated.

For your information I indicate by my signature opposite the applicable item that all the pertinent information and requirements will be available and fulfilled by the proposed information date shown on the attached "Advance Notice".

ITEM	SIGNATURE	SECTION
1. Strip Maps		Materials
2. Bridge D4 & Drawings (Struct. Steel)		Bridge
3. Property Acquired		Property
4. R.D.O. Cont. Data & Drawings		Road Design
5. Contract Prints		Reproduction
6. Rwy. Board Approval		Spec. Liaison
7. TCH Approval		Trans Canada
8. Navigable Water Clearance		Bridge
9. Prior Contract Clearance		Cont. Control
10. Staff Availability		Cont. Control
11. TBC Approval		Cont. Control

Remarks:

IF YOUR PARTICULAR ITEM FOR THIS CONTRACT DOES NOT REQUIRE YOUR INFORMATION OR REQUIREMENTS PLEASE SIGNIFY N/A.

1st COPY - TO BE RETURNED TO SCHEDULING SECTION AS SOON AS POSSIBLE.
2nd COPY - TO BE RETAINED BY SECTION.

Figure 7.

Materials and Research Section.—The same preliminary time is available to this section. It is also used for the investigation of structure sites and foundation problems. An attempt is made to foresee any major soil problems which may affect a major part of the location of an entire project.

In Ontario field data can be gathered only between the first of May and the first of November. With an around-the-year schedule, the location section would be turning out final data during the winter months which this section's field staff would be unable to use until after May first. However, there are sufficient data in the preliminary plans and profiles so that field work can be completed before fall. Therefore when the

Form FC-BA-1 Rev

DEPARTMENT OF HIGHWAYS

TOTAL

Treasury Board Certificate

DATE August 15 NO. 103 PAGE NO ___ OF ___

Contract No 60 -	W P Number	District	Highway No	Description of Work	Location	Total Estimated Cost & (Cost per Mile)	Estimated Current Year's Expenditure
210	41-59	8	401	Grading Paving & Structure	New Hwy 38	350,000	160,000
213	188-59	6	2	Grading Culverts & Paving	Pickering to Metro East Limits -5 5 mi	250,000	70,000
192	35-56 112-58	3	8 C A H	Grading Culverts & Structure	Freeport Diversion & L E N Rly Overhead 2 5 mi	650,000 (200,000)	150,000
214	102-58-1 221-59	11	60	Grading Culverts Granular Base, Structure & Paving	Algonquin Park Gates to Smoke Crk includ Structure at Smoke Crk. 7 0 miles	600,000 (80,000)	90,000
215	247-59	5	92	Structure	Nottawasaga River at Wasaga	453,000	160,000
					TOTAL	2,303,000	630,000

CERTIFICATION

I hereby certify that this work is necessary and that the estimated cost has been carefully calculated	I hereby certify that sufficient construction personnel is available to supervise this (these) Contract (s)	I hereby certify that the Department has funds available to meet the estimated expenditures on this(these) contract (s) within the current fiscal year
DIRECTOR OF PLANNING & DESIGN	MANAGER OF OPERATIONS	FINANCIAL COMPTROLLER.

FINANCIAL SUMMARY

(CAPITAL CONTRACTS ONLY)

	Total Estimated Cost $	Estimated Current Year Expenditure.
Total per prev cert -	65,362,733	33,650,000
Add-this Certificate-	2,303,000	630,000
Total Reported to-date -	67,665,733	34,280,000
Adjustments after award of contracts-	256,451	60,000
TOTAL TO-DATE	67,409,282	34,220,000

APPROVAL

DEPUTY MINISTER OF HIGHWAYS

MINISTER OF HIGHWAYS

PROVINCIAL TREASURER

Figure 8.

location section finishes its approved plans and profiles the materials and research section can add information and complete all work on schedule even though this may be in the middle of winter. The section is given three months from receipt of approved plans and profiles from the location section to forward its data to the road design section.

Road Design Section.—The function of this section is to utilize all data provided by the other sections (excepting property and property survey sections) at various intervals throughout the nine months allowed, for the preparation of the necessary design, specifications, and estimates. As these intervals can be as short as two weeks, expediting is very important in this section to see that all data are received on time. Commencement date for this section is the receipt of approved functional plans from the location section. Two weeks before the completion of field work, the bridge section forwards a preliminary design of any structures that may be included in the project, so that all the necessary field work may be completed in the allotted three months. In addition the project engineer, with the district or construction engineer, will make a field inspection trip and meet with municipal authorities, if they are involved, to ascertain their requirements. The project engineer report is made final three weeks after the completion of the field work. At this point the approved grade and recommendations are received from the materials and research section so that the work of computing quantities can proceed. Two months after the commencement date a preliminary property request showing property obviously required is forwarded to the property and property survey section. Three months later a final property request is forwarded. Two months prior to completion date, final designs and estimates are received from the bridge section. The regional office, which has performed all of the foregoing, now has one month to complete and forward to the head office all plans and estimates required for the contract.

If the project is a railway overhead, in which case a subsidy is received, the regional office will forward, through the special services liaison engineer, plans and estimates to the Board of Transport commissioners for approval. This is forwarded one week before information is sent to the head office.

Property Section.—Two months after the road design section begins its work a preliminary property request is forwarded to the property section. This enables such work as registry office searches and property appraisals to be done prior to the receipt of final requirements. All property should be acquired seven months after the final property request is received.

The property section's completion date extends three months beyond the completion of all pre-contract engineering data. It has been found, that all the time possible should be allowed for property acquisition in order to maintain good public relations.

Scheduling Section,
Date Aug. 25/60.

MEMORANDUM TO:

Mr. T. C. Muir,
Contract Control Engineer,
Room 2630.

RE: FINAL NOTICE FOR CALLING TENDERS

Cont. No. 60-192 W.P. No. 35-56 Dist. No. _____

Hwy. No. 8 C.A.H. Type of Work Grading, Drainage and Structure

Location Freeport Diversion and L.E.N. Rly. - 2.5 miles.

This is to advise that all necessary clearances for calling tenders have been received and are listed below.

		DATE	REMARKS
1.	Strip Maps	Aug. 1/60	Board Order #100248
2.	Bridge Cont. Data (S.S.)	Aug. 3/60	Cost Participation
3.	Property	Aug. 4/60	80% by Rly. Bd. - $ 161,800
4.	RDO Cont. Data	Aug. 8/60	5% by L.E.N. Rly. $ 10,100
5.	Reproductions	Aug. 8/60	
6.	Rwy. Board Approval	Aug. 4/60	
7.	TCH Approval	N.A.	
8.	Navigable Water	N.A.	
9.	Prior Cont. Clearance	Aug. 15/60	
10.	Staff Availability	Aug. 21/60	
11.	TBC Approval	Aug. 3/60	

SCHEDULING SUPERVISOR

Figure 9.

Scheduling Section & Contract Control

When the road design section has completed the estimate for a contract it is forwarded to the scheduling section for a contract number. All pertinent data are filled in on an "Advance Notice for Calling Tender" (Fig. 6) which is forwarded to the contract control engineer. At the same time the scheduling section fills out a Clearance Notice (Fig. 7) and forwards it along with a copy of the Advance Notice to all 9 sections listed. Clearance from sections will indicate the following:—

1. Road design: all plans & estimates will be complete;
2. Materials and research: strip maps will be available;
3. District engineer: staff will be available;
4. Construction engineer: staff will be available;
5. Property section: all property will be acquired;
6. Bridge section: all structural steel design plans and estimates will be complete and clearance under the Navigable Waters Act will be obtained;
7. Special liaison section: Railway Board approval and any clearances from the railway company itself will be obtained;
8. Trans-Canada liaison engineer: approval will have been obtained from the federal trans-Canada highway engineer; and
9. Contract control engineer: completion of former grading work or abutments will coincide with the commencement of the impending paving or structural steel contract.

When the contract control engineer receives the "Advance Notice" he will fill in all required data on the Treasury Board Certificate (Fig. 8) and circulate for approvals.

Date March 2/60 — APPROVED SCHEDULE FOR 1960 - 61 — PROGRAM OF CONSTRUCTION — TENDER OPENING No. 28 — Page 1 of 1

W P No.	DIST	HWY No.	Type of work	LOCATION	Date of Advert	Date of Award	CONT No.
41-59	8	401	G, GB, Pav & Struct	New Hwy 38 Interchange	Sept 9/60	Oct 12/60	60-210
188-59	6	2	G D, GB & Pav	Pickering to Metro E. Limits- 5 5 miles	Sept. 7/60	Oct 12/60	60-213
35-56 112-58	3	8 CAH	G D & Struct	Freeport Diversion & L E N Rly O'Head 2 5 mi	Sept.7/60	Oct 12/60	60-192
102-58-1 221-59	11	60	G, D, GB. Pav. & Struct	Algonquin Park Gates to Smoke Creek including Struct. at Smoke Crk. - 7 0 miles	Sept.7/60.	Oct. 12/60	60-214
247-59	5	92	Struct	Nottawasaga River Bridge at Wasaga	Sept 7/60	Oct. 12/60.	60-215

Figure 10.

On receiving these certifications, the contract control engineer forwards the certificate to the Minister and Deputy Minister for their approval who in turn forward it to the Treasury Board where the provincial treasurer will sign for the Board's approval and return it to the contract control engineer.

When the scheduling section receives all clearances a "Final Notice for Calling Tenders" (Fig. 9) is forwarded to the contract control engineer who advises that all clearances have been received and therefore tenders can be called.

SCHEDULING OF AWARDS AND DETERMINATION OF CONSTRUCTION EXPENDITURES

Scheduling of Contract Awards

In establishing a schedule of award the following factors are considered:

PROPOSED SCHEDULE OF

TENDER CALLS

FOR CAPITAL CONSTRUCTION CONTRACTS

DURING MONTHS OF JULY & AUGUST 1960

GENERAL

Type of Contract	Month of Advertising		Total
	July	August	
Grading	4	3	7
Grading and Paving	5	10	15
Hot Mix Paving	9	3	9
Structure	2	7	6
Structural Steel	4	2	1
Miscellaneous	0	1	1
	24	26	50

DETAIL

Group #1 - Grading

District	Hwy.	Location	Mileage	Month of Advertising
Chatham	Dev. Rd. 471	Alvinston Westerly.	5.7	July
Huntsville	69 TC	Parry Sound By-Pass including Sequin Ri. Struct.	3.5	July
Fort William	17 TC	20 0 miles East of Nipigon to 2.0 mi. W. of Cavers including the Cypress River Bridge.	11.0	August
Kenora	17 TC	19 5 mi. to 30.0 miles East of Hwy. #17.	11.5	August

Figure 11.

1. The primary concern is to schedule the awards of contracts so as not to exceed the amount of money available for the year.
2. The awards should be so scheduled so as to conform as closely as possible with the priority assigned to each project.
3. Every attempt is made to arrange the award of a contract whose progress after award is dependent on a contract under way from the previous year or years so that no delay would occur. If this is not done then the door is being left open for claims. (For

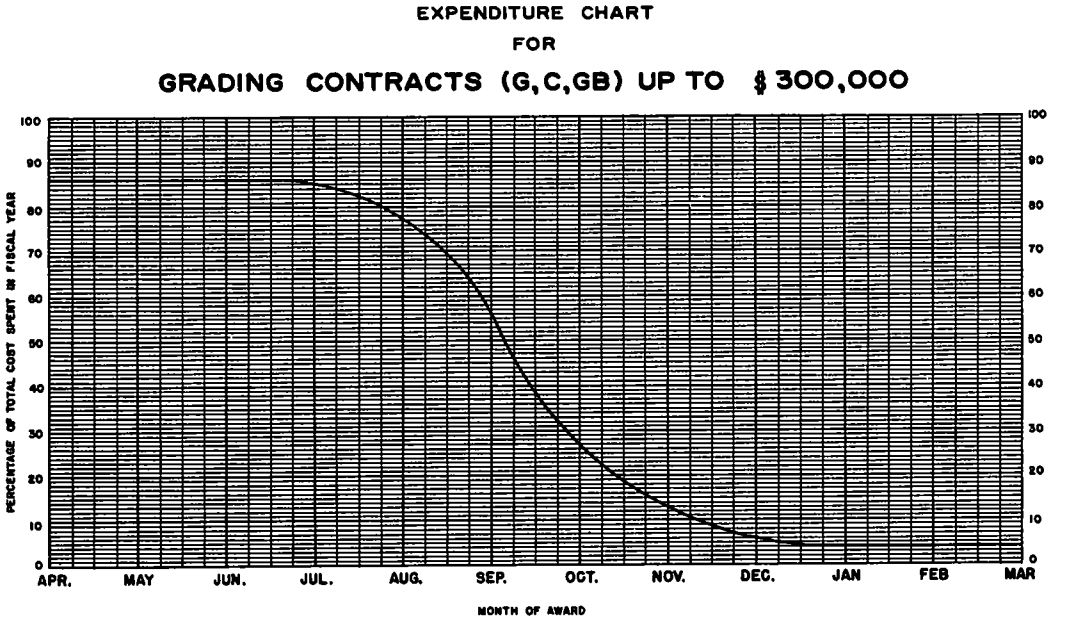


Figure 12.

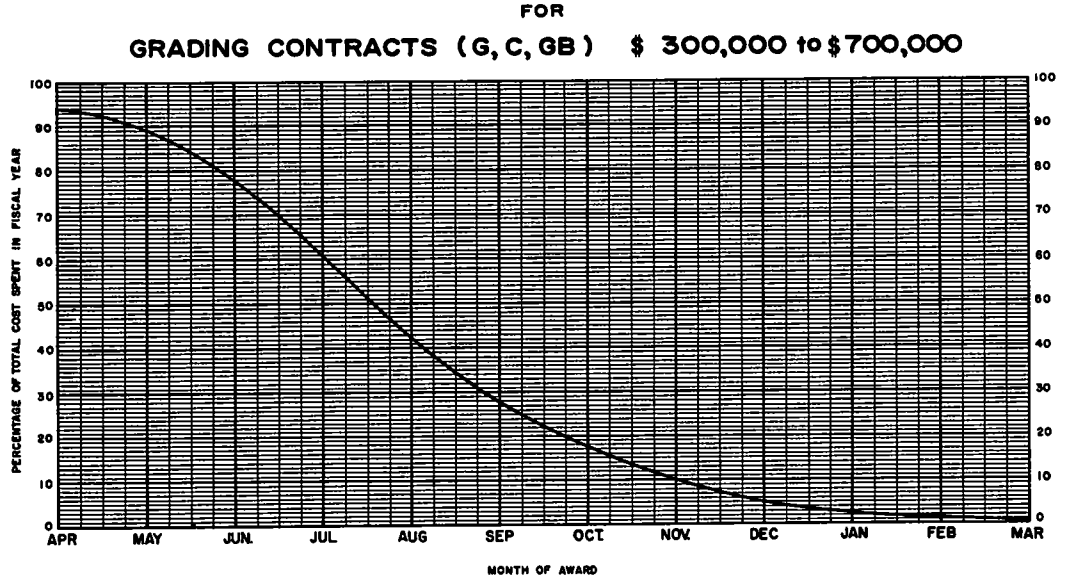


Figure 13.

example, a paving contract following a grading project for the same section of highway; or a grading project in which the contractor's mobility is dependent on a key structure being completed by a previous contractor.)

4. Due consideration must be given to distributing the work in work in each district in such a manner so as to not create an impossible situation with respect to the supervising staff.

5. In view of weather conditions in Ontario some contracts must be awarded suffi-

EXPENDITURE CHART
FOR
GRADING CONTRACTS (G, C, GB) $700,000 to $1,000,000

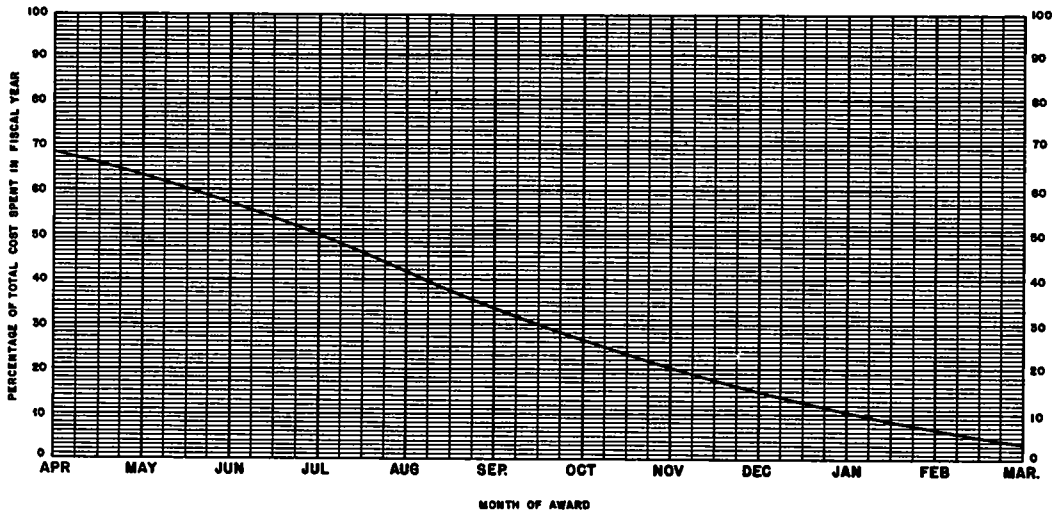


Figure 14.

FOR
GRADING CONTRACTS (G, C, GB) OVER $ 1,000,000

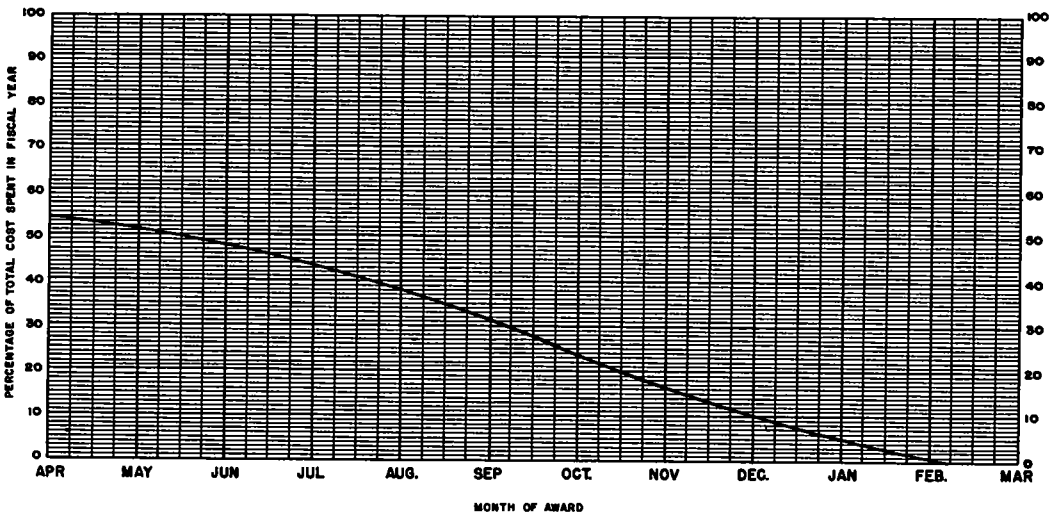


Figure 15.

ciently in advance of winter. One example is when rock excavation is a significant part of the project sufficient time must be allowed for the contractor to carry out overburden stripping operations before freeze-up. Another example is where sufficient time should be allowed for a hot mix paving contract to be completed rather than to be forced to shut down operations because of cold weather.

6. In Ontario the policy with respect to detouring traffic during construction opera-

EXPENDITURE CHART

FOR

STRUCTURE CONTRACTS UP TO $100,000

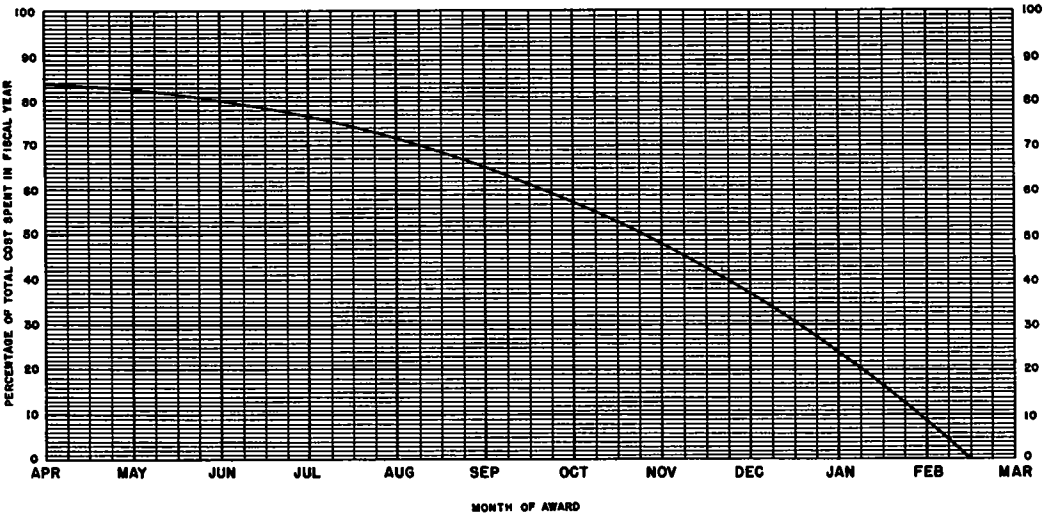


Figure 16.

FOR

STRUCTURE CONTRACTS $100,000 to $400,000

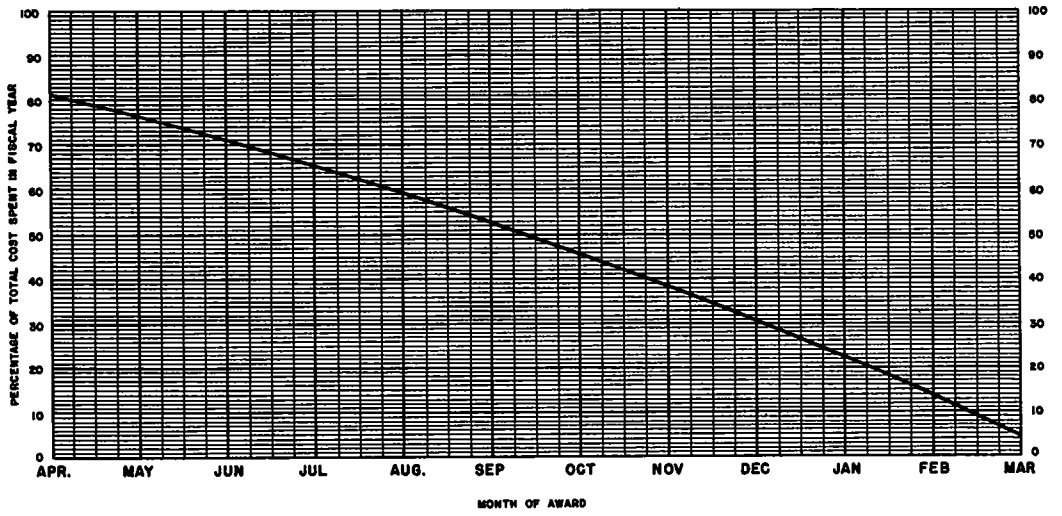


Figure 17.

tions is in the vast majority of cases such that traffic must be handled at the same time. In other words a section of highway under construction is not closed to the motoring public. In view of this, due regard must be given to avoiding long sections (2 or more contracts) of continuous construction.

7. The question of maintenance must be considered. At times, if the award of a rehabilitation project is delayed until late in the construction season, district forces would

EXPENDITURE CHART
FOR
STRUCTURE CONTRACTS OVER $400,000

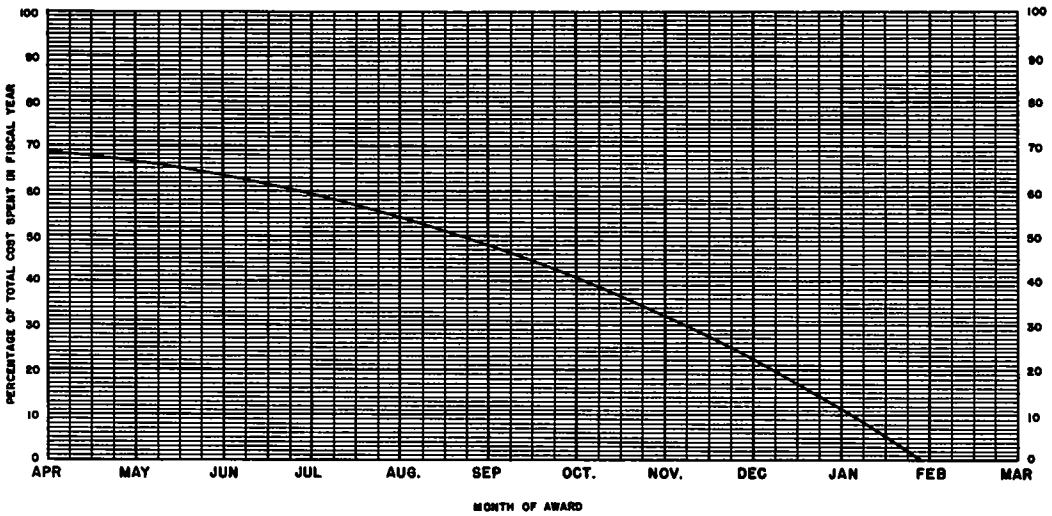


Figure 18.

FOR
HOT MIX PAVING CONTRACTS UP TO $ 500,000

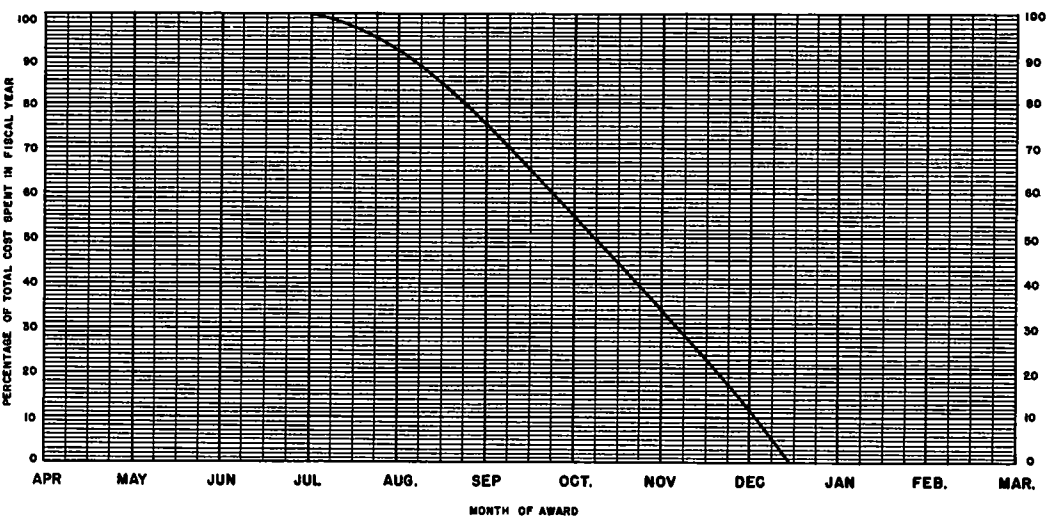


Figure 19.

have no alternative but to carry out costly maintenance measures, which are immediately wasted following the start of construction. This could be avoided by awarding the contract early in the season.

Awards of highway contracts are scheduled by "tender openings." The number of the tender opening determines on what date the call for tenders will be made and on what date the tenders will be opened (Fig. 10). Prior to the practice of prequalifica-

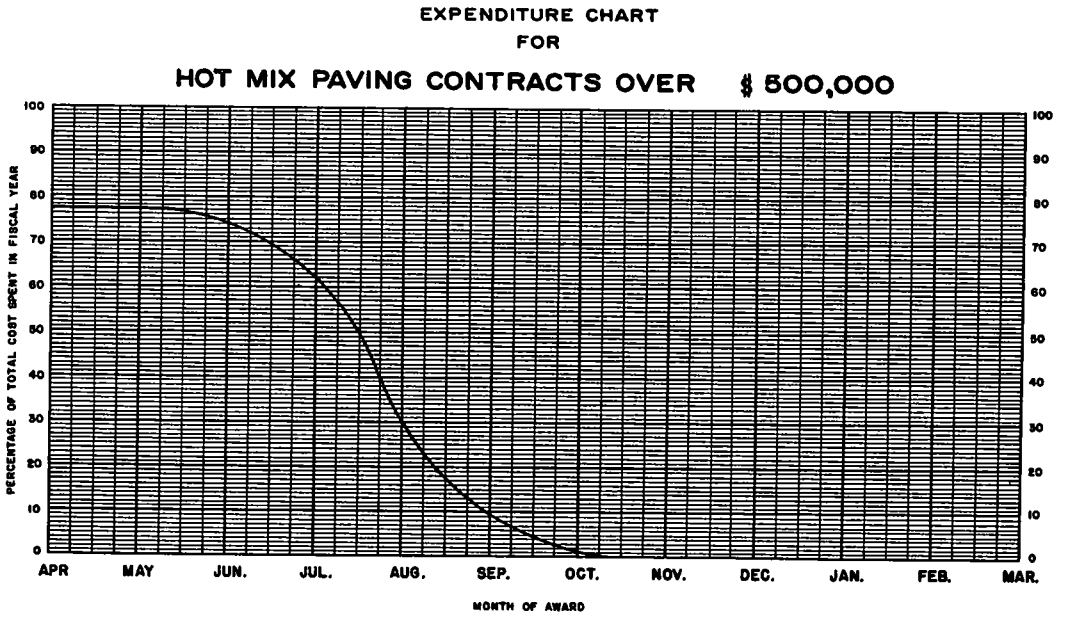


Figure 20.

tion of contractors three weeks were allowed for the preparation and submission of bids. Since prequalification five weeks has been the standard practice.

As an aid to members of the department, members of the legislature, and more significantly, to all interested contractors, a two month advance notice of what project will be called, is provided (Fig. 11). This allows an interested contractor further time to investigate general problems which may be encountered if the contract is awarded to him. It is particularly useful in cases where the call for tenders is made coincident with the first snowfall or soon after. The two months advance notice enables the prospective successful bidder to study the general aspects of the project before the ground becomes snow covered.

Determination of Construction Expenditures

In dealing with this problem there are two major divisions to be considered: (a) construction under way or "carryover," and (b) new construction.

Carryover.—The method used in determining what expenditure can be expected on contracts that are under way leans very heavily on past experience. By keeping records over several years it has been firmly established that on the average, for work started in the year previous to the one under consideration, 85 percent of the carryover value will be spent during the year being considered, and for contracts started two or more years prior to the year in question, 100 percent will be spent. Therefore, without considering each project individually, these percentages are applied to the total values of carryover thereby giving the amount that will be spent. There will, of course, be exceptions to this empirical method but the results obtained are within acceptable limits.

New Work.—In the case of new construction a graphical method (Figs. 12-20) is used to determine the expenditure to be expected. The graphs were developed by recording results since 1956 and are based on the date of award and type of contract. It should be noted that since the prequalification of contractors has been instituted in 1956 and the insertion of liquidated damages in contracts the rate of expenditure has been conconsiderably increased, that is, construction work is significantly more rapid and more consistent time-wise than prior to prequalification.

Discussion

Bidell. —I would like to cover some of the problems that we encountered in developing construction schedules. The first major problem that Ontario faces is what money will be available for a construction program. In Ontario, funds are appropriated by the legislature out of a consolidated general revenue fund. That is, all workings of the government are financed by this one fund. I believe that there are several States operating on that same basis, for example, New Jersey and New York.

In Ontario, we only know what money will be available for the year immediately following the request for the funds. This usually is known about two or three months before the actual fiscal year starts. The fiscal year runs from April 1st to March 30th. That makes scheduling ahead three to five years extremely difficult.

For the last five years, however, we have been very fortunate in getting the money that we had anticipated. But last year we found that we were cut off about $15 million —about 10 percent of our proposed capital budget.

This makes it impossible to maintain the pre-contract engineering schedule and award schedule as previously determined. This changes the whole thing.

The next major problem is additions to the work schedule and award schedule. These occur for several reasons, such as commitments by the government and emergency situations that were not foreseen.

Obviously, when you add such additions into the very complicated stream of work required in preparing jobs for contract, it upsets the balance markedly. There is no time to make the necessary soil investigations, no adequate time for property acquisition, liaison with utility companies, etc. However, this is a problem which I think is going to continue. You will never entirely get rid of it. The only thing is to try and cut it down to a practicable minimum.

Many people in the highway department itself do not realize fully what the implication is when a statement is made, "We want this contract advertised by such-and-such a date."

I do not think some really understand just how much work is involved in preparing a job for advertising. I think it is still a hold-over from the days when the chief engineer would get on the phone to the district engineer at the beginning of the week and say, "We are going to have a job advertised on such-and-such a road by the end of this week."

However, we are becoming more successful in convincing people that when a project is added in that manner, something else must be delayed; and furthermore, the fact that they are adding it upsets the work schedule and workload of all staff involved.

The next problem is additions to project scope. As time goes on, a project often grows in scope; that is, it includes more work done than originally anticipated. So this obviously will increase the cost, and allowance should be made for that.

Next is the problem of making preliminary estimates and setting up the award schedule, etc. At the time that this must be done, frequently no detailed estimates are available in advance. That is, the design and specifications have not been completed, and you have to rely on past experience and past jobs of a similar nature to arrive at some cost. In doing this, we have been consistently low in estimating the actual cost of the job. Therefore, we have had to add 10 or 15 percent, after arriving at what was thought to be a satisfactory preliminary estimate.

The next problem is that although we have our lead time fairly well down to a regular routine, now, it still is not enough time to prepare all the various phases of the projects properly. Our budget doubled in four years, and many short-cuts had to be taken to have projects prepared on time.

We have the situation where we are awarding contracts just ahead of the movement of utilities and the acquisition of right-of-way. This, obviously, leads to claims once the contractor gets in and he is held up by these various factors.

The last problem is change of standards. A job will be almost nearing completion, or even completed, and then the design standards will be changed.

Someone mentioned that at one time you are 90 percent complete and yet later you are only 10 percent complete, due to a change in location or standards.

I would like to outline some of the goals that we think should be achieved.

First, time, money and staff requirements should be adjusted so as to enable projects to be done when they are needed. In other words, we should not allow, as far as it is possible, for those factors to dictate when the job is to be done. Rather, we should say when the job should be done and adjust staff, time and money to meet that date. True, many difficulties will be encountered in achieving that, but that should be the aim.

Use of consultants has helped to a great extent. Just two years ago, for example, about 60 percent of our bridge design was done by consultants, simply because we did not have the staff to have this work prepared on time.

However, our goal is to have about 75 percent of the work in the pre-contract engineering done by our own forces, and leave about 25 percent for consultants.

Second, the award schedule should be set up for at least four years in advance of construction. This will allow the time for all necessary functions to be carried out.

The program in any one year should consist of taking on construction of new projects, plus continuing projects under way, and the movement of utilities, the clearing, fencing, and acquisition of right-of-way on projects that will be started in the following year.

Breaking down that four years, we should take three years to prepare a project and one year for the acquisition of right-of-way, utilities, etc., so the project should be scheduled at least four years in advance of construction.

This does not take care of some of the more major projects in urban areas, where it takes a lot longer. These possibly will have to be six or seven years in advance.

Third, efforts should be made to accelerate the output so as to get ahead of the game. This will eliminate the use of short-cuts that are now being taken in the preparation of pre-contract engineering, and it would also make the programs a little more flexible.

I think that the award schedules should be such that flexibility is inherent in them, so that if a change is required for various reasons, the change could be made. You would just have to delay one and advance the other, because the engineering has been completed on both.

We are trying to achieve the goal where the engineering for the preparation of advertising of a project is finished at least a year in advance of that advertising.

The next goal in conjunction with the first goal I mentioned, (adjusting time and money requirements to fit the jobs when they are needed) is that the procedures and organization should be carefully scrutinized to see that they are functioning as smoothly as possible to cut down to a minimum time for preparing the job.

Lastly there is the future role of computers in this work. We think that there is a real future in the utilization of computer work in setting up and control of award schedules.

Aitken.—In Figure 1 of your paper, you referred to a steel stock pile. Does that mean you furnish steel to your contractors?

Bidell.—Yes. This does not include prefabricated steel. It is just reinforcing steel and standard rolled shapes.

Aitken.—In your advance calling of tenders (bids) (Fig. 6), you have total estimated cost. Do you always give the contractors an estimated figure?

Bidell.—No. This particular sheet does not go to the contractors.

Aiken.—In your graph on structure contracts (Fig. 16), are those accumulative for all of your construction contracts that are operating at any time, or active?

Bidell.—No, this is for an individual structure.

Aitken.—I am more amazed, then. You mean you let a bridge contract in April, and the first month you have that much expenditure?

Bidell.—No, that means, if you let an average structure in April, by the end of the fiscal year, ending March 31, you would have made that much expenditure, over nearly a year.

Another example: at the very end of the curve, if you awarded it in February, which is just a month before the close of the fiscal year, you do not spend very much during

that particular fiscal year. If we awarded a structure in August, we will spend about 70 percent in the fiscal year.

Granum.—You might add, that up until recently, Ontario had not had pre-qualification of contractors, and so there has been some difficulty in adhering to a completion schedule once an award is made. But more recently, you have improved on that situation.

Bidell.—Prior to 1956, there was no pre-qualification or liquidated damages clause in the contract; we could award a contract and then nothing would be done for a year. On that basis, it was extremely difficult, if not impossible, to estimate how much money was going to be spent on that particular contract in a given time period.

But now, with pre-qualification of contractors, and also liquidated damages, we can make a very close approximation of what will actually be done.

It is true that we do encounter some problems. In setting up the number of working days on which the liquidated damages are based, no work is planned for the winter. That is, there are no working days set up during the winter. So the contractor could shut down. But that does not mean the contractor could not work during the winter, if it is rock excavation or something like that. If he so chooses, he could do this type of work during the winter, in which case the job might be finished a little sooner than we had anticipated. But this does not happen very often. Our severe winters rather insure that.

Campbell.—Can those charts on percent of work done during the fiscal year be used in other areas or States? Are the charts influenced by the number of working days set up in a contract, or is the number of working days taken from the chart? What is the relation between working days and work needed?

Bidell.—The working days are not taken from the charts. Working days are estimated from past experience—how long it does take a contractor to complete a certain type of job in a certain region at a certain time of year.

Of course, the two are tied in very closely, but from independent analysis. I mean there is no force that is bringing them together—that is just the way it comes out.

Campbell.—Do you think those charts might be useful here in the States?

Bidell.—Yes.

Granum.—Pennsylvania and other States have similar work time and expenditure charts.

Campbell.—How many charts has Ontario developed?

Bidell.—The charts that we do have are in the paper. We can see a lot of deficiencies in these charts. They cover too wide a range. They do not take into account the type of grading work, whether it is all earth or whether it is all rock.

Furthermore, these charts also can be extended to take care of the amount of money that will be spent in the second year of the contract.

Right now, we have found that in the second year, of the total value of the work that is carried over into that year, approximately 85 percent will be spent.

For the moment, that is the only way we have of estimating how much will be spent in the second year of the contract. But with the accumulation of more data, I think that we can also come up with similar charts for the second year, and the third year, if it became necessary. Probably it should all be put on a computer.

Morf.—Have you established any particular parameters in the charts? You mentioned the size of the project. You mentioned weather, which you could also say is a function of latitude. I was wondering how far you would rationalize the parameters that apply to these curves.

Bidell.—I do not think that you could go very much further on that; except, as I say, to narrow down the range of these parameters.

Morf.—The month of the year in which a contract is awarded is another thing.

Bidell.—Yes. We are using the month of the year, now. If it is awarded in that month

of the year, so much will be spent. But I do not think you can tie it down any closer than that.

Babcock. —Bidell, in Ontario who determines the projects that actually are going to be awarded?

Bidell. —I do. That is, of course, I prepare them for the necessary approvals, etc.

Babcock. —Is that list approved by something like a highway commission or a legislature? Is it strictly engineering, or is there liaison such as a highway commission in the people's interest, so to speak?

Bidell. —First, of course, it is approved by the top level, insofar as engineering is concerned; and then a meeting is held with the political head, the Minister of Transportation.

Babcock. —The Minister would normally make a final determination, then?

Bidell. —That is right. In that regard we have not encountered very much change when it is presented to the Minister of Highways. About 95 percent of our program is based on bona fide needs, and the other 5 percent is something that one cannot do anything about.

However, even as far as the 5 percent is concerned, it is true that the project often is only advanced. We might not have had it planned until, say three years ahead. Now, we might have to advance it to only one year ahead.

So talking about this 5 percent, it is not really as though a job is pulled out of the air that nobody has anticipated doing any work on at all for the next 10 years, and then suddenly you are confronted with something that must be done right now. So the net effect of outside influences other than engineering, I would say, are maybe only 2 percent, on that basis.

If you have the engineering answer as to why unwarranted projects from an engineering point of view should not be put in a program, I think that you will be backed up about 90 percent of the time. However, if you do not have an answer, you are done.

Donnell. —I would like to know how you get right-of-way a year in advance of letting the contract.

Bidell. — There is a fund set up for right-of-way acquisition. You will see in Figure 1 of my paper those services mentioned. That includes the acquisition of right-of-way.

Donnell. —I understand that; but how do you keep from building the project once you get your right-of-way cleared and utilities adjusted? How do you keep the pressure of the public off your back for a year before you let that project?

Bidell. —Because we have already made it known that we are going to do that job. I think this is one of the advantages of actually publicizing an approved program, arrived at mainly by engineering considerations.

The fact of the matter is that this is the program we are going to be doing during the following year. So there should not be any fear of providing a right-of-way for the project and clearing the right-of-way, etc., and then finding out that you are not going to do it.

Livingston. —In Figure 4 of Bidell's paper, there are dates for closures for certain phases of the engineering work. They have been established. I want to know what authority lies behind these, who establishes that authority, and what do you do when somebody falls down on meeting their deadline, throwing the schedule out of gear?

Bidell. —It is not really a case of authority. Once the date is set, that is it. Everybody works towards that date.

Livingston. —But you have a number of diverse engineering divisions that have to be coordinated here. One man establishes final design criteria. This is fairly easily done. Then the location section, maybe because of weather or something else, does not get its work done on time, which leaves the designer in trouble, because he does not have the necessary information to start from.

How do you enforce the engineering work schedule, or keep it adjusted and coordinated?

Bidell.—We attempt to take care of this in advance. In setting up the schedule, if we find that the location section could be finished, it will be too late for any soils investigation to be done (other than for structures, foundation problems, etc.). So we do not set that early a date for location. We extend that date on until perhaps May of the following year.

Livingston.—Then you revise your schedule to fit these kinds of conditions that come about?

Bidell.—It is not really a revision. We attempt to set it up that way in the first place, to take care of these problems.

Granum.—You will find that you have frequent conferences to readjust the schedule. As a matter of fact, the schedule in your paper is a revision, dated January 20.

Bidell.—No matter how well you set up the schedule, there are always going to be changes. There are unforeseen delays. That is why I mentioned previously that the time we have set up, as shown here, is really too short. If there are no delays, or any serious delays, we can get it done. But with more lead time, if one section is late, you can push another section to get its work done a little sooner to make up lost time and still meet an advertising date.

The schedule system that we now have set up is too short, but it was done that way with a purpose. That is, if we had not set it up in that short length of time, it would have taken us several years to get to the point which we should reach, that is, getting the engineering job done a year ahead of construction. So we had to tighten up the schedule.

Burnes.—Bidell, who has the authority to do the pushing? Where does that authority come from?

Bidell.—All the people involved here are under the Director of Planning and Design. The authority comes from him.

Livingston.—You said you had jobs that get to the 90 percent completion stage on engineering, and then the next day you are at 10 percent because of a change in design. How do you handle that?

Bidell.—You mean that somebody might say, "Oh, this section is no good. We will have to change it. The shoulders are too narrow, and so on." We do not have much trouble with that, but rather in the detailed design. That is, for example, lately a decision was made to carry the granular material out to full width of shoulders. A change like that might require the whole job to be scrapped and recalculated. There will come a time when most of these things will settle down.

Morf.—I think most of us here do not have to be exhorted to do good and avoid evil. I think we know what good and evil are and we know what the problems are in achieving good.

But the next step is: Given an array, good or evil, of work to be gotten into a program, how do you actually execute this in view of the limitations of time, of decisions, and of the management of funds? I think Mr. Bidell has done a very excellent job. I am particularly fascinated by something that apparently we do not know as much about as he does, and we would like to know more about it. That is his schedule of completion and time requirements, of any type of work. I think this is a very good contribution to the technique of programing.

Most of the States are up against a very peculiar financial cycle. That is, their money becomes available in a surge around the first of the year, when the licenses are sold; but this does not correspond with the period of greatest expenditure for construction, which usually occurs late in the summer and fall.

Also, the legislature meets when the balance is greatest, because funds are in, but construction expenditures have not yet begun. The legislature likes to look at a highway

fund balance of $80 million that the treasurer reports is lying right there, and think of the many other things that they would like to do with it.

One of our big problems has been to maintain a very close scheduling of construction expenditures, so that we can point to a rock bottom point in the financial cycle; and this usually occurs in November, when cash balances are at a very low level. This is good.

Those are problems that have to be considered—they may be of technique rather than principle, but they are very crucial matters of technique.

Bidell. — When income is available at the beginning of the year, but you have not really started on your construction, would it not be possible to put this money in a holding fund?

Morf. —You are not going to conceal it from the legislature by doing that.

Granum. —Many States operate on an encumbered basis, as distinguished from a cash flow basis. I think you should realize that in Ontario it is on a cash expenditure, cash flow basis. Operation of such programs depend upon rate of expenditure or outlay of cash. Other States, which require encumbrance of full contract amounts against available funds or budgets, may have cash lying idle in the bank for a long time, even though the full amount is encumbered and will eventually be spent.

This is part of the budget management that Jim Martin discussed. It involves legislation relating to these things, and it involves money management, which is one of the reasons for the title of Bidell's paper.

Donnell. —When we program a project, our funds are set aside or encumbered, and therefore are never shown to the legislature as money that we have in our pockets. The project money cannot be used for anything else.

Granum. —Except that the treasurer's balance will show some cash, will it not?

Donnell. —He may have $40 or $50 million in cash, but actually only have a million dollars unencumbered.

Morf. —This is the story of my life, trying to explain the difference between an unencumbered balance and a cash balance. But I have never won. I do not know how. Do you take it out of the bank and put it in a wooden chest or bury it? How do you get it out of the treasurer's account?

Donnell. —The treasurer transfers it to his account.

Johnson. —In Kansas, we have six highway commissioners representing geographical areas. Available construction funds, other than Interstate, are split six ways on a percentage basis, without any particular regard for needs within the divisions.

This is not too bad, in a way, but it does result in some projects being advanced to construction much sooner than you would ordinarily like to have them, from a purely engineering and need standpoint; you could still tolerate them for quite a long time. Of course our worst problems are near the urban areas and in the eastern part of the State.

While the mileages in the different areas are quite comparable, the fund splits range from 9½ percent to 24 percent of the available funds, arrived at by an agreement between the commissioners that were in office 20 or 25 years ago. Periodically, as commissioners change, the distribution of funds comes up for discussion: "Should we continue this as it is, or should we adjust it slightly?" Of course, the ones that are interested in adjusting are the ones that need a little more. But there has only been one change in at least 20 years, and I do not expect there will be anything happening soon in the future.

I do not know how many States have that kind of a situation and what they have done about it, if anything, or what can be done about it, or if anything should be done about it. It works fairly well.

Granum. —Legarra pointed out the "splits" they have in California, and I know there are other states that have similar splits. I know in Tennessee the highway needs study indicated a very nice split among the four divisions, each of which includes one of the four major cities.

Donnell. —That is right; but we do not have to split, by law or edict. We divide construction funds on the basis of need: 24 percent, 21 percent, 25 percent, and 29 percent.

Buswell. —In Montana, by State law, we split the Interstate funds into 12 financial districts on the basis of the Interstate need study. Finally we split that on the basis of deficient mileage. We split other funds into the 56 counties on the basis of land area, rural population, rural road mileage, and value of rural lands. Urban money is split among the 14 cities over 5,000 population on the basis of population.

Granum. —I would like to summarize Bidell's discussion.

Bidell pointed out first that the needs of the highway system come first; that the goal of a construction schedule should be to build the projects that are needed, when they are needed.

Second, the available funds are all-important, because the cash flow of expenditure must balance with the money that is available when it is needed.

Third, there must be time for planning and for construction. Within the time problem, the paper shows how an internal work schedule is developed, including the effects of contract letting dates and the time of construction itself.

One thing that has not been done completely, but I wish he had more time to do, is to show you something more about how they keep track of this. Ontario has an elaborate system which is continually undergoing revision.

Work schedules mean nothing unless somebody pays some attention to them, and that involves a high degree of reporting and control.

Control and Adjustments of Construction Schedule

M. J. WALKER

Commissioner John C. Mackie, soon after taking office in 1957, outlined a dynamic and progressive five-year construction program, which would give Michigan 2,900 miles of new or reconstructed highways, and included 905 miles of new expressways connecting all major cities of 50,000 population or over. This 905 miles, in turn, included construction of 580 miles on the Interstate System, and 325 miles of other arterial 4-lane, divided routes, and provides for the surfacing of all remaining 800 miles of gravel roads existing on Michigan trunklines. Since July 1957, 296 miles of divided highways have been awarded and opened to traffic, and 251 miles of divided highways are now under construction. There have been 634 miles of gravel trunklines hard surfaced.

The estimated cost of this five year program is 1 billion 250 million dollars, to be financed by $505 million in Federal aid, $330 million in State funds, and $415 million in bonds.

This complete program was made public, with letting dates on each project, in advance, and schedules with target dates were set up for each division to meet in order that the entire schedules for the divisions could meet the predetermined letting dates.

It was evident, with such an enormous program in view, that the divisions and district engineers would have to be aware of target dates they would have to meet in their respective areas of work, in order to meet the letting dates made public on each project.

It also seemed desirable that some central system of reporting to top management, in view of the tremendous responsibility involved in a program of this size, was desirable. It was felt that a central reporting procedure would eliminate many engineering manhours at top levels in the searching out and putting together information from the various divisions. It also was felt that such a system could stop many delays before they materialized. The section that seemed most desirable to initiate this procedure was "records and reports," as all of the basic information on the trunkline system was already there; and much of the information that would be needed was already available. The section was expanded, and the new area of work incorporated was called "program performance."

The first step was preparing simple bar charts, by districts, on every project; showing the work schedules and target dates necessary for each division and section to meet, in order to award the project on the date already made public. These charts were distributed to the district engineers, division heads and top management. (A sample of this bar chart is shown in Figure 1.) By acquainting the various divisions of the target dates necessary for them to complete their phase of the work, it indicated to them where their work pattern would fit in the over-all picture, and made the division head aware that if a project was falling behind in his phase of the work he must take some steps to bring the work back on schedule. By acquainting the district engineers for construction, bridge, soils, traffic, and right-of-way of the scheduled pattern, it permitted them to review these projects as they pertained to the different phases of the work well in advance of even the survey stage, with the thought that anything that came to their attention in this review that might cause delays in the progress in the division's phase of the project could be brought to the attention of the division head in Lansing for review well in advance of their entry of their phase of the work on the project schedule. It also permitted the district engineers to estimate their manpower requirements for each quarter of each year's program well in advance, so that the central personnel of-

DISTRICT 7

WORK SCHEDULE

PROGRAM

FORM 2214

CONTROL SECTION NO 11014 & 11015

PROJECT NO

COUNTY Berrien

LENGTH 24.0

EST COST 12,000,000

DESCRIPTION US-12 Relocation Indiana State Line N. to Stevensville

TYPE Grading, Surfacing and Structures

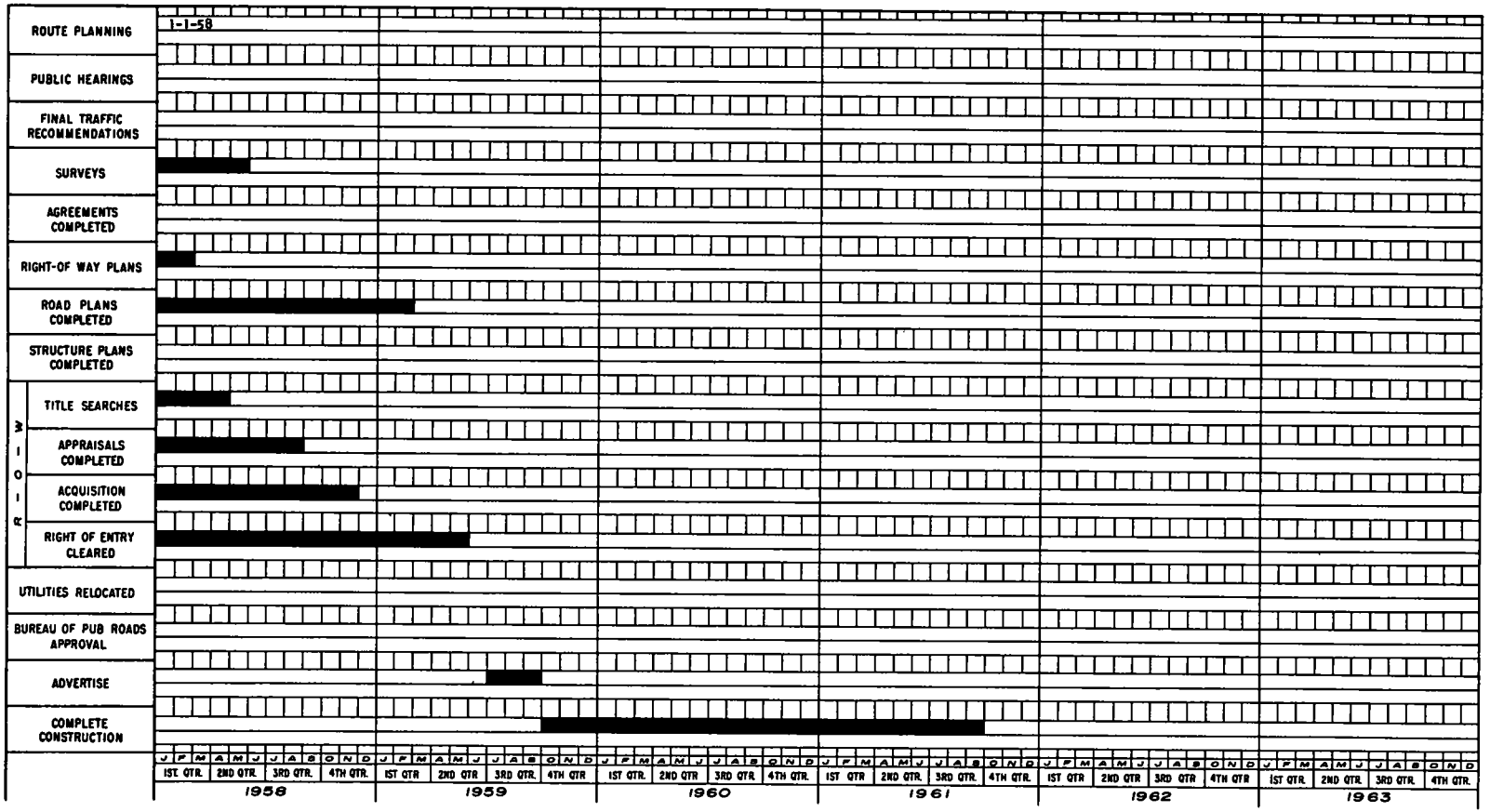


Figure 1. Work schedules.

fice might formulate necessary training programs and recruitment programs to meet these personnel requirements. It permitted the district engineers to have available information for the public within their various districts on the entire five-year program. It fixed responsibility of each division on the schedule that they would have to meet on each project to coordinate with the other divisions in the completion of each project on predetermined schedule.

The next step was to contact the various divisions for the correlating of reports from every division to flow into the central reporting section, giving current information on the status of every project in this five-year program. This was accomplished by utilizing divisional internal forms, and in some cases, designing new forms for them to use, or recommending slight changes in forms they were already using.

The third step was the development of a program performance chart, giving information on every project from the selection of the corridor, to the final disposal of any excess property which would have to be acquired in connection with the purchase of right-of-way. Figure 2 shows this form which carries approximately 70 items involved in the construction of all major projects. It is felt that although this is a transferral of information from each section of the department, that eventually it will give us valuable information for an analysis sheet to eliminate bottlenecks where undue lengths of time seem to be involved in the completion of certain phases of the project. It will furnish the department with a complete record on every project that is constructed in the future in one place, on one sheet. From this analysis, the future programing and planning sections will have substantial, realistic data on which to base their schedules, finances, and manpower requirements. In the course of this activity, we found that the Highway Department had accumulated, over the years, over $15 million worth of excess property, and very little effort had been made to dispose of this property. A plan has been inaugurated to sell this property by the auction method, and already this has restored over $2 million in excess property to the local tax rolls, and the money has been made available for highway construction. Written procedures were developed in the disposal of this property.

The fourth step was to prepare program route reports on all Interstate and arterial highways (developed from information flowing

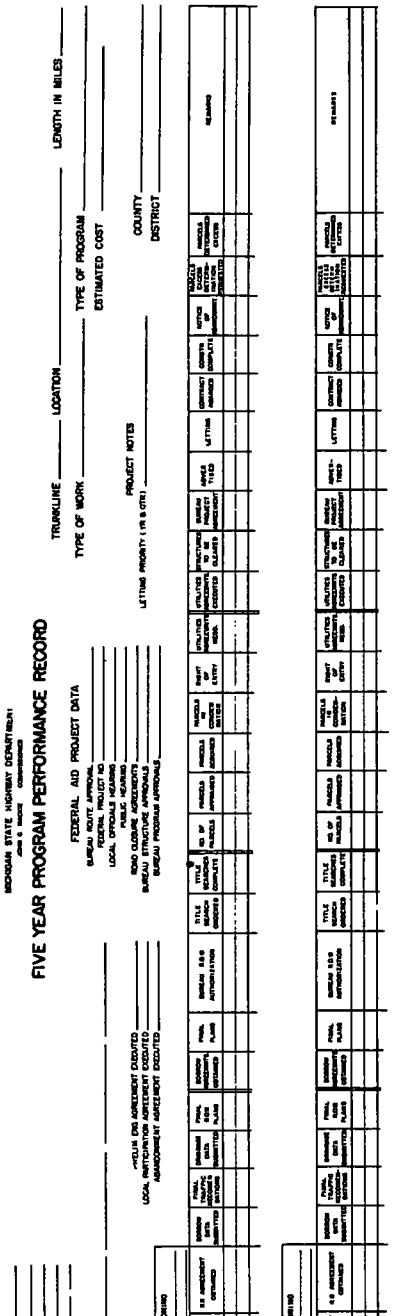


Figure 2. Construction program performance control chart.

CONSTRUCTION STATUS

Interstate Route #94
International Bridge At Port Huron To Indiana State Line
Including Edsel Ford Expressway, Detroit, Industrial Expressway & US-12

October 1, 1960

Center of International Bridge W. to M-146 (St. Clair Co.)	1.999	Open
M-146 (St. Clair Co.) S. to Griswold Rd. (St. Clair Co.)	2.600	Plotting Rd. Plan Stage
Griswold Rd. (St. Clair Co.) S. to Hessen Road	15.400	R.O.W. Title Search Stage
Hessen Rd. (St. Clair Co.) S.W. to Macomb-St. Clair Co. Line	5.800*	R.O.W. Appraisal Stage
N. Macomb Co. Line S. to M-29 (Macomb Co.)	6.200*	R.O.W. Acquisition Stage
M-29 (Macomb Co.) S. to Cotton Rd. (Macomb Co.)	0.750	R.O.W. Acquisition Stage
Cotton Rd. (Macomb Co.) S. to Joy Rd. (Macomb Co.)	3.100	R.O.W. Appraisal Stage
Joy Rd. (Macomb Co.) S. to Shook Rd. (Macomb Co.)	4.715	R.O.W. Appraisal Stage
Shook Rd. (Macomb Co.) S. to 12½ Mile Rd. (Macomb Co.)	4.491	R.O.W. Appraisal Stage
12½ Mile Rd. (Macomb Co.) S. to 8 Mile Rd. (Wayne-Macomb)	4.694	R.O.W. Acquisition Stage
8 Mile Rd. (Wayne Co.) S. to Ridgemont Rd. (Wayne Co.)	0.100*	Under Contract
Ridgemont Rd. (Wayne Co.) S. to Vernier (Wayne Co.)	0.212	Under Contract
Vernier Hwy. (Wayne Co.) W. to E. of Barrett (Detroit)	4.953	Open
E. of Barrett (Detroit) S.W. to M-14 (Washtenaw Co.)	49.244	Open
M-14 (Washtenaw Co.) W. to W. of Baker Rd. (Washtenaw Co.)	5.176	Under Contract
W. of Baker Rd. W. to Fletcher Rd. (Washtenaw Co.)	4.978	Under Contract
Fletcher Rd. W. to Jackson-Washtenaw County Line	7.815	Under Contract
E. Jackson Co. Line W. to US-12 BR (Jackson Co.)	9.873	Under Contract
US-12 BR (Jackson Co.) W. to E. of M-99 (Jackson Co.)	19.634	Open
E. of M-99 (Jackson Co.) W. to Jackson-Calhoun Co. Line	1.167	Open
E. Calhoun Co. Line W. to E. of Wheatfield (Calhoun Co.)	19.197	Open
E. of Wheatfield (Calhoun Co.) W. to Kalamazoo-Calhoun Co. Line	12.216	Open

E. Kalamazoo Co. Line SW to Van Buren-Kalamazoo Co. Line	25.054	Open
E. Van Buren Co. Line W. to M-119 (Van Buren Co.)	6.566	Open
M-119 (Van Buren Co.) W. to Hartford Rd. (Van Buren Co.)	14.514	Open
Hartford Rd. (Van Buren Co.) W. to Berrien-Van Buren Co. Line	2.947	Open
E. Berrien Co. Line S.W. to Hicks Rd. (Berrien Co.)	7.627	Open
Hicks Rd. (Berrien Co.) S.W. to Ridge Rd. (Berrien Co.)	12.292	Under Contract
Ridge Rd. (Berrien Co.) S.W. to Snow Rd. (Berrien Co.)	7.984	Under Contract
Snow Rd. (Berrien Co.) W. to S. of Easy St. (Berrien Co.)	6.789	Under Contract
S. of Easy St. (Berrien Co.) S.W. to M-60 & US-112 (Berrien Co.)	5.025	Under Contract
M-60 & US-112 W. to Indiana-Michigan State Line	3.107	R.O.W. Acquisition Stage
TOTAL MILES	276.219	

* Estimated Mileage

Open	165.118
Under Contract	60.244
R.O.W. Acquisition Stage	19.242
R.O.W. Appraisal Stage	13.615
R.O.W. Title Search Stage	15.400
Plotting Rd. Plan Stage	2.600
TOTAL MILES	276.219

Figure 3a. Route reports—Interstate and arterial systems.

into the central reporting section from the various divisions) to give top management a comprehensive picture of each project on Interstate and arterial highways covered, pointing out the project which starts falling behind the original scheduled completion dates for different phases of the work. This allows management a clear picture of where certain projects might be getting into trouble so that they can take whatever steps are necessary to bring them back on schedule. At present there are 23 Interstate and arterial route reports in progress, and these route reports are brought up-to-date monthly for management. Combined with these route reports are a quick reference, visual strip map, giving the date of the future letting on each project and the phase of work being done on the project—either surveys, design or the various steps in the acquisition of right-of-way. These reports are also kept up-to-date for top management

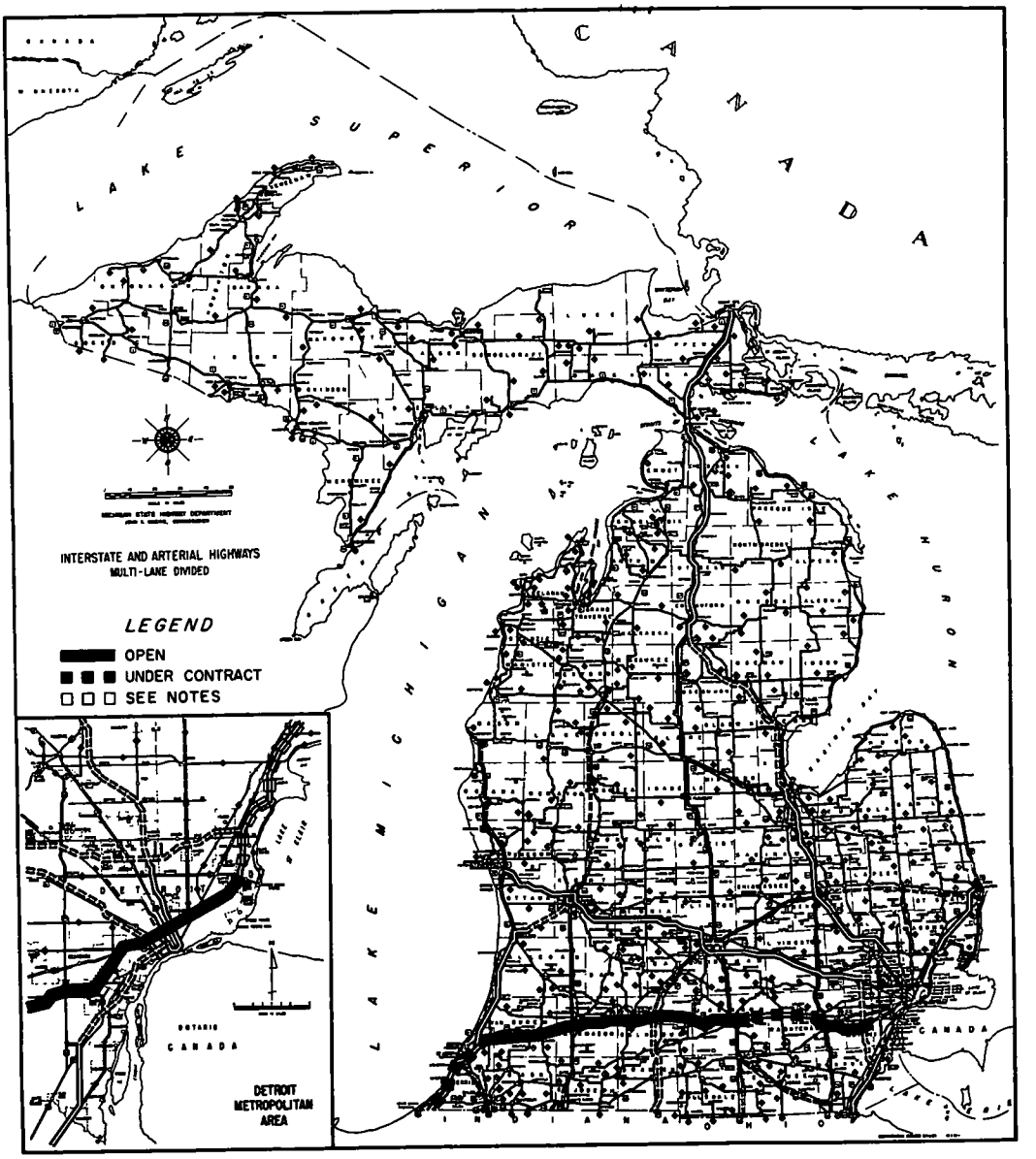
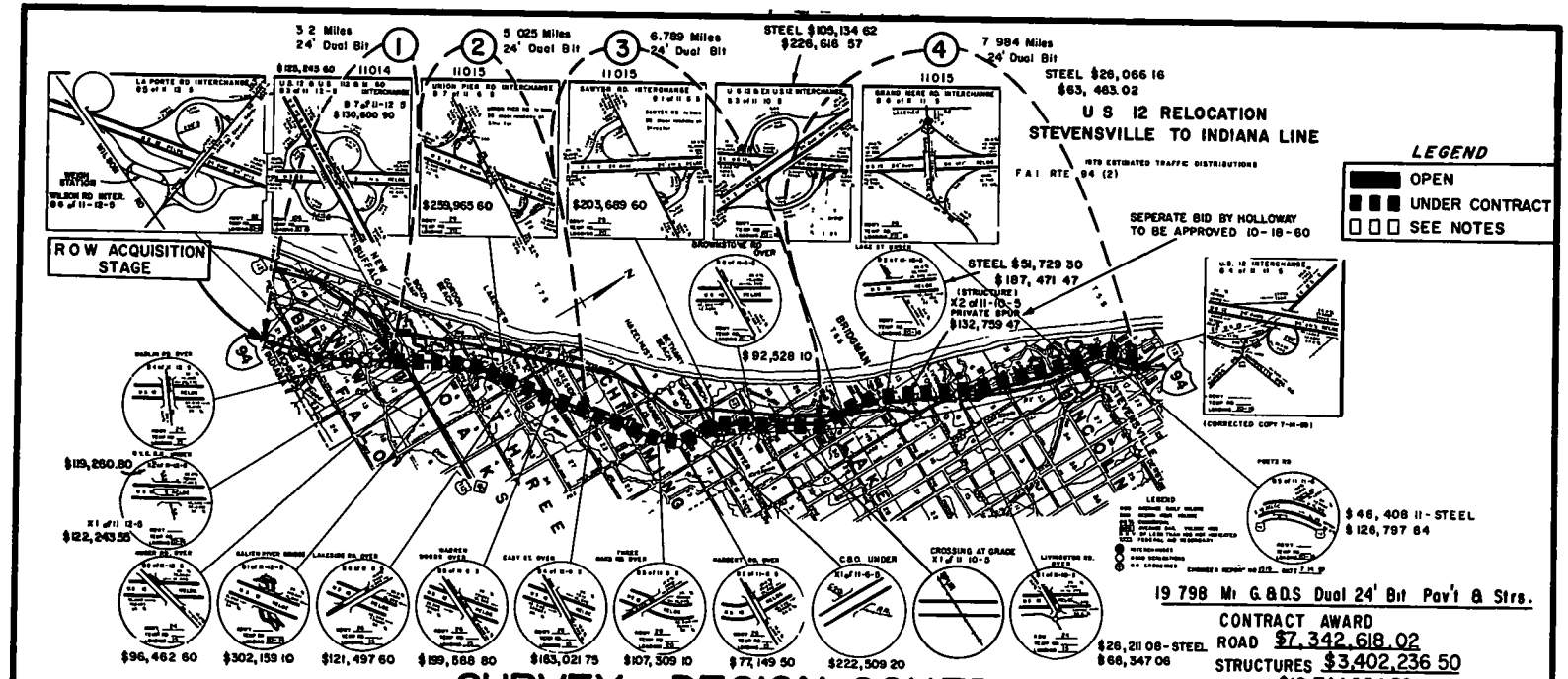


Figure 3b. Route map—Interstate and arterial systems.



SURVEY - DESIGN SCHEDULES

5 YEAR PROGRAM SCHEDULE DATES									ACTUAL DATES - SURVEY COMPLETED OR PLANS SUBMITTED							
SECTION	ENG. REP	SURVEY	PLOTTED PL. to R/W	G I & PREL R/W	FINAL R/W	LETTING QUARTER	RESCHEDULED	LOCATION DESCRIPTION	ENG REP	SURVEY	PLOTTED PL. to R/W	G I & PREL R/W	FINAL R/W	LET	COMBINED COST OF ROAD & STR'S	
①	1-1-58	6-1-58			9-1-58	3rd 59	2nd 62	State Line To M-60 & US-12	2-5-58	* 6-58	10-23-58		12-5-58 1-8-59			
②	1-1-58	6-1-58			9-1-58	3rd 59	4-6-60	M-60 & US-12 N To S of Easy St	2-5-58	* 6-58	10-15-58		11-10-58 1-6-59	4-6-60	$3,895,428,97	GARAVAGLIA
③	1-1-58	6-1-58			9-1-58	3rd 59	2-17-60	S of Easy St To Snow Road	2-5-58		5-16-58		7-31-58 10-3-58	2-17-60	$3,040,287 70	CANONIE & STUKEY
④	1-1-58	6-1-58			9-1-58	3rd 59	4-27-60	Snow Road To Ridge Road	2-5-58		5-21-58		8-21-58	4-27-60	$3,676,378.38	HOLLOWAY
														10-18-60 X2 of 11-10-60	$132,759 47	HOLLOWAY

Figure 3c. Strip maps—Interstate and arterial systems.

STATUS OF CONSTRUCTION PROGRAM SCHEDULE

BY PROGRESS OF COMPLETION

Form 2221

DATE OF REPORT October 1, 1960

ROUTE Interstate Route 94

DESCRIPTION International Bridge at Port Huron to Indiana State Line
Edsel Ford Expressway & Detroit Industrial Expressway & US-12

PROJECT DESCRIPTION	ROUTE PLANNING		SURVEYS		R O W PLANS		ROAD PLANS		TITLE SEARCH		APPRAISALS		ACQUISITION		RIGHT OF ENTRY		LETTING SCHEDULE	REMARKS
	Sched Date	Comp'l or %	Sched Date	Comp'l or %	Sched Date	Comp'l or %	Sched Date	Comp'l or %	Sched Date	Comp'l or %	Sched Date	Comp'l or %	Sched Date	Comp'l or %	Sched Date	Comp'l or %		
9 Mile Rd. to 8 Mile Rd.	completed		completed		completed		8-15-61	finals 15	completed			1/	12-1-60	2/			5-21-61	1/ 143 of 162 appraised 2/ 143 of 162 optioned 134 bldgs. in ROW
50111																		
	B12 of 50-7-4		9 Mile Rd----------					-plotting 50%										
	B13 of 50-7-4		9 Mile Rd----------					-assigned										
	B14 of 50-7-4		Shady Lane Rd----------					-plotting 50%										
WAYNE COUNTY																		
Haggerty Rd. Interchange	completed		completed		11-1-60		5-15-62	plott'g 100									2nd 62	
82021																		
	B4 of 82-21-6		Over Tot. Rte. 94----------															
	B1 of 82-21-28		Over Tot. Belleville Lake------															
WASHTENAW COUNTY																		
Interchange @ US-23																	2-22-61	
81062	B3 of 81-11-27		AA S. Belt----------					-finals 35% - separate contract			1-61							
Rawsonville Rd Interchange	completed		completed		completed		8-15-61	finals 20		90	1-2-61		4-2-61				8-2-61	
81041																		
	B4 of 81-20-13		Rawsonville Rd Reloc.----------					-assigned										
BERRIEN COUNTY																		
State Line to M-60 & US-112	completed		completed		completed		4-13-60	finals 90 *	completed		completed		3-1-60	1/ *			2nd 62	1/ 42 of 78 optioned 36 unsecured H/N 4-28-60 R/E 6-20-60 30 bldgs. in ROW
11014																		
	B4 of 11-12-5		Madlin Rd----------					-finals 100%										
	B5 of 11-12-5		LaPorte Rd----------					-finals 95%										
	B6 of 11-12-5		Wilson Rd----------					-finals 100%										

Figure 3d. Divisional status—Interstate and arterial systems.

BERRIEN COUNTY #11

STATUS OF CONSTRUCTION BY COUNTY

COMPLETED

US-112 & M-60---In Three Oaks & West

Project No:	M 11021 C1R & C2U
Type.	Concrete Patching & Bituminous Concrete Surfacing
Miles.	0.350
Date·	November 14, 1957
Award Amt·	$23,118.60

M-140 Rel.---Intersection US-12 in Watervliet and West and North to North County Line

Project No:	F 11071 C1R & C2U
Type:	G&DS, Concrete Widen & Concrete Surfacing
Miles:	5.080
Date:	October 21, 1958
Award Amt	$164,386.22

M-140 Old---North Limits Watervliet North, West and North to County Line

Project No:	M 11072 C3R
Type.	Bituminous Concrete Resurfacing
Miles	4.451
Date·	October 21, 1958
Award Amt:	$59,125.00

Structures Completed in Control Section No. 11016

5 @	$664,666.80

Structures Completed in Control Section No. 11017

6 @	$909,018.95

Structures Completed in Control Section No. 11018

2 @	$295,242.31

UNDER CONTRACT

US-12---Colome Park Road

Project No·	BM 11017 C4RN
Type·	G&DS, Aggregate Base, Bituminous Concrete Surfacing
Miles	0.212
Awarded.	September 9, 1958
Sched. Comp·	July 31, 1960
Award Amt·	$15,003.63

M-140 Existing---US-31 & US-33 North to Existing M-62

Project No:	M 11074 C1R
Type·	G&DS, Bituminous Aggregate Surfacing
Miles:	9.457
Awarded:	March 15, 1960
Sched. Comp:	October 30, 1960
Award Amt·	$249,256.40

Structures Under Contract in Control Section No. 11015

28 @	$4,293,539.11

Structures Under Contract in Control Section No. 11016

8 @	$2,050,209.76

Structures Under Contract in Control Section No. 11017

1 @	$ 91,046.00

PROGRAMED FOR LETTING OR LET

US-12---In New Buffalo & North to M-60

Project No:	M 11011
Type	Bituminous Resurface
Miles·	1.000
Let	March 1, 1960 (held)
Engr. Est:	$16,000.00

US-12 BR Rel.---(M-139) Fair Avenue East to I-94

Project No·	EBBF 11081 C5R & C6R
Type.	G&DS, 2@24' Concrete Roadways
Miles	2.300
Letting:	November 16, 1960
Engr. Est·	$650,000.00

US-31 & US-33---Whittlesey Road to Lane Drive in St. Joseph

Project No:	M 11052 C1U
Type	G&DS, Concrete Surface
Miles	0.247
Let·	September 21, 1960
Low Bid·	$116,200.50

I-94 (US-12 Rel.)---Indiana State Line Northeast

Project No·	BI 11014
Type·	G&DS, 2@24' Concrete Roadways & Structures
Miles:	3.107
Letting·	2nd Quarter 1962
Engr. Est:	$1,670,000.00

Figure 4. County status of projects.

STATUS OF PROJECTS FOR LETTING

Revised 10-14-60

2nd Qtr. 1962

M 05012
(1-59)

US-31 Eastport to Atwood

GI Held
R.O.W. - none required
Final plans - prelims 100%

BI 11014 C RN
BI B4, 5 & 6 of 11-12-5
(3-59)

I-94 (US-12 Rel.) Indiana State Line N. to M-60 & US-112 and Weigh Station & Rest Area

Engr. Report 1519 submitted to BPR 7-10-58
Abandonment Agreement - prepared
GI Held
R.O.W. - title search - 78
appraised - 78
optioned - 42
unsecured - 36 H/N 4-28-60 - R/E 6-20-60
pcls. w/bldgs. - 30
Final plans - 90%
Structure plans - BI B4 of 11-12-5 finals 100% BPR App'd
BI B5 of 11-12-5 finals 95% BPR App'd
BI B6 of 11-12-5 finals 100% BPR App'd
R.R. Agreement - none required
Utilities Advance Meeting Notice - submitted 1-12-59
Not Programed

BI 17033
BI B3 of 17-4-6
(3-61)

I-75 (US-2 Rel.) Dafter Road N. to Charlotte River

Public Hearing - scheduled 7-14-60
Engr. Report 1505 S Approved 5-58
Survey - completed 6-2-59 add'l survey completed 6-14-60
GI Held 10-6-59
R.O.W. - prelims rec'd 7-13-59
title search - ordered
Final plans - plotted 100%
Structure plans - assigned
R.R. Agreement - none required
Not programed

BI 17034
BI B1 & 2 of 17-4-6
(3-61)

I-75 (US-12 Rel.) Charlotte River N. to S. Limits of Soo

Public Hearing - scheduled 7-14-60
Engr. Report 1498 S Approved 3-58 (line change)
Survey - completed 6-14-60 - add'l survey 100%
GI required
R.O.W. - see FAS 231 N. to Easterday St.
Final plans - plotted 100%
Structure plans - BI B1 of 17-4-6 assigned
BI B2 of 17-4-6 assigned
R.R. Agreement - none required
Not programed

Figure 5. Status of projects for letting.

each month. Figures 3a-3d show samples of these strip maps, and reports. Dots indicate to management the phase of the project which is falling behind in schedule.

It became apparent, when the Commissioner and management who had to meet with

the public and county officials, and also public relations for county press releases, that it was desirable to have reports giving the complete data on every project by counties. These were developed, giving a full picture in each county of every project included in the five-year program, giving type of construction, length of project, location of project, and either the engineer's estimates, or in the case the projects had been let, the contract award amount, and the complete schedule on all projects and other pertinent data relating to each project. These county reports are kept up-to-date weekly, and any supplements to the five-year program are inserted (Fig. 4).

Ninety days before a letting, weekly reports are given to top management on the right-of-way acquisition situation, as that has been one of our problems causing some delay in letting projects on schedule in the past. This permits management to take necessary steps to, wherever possible, give these projects that are behind schedule special attention to facilitate an increase in acquisition of right-of-way involved (Fig. 5). This central reporting section, due to the current information available on all projects, receives many requests each day from divisions and others concerning the status of projects within the five-year program, and it also supplies the Bureau of Public Roads with copies of these route reports.

Additional duties of this section include information on various types of highway road and bridge construction; maintenance data on Michigan State highway system for maintenance budgets; written and map data for legal establishment and abandonment of State trunklines and for the relinquishment of service roads; designation and control of departmental chargeability of highway engineering, right-of-way acquisition, construction, maintenance and related activities by control sections; various types of records, statistics, and logs on each control section and various reports on State, Federal and county road systems; departmental reports to the Governor, Legislature, Bureau of Public Roads, U.S. Congressmen, and other agencies; data for highway needs, and finance studies; the legal historical and current status of the trunkline system revision; and presentation data for highway maps, trucker maps, construction program maps, etc. The section prepares reports and special assignments for division heads, Deputy Commissioner, Managing Director, and the Highway Commissioner.

The financial projection of future income and expenditures used by the Michigan State Highway Department is fully covered in a paper presented by Alfred H. Lawrence, at the October meeting of the AASHO.

Although the central records and reporting section has been in operation for over a year, and has contributed much to management, there have been some projects that have not been able to meet the scheduled letting dates through unforeseen difficulties. However, these have been very much in the minority, and very few have been delayed over one or two months from the original schedules. Most delays in meeting schedules have been caused in acquisition of rights-of-way.

In the fiscal year 1959-60, we had approximately 1,500 condemnation cases, and each one of these cases generally took about 90 days before right of entry was secured. This has created some delay in letting projects. We have been able to advertise projects where all right-of-way has not been secured, and all buildings have not been removed, by inserting a clause making the contractor aware of these situations so that no claims would be made against the department for delays. We are, however, holding the divisions to the previous schedules, and are making every effort to eliminate delays in advertising projects on schedule.

Central reporting can only be successful with the full cooperation between top management, the divisions, and the districts as well.

Discussion

Granum.—This is one element in carrying out a systematic programing procedure.

Near the beginning of Walker's paper there is a classic understatement to the effect that, "It also seemed desirable that some central system of reporting to top management," and so forth. This seems so essential (in fact the whole subject of our meeting

for these two days seems so essential) that we can ask, "Well, why hasn't this been done before in a comprehensive way?"

I am sure that every State has pieces of it, but I believe it is the comprehensive approach—from beginning to end—that we are trying to resolve today.

A good deal of what Walker has presented is somewhat like the telephone company's presentation. But I notice that there are some things missing—money, for example. And in Bidell's paper we have indicated the importance of money in these operations.

Babcock.—Walker, how large a staff do you have doing this work?

Walker.—On the program performance staff, we have about six people. We found that setting it up required quite a staff, but keeping it up does not require anywhere near the staff.

Most of that work is done at the lower levels. There is no way of knowing how many manhours of top level time are saved.

Another advantage that we find is that, in having this material flowing in on a current basis, we have at our fingertips many, many answers that could not be gotten together formerly in a month's time.

Babcock.—In other words, this section is fundamentally just a reporting section to management, which tries to unscramble something that is not going right?

Walker.—That is right—in the program performance area, it is.

Granum.—What do you do about the advance planning such as area, regional, corridor and city general route location studies? Is that scheduled, as well as the more detailed location studies, design, etc.?

Walker.—Yes, that is handled by planning. All of that has been done, and we expect to announce another five-year program that will be scheduled by the pre-construction engineering operations in the same way. That will be publicly announced before the first of the year.

Of course, our programs will drop. This year we hope to hit, in actual awards, around $245 million. When engineering is included, it goes up to $325 million. The next five-year program will have rather a uniform program of $140 million a year, including right-of-way and engineering.

Granum.—Is the broad-gauged advance planning, such as might involve an origin-destination study of an urban area, set into these advance schedules, with a completion date, etc.?

Walker.—Yes.

Aitken.—You referred to your major sources of money. Now, since this was made in 1957, it was before the Federal-aid trust fund was in trouble. I assume that the money from your bonds gave you enough latitude so that you could stay within your schedule. All you did was shift the source of financing. You did not have to delay projects?

Walker.—That is right. Michigan's loss, I think, was about $25 million a year. But by selling bonds we stayed on schedule.

Aitken.—That is one thing that gives us a great deal of trouble in the District of Columbia. We do not have bonds. And we are better than a year behind in terms of availability of Interstate money apportioned to the District. So it is a difficult problem.

Granum.—Aitken, you are behind on your money. Does that mean you are now a year ahead on plans?

Aitken.—We have plans more than a year ahead. We had the District funds to match, but we cannot get the Federal money. And with 90 percent coming from the Interstate fund, this is serious. This delay is hurting the program in the District, because we cannot get sections of freeway finished and in service.

Walker.—Has any other State set up a reporting and control system?

Granum. — Ontario certainly has. Bidell has just described it, generally. But what about others? Does anybody want to volunteer?

Buswell. — We have a pegboard on which we keep a record of every project, and we pull out a tape to show what the status is. It is similar to what you have here, and yet different.

Legarra. — I do not know if we follow the central control in the same manner Walker does. We do have some of the various controls that have been described here, possibly handled in a somewhat different manner. Schedules of a particular project are maintained — insofar as design is concerned, right-of-way acquisition, etc. That is prepared in every district, on a monthly basis, and, submitted to headquarters where it is used as a control.

But we do not have one single control agency that accumulates all these data in one report. On the other hand, we have other types of controls, such as Federal-aid control, so that top management will be able to tell where we are insofar as Federal-aid is concerned. That is prepared by another group in headquarters. I assume that Walker's central agency does all of that.

Granum. — Except for money, I gather, which surprises me. Mr. Walker does not seem to deal with money problems at all.

Walker. — No.

Legarra. — Essentially, California has all the controls, but possibly in a little different manner from what has been described. I believe we cover the same information.

W. Johnson. — Kansas has a few individual controls, but nothing nearly so complex.

Babcock. — We have a master control board that I keep up-to-date. We usually know where the projects are. I have been interested in both of these papers. I already have some revisions in mind, based on them.

Donnell. — We really had not planned on quite as comprehensive a set-up as Walker has, but I can see its advantage.

We have been asked to set up a procedure whereby the Commissioner or chief engineer at any time can find out, with a telephone call, the status of any project, or within a short time would be given an IBM listing of the status of the whole program.

Hart. — We do not get as specific as Michigan does in setting up these individual time schedules for the various pre-construction operations. We are operating now on a letting date procedure, and more or less permitting the individual districts to work out this schedule up to the letting date.

We are hoping to move back into this pre-construction period, getting more headquarter's control of the individual sections of the pre-engineering; but we have not got it now. We are working on only the basis of a letting date schedule, and the individual things take care of themselves through the individual sections.

Granum. — Why are there only 23 of these progress route reports? You have a lot more projects than that in Michigan, haven't you?

Walker. — Well, these route reports are confined to the arterial and the Interstate System, because we have concentrated on Interstate.

On other projects, we have control through another report that has been kept up monthly a year in advance, and weekly when you get down close to the wire, similar to our 90-day report on right-of-way, that gives the status of all of those projects as we go along.

Granum. — Obviously a construction schedule and a pre-construction engineering schedule, time-based and money-based, is no good unless it is not only kept up-to-date, but revised in accordance with the situation as it develops. In other words, there is a feed-back problem which should affect both the availability of money, and the time and personnel problem.

I would like to hear some thoughts on that subject, because I think this is one of the

areas where programs and scheduling fall down. We start out in a big way, we have everything down in black and white, and the next thing you know, six months later it is so out-of-date that everybody forgets about it. It involves a lot of work and a lot of time.

Electronic computing may eventually give us the answers, but you will run into a lot of problems in that, I am sure.

Walker. — We are in the process now of examining all of our reporting. We are contacting management that we serve to determine the effectiveness and timeliness of our data, and for any ideas that they might have of how we can improve it. I think you have to do that, from time to time, on any system of this type. I said we have five or six people on the program performance, but we also have about 26 on these other activities in the sections.

Martin. — From my own experience, it seems to me that the commissioners' value of such reports would be multiplied, not merely added to, by articulating the money situation—and I am talking especially about pre-contract activity—with the technical status, such as Walker reports in Michigan.

I do not know what other commissioners have found, but it seems to me that ability to control the money situation as we go along is essential. I mean "control" in the sense of being aware of it, so that administrative measures can be taken with respect to the expenditures, as well as with respect to the technical progress that is being made. It would seem that the high speed computer would make this possible.

The use of computers would stand a chance, it seems to me, of giving a service that would be enormously greater than the service that a commissioner could get simply from the physical progress information. That is, it would be much better if he had the two timed together, so that the expenditure data were timed with the operating data, or substantially so.

Walker. — Of course, we have that in our county reports, either the engineer's estimate or the contract award amount, that the commissioner carries with him all the time. That is, the reports show projects in every county that are on the five-year program, both moneywise and schedulewise, and what we have done and what we are doing. That is one service.

Granum. — California has a fairly effective money reporting system. They have a reservoir in which savings from award prices are thrown back into the pot and made available for use on other projects from time to time. Conversely, over-runs are paid for out of this reservoir.

Iowa has a somewhat similar procedure. Iowa has a fairly good basic programing procedure, which they are just getting into effective use over the past couple of years.

As an example, Iowa found last summer that $5 million were not going to be spent as planned in the current budget year, because of bad weather delays last spring. Projects that had been awarded did not proceed as rapidly as they had expected, and so their cash outlay would be $5 million less than anticipated.

Through their system of keeping track of the money schedule as well as the engineering schedule, they were able to pick up this $5 million and award that much more work this year, advanced from the second year construction schedule to the first year, because they had plans available.

Donnell. — At what stage in Michigan to you determine which routes are going to be improved? Evidently that follows important routes, where a decision has been made at some time by the Commissioner that route so-and-so is going to be built. That would affect the priority rating.

You might want to build low-priority sections into certain routes that had general priority; for continuity purposes you would want to build those in to improve a whole route in Michigan.

At what stage does that type of broad planning come in?

Walker. — That was all done prior to laying out the five-year program. It so happened that our Interstate routes were the ones that were really bad, as far as traffic congestion, alinement, etc. are concerned. So there was no criticism when we planned to go to work mainly on the Interstate System.

Donnell. — Who made the decision as to which one of those routes should come first?

Walker. — The planning division. We do not have to get approval from the legislature on any program. That rests within our own department. The Commissioner makes the final approval.

Hall. — I would like to throw a cautionary thought in about these detailed reports. Let me give a very recent experience.

In Phoenix, five weeks ago, I found that the residential improvement districts reports were prepared monthly at great length, some six or eight typewritten pages. I read them and could not make heads or tails of them. I asked the city manager and council, and they said, "Yes, we do receive these filings each month, but we can't understand them, either."

Then I inquired, and was given a three-page, three-foot-square report in bar chart form, which identified in great detail every step of every major street project, although none had been put to contract for about three years. It did show why the status was not moving.

I inquired of the council and the city manager what use they made of those, and they said not only did it make them mad because it indicated no progress, but it made them mad because they could not understand them.

The last report just received had only six lines on it. Top management now has: the number of petitions being circulated, year to date and last month; the hearings, year to date and last month; the approved petitions; miles under petition; miles approved; and total dollars under construction and approved. No one had figured it out until we totaled it. It was $900,000 worth of work since January 1, 1960.

Those six elements, as far as I am concerned, give me enough information to start controlling, I think, because if this does not move month to month, I will find out why. But I do not have to spend hours trying to figure out where all these particulars are.

Now, for the major streets, the big money projects, I would propose to have some sort of similar control. The point I am trying to make: I wonder sometimes, how much detail we need. I do not know the answer. But we are searching, in city work, to try to find some means for management control that will alert us quickly if something basic is going astray.

Granum. — You probably need several levels, do you not? A pyramid of less and less detail which reaches a very distilled point at the top?

Hall. — I think you summarized it very well. In the engineering division of a city, surely the bar charts and the progress details are essential; but to the director of public works, I would say quite a bit can be cut out. I do not need all that. And the council needs less than I do.

Bidell. — Would you like to discuss Ontario's tentative control system? We try to keep a rather strict control on both the money, the way the cash is going out, and on the status of the preparation of all of these jobs. Furthermore; we do not bother reporting to management anything that is on schedule, because possibly a year or so before this, they had approved this schedule. If it is on time, as far as we could see, management is not really concerned.

Therefore, we concentrate on bringing to management's attention only those projects that are falling seriously behind, and if there is a serious financial problem looming in the immediate future.

I would agree that too many details can be presented to management. We have found that if you present too much detail, they do not know anything about it, because they do not bother reading it. They just get the report and put in aside and they are not really aware of the problem, if there is any. We have found that selecting the problems that we think management should be made aware of, and only presenting those to them, is the best approach.

Granum. — How do you keep track of where you are?

Bidell. — We go through the charts and if everything is being awarded on schedule, we

are assuming that that is the way the money is going to be spent. But if we find that there are cases of serious deviations from the schedule of awards that have been set up previously, then we start studying it to see what effect it is going to make on the outflow of money.

Furthermore as in Iowa, if we find that this year, for example, we are going to have more money than we thought, we advance some projects that are ready — some of those that we were not intending to award until a later date.

Haxton. — I agree with top managements lack of interest in detail; but if you could see some of the correspondence that comes into the Washington office of the Bureau of Public Roads, you might want a little more detail. We have all of your Congressmen, Senators and constituents asking us questions, and they want answers.

Granum. — What experience have the States had with various kinds of visual aids on production control; such as, the Productrol and the Schedulegraph equipment that is commercially available? Would anyone want to comment on that?

Bidell. — We used it, but we found it was difficult to cart around to the various rooms in which meetings took place. So we discontinued the use of the Productrol.

England. — We tried it for a while and gave it up, for the same reason. We found we had to keep a staff working on it all the time to keep it up to date, plus the fact that we could not move it, unless we photographed it and took the photographs into the meetings.

Babcock. — Our biggest problem is not in the scheduling. The biggest problem that faces me and a lot of other people is the fact that we do not have as rational an understanding as I think we should have as to what can be produced in a given time. We need a measurement of engineering production efficiency, because, in setting up a construction schedule, you first make your basic assumption that it is equivalent to the efficiency of your organization. I wonder if anyone has a pat answer?

Walker, have you any data showing that we should allow X amount of time for X number of people to design a given kind of a bridge?

Walker. — We have a book that was made about a year ago, in which they went into design. I am not too familiar with it.

Granum. — Ontario could supply some information along that line. It has been suggested that the Ontario data be prepared as a Highway Research Board paper, because it was a research project and a very valuable one.

Burnes. — This gets into the area of work measurement, which I think plagues quite a few administrators, if not all of them. In an effort to get at work measurement, in one sense, by finding out what restricts plans production the Bureau of Public Roads has had a pilot study under way in Wisconsin for about 18 months. We hope to find out some of the restrictive elements, both external and internal, to plans production, and from that maybe we can work out some work measurements.

Session Five

Tuesday, September 20, 1960, at 7:30 P. M.

ADMINISTRATION AND MANAGEMENT

HOPE S. WILEY, Presiding

Highway Programing Law

DAVID R. LEVIN

It is perhaps characteristic of much of the highway subject matter most of us have to deal with, that it is all so interrelated in its component parts. Such, too, has been our experience in trying to excavate and evaluate the law dealing with highway programing. We begin by trying to isolate those provisions in the statutes that deal directly with the matter and soon we find that we have gone way beyond those provisions and have gone into many other kinds of things, but only because they concern the matter of highway programing, directly or indirectly.

This analysis of the legal basis for highway programing is based upon a study of the law that is now in progress under the auspices of the Highway Laws Committee of the Highway Research Board. Miss Helen J. Schwartz, of the District of Columbia Bar, is doing the work on this phase of the Highway Laws Project. There are also some other sources of information to which I have had access. Because we have not yet completed the assembly and analysis of statutes and case materials, this cannot be deemed to be an exhaustive treatment of the legal aspects of programing. But a good bit of the ground is believed to have been covered; accordingly, it should be revealing of the general state of the law on the subject and its deficiencies, if any.

The law relating to highway programing may be said to be a composite of elements relating to long-range planning, annual programs of needs, the cumulation of certain kinds of data for budget and finance purposes, the sufficiency rating mechanism, intergovernmental cooperation, highway system classification, the acquisition of lands for future highway needs, and perhaps some others.

LONG-RANGE HIGHWAY PROGRAMS

Only a handful of States have statutes relating, even generally, to long-range highway programs. Thus far, we could find only twelve such States. The nature of these provisions is detailed in Table 1. All but four of these involve the State highway activity; one (Connecticut) is limited to towns in its application; another one involves the State Department of Commerce (Massachusetts); the remaining two are limited to counties (Texas and Washington).

The variations even in these few statutory provisions are many. For example, the Arkansas law authorized the State Highway Commission generally to establish a program of current and long-range planning for the State Highway system.[1] More detailed provisions are found in Illinois, Indiana, and Iowa, making it the duty of the highway commission specifically to prepare, adopt, and publish a long-range program containing statements of intended construction and other related works, an estimate of revenues which will become available, and such other information as will enable the public to

1/ Arkansas Statutes 1947, 76-201.5.

have the most complete understanding of the needs of the highway system.[2]

Incidentally, these laws also provide that the sufficiency rating principle be applied insofar as is practicable, in determining the projects to be included in the long-range program. The enactments also specify that there be a periodic reinspection of the system of highways, in order to better revise the estimates of future needs to conform to the actual physical and service condition of the highways.

ANNUAL PROGRAMS

Highway officials are sometimes directed, either as part of a long-range program, or independently thereof, to publish a program of highway improvements to be accomplished within the following year, as in Illinois,[3] or within the following two years, as in Indiana and Michigan, for example.[4] At least seventeen States are known to have general provisions relating to annual programs, and these are outlined in Table 2.

Annual programs are required by statute in some States which do not have long-range programing requirements. For example, in North Dakota the chief engineer is required by law to submit annually to the highway commissioner, a statement showing what improvements, structures, and construction work have been requested and proposed and may be undertaken by the department. This statement is to contain the estimated quantities and the estimated unit cost of each class and type, together with the totals for each project or improvement, and the totals for all such projects or improvements, and the average quantities and unit costs for all such projects or improvements. From this, the highway commissioner is to adopt a construction program, determining what projects and improvements are to be undertaken during the ensuing construction season, and their order of priority.[5]

Some of these provisions relate to highway departments at the local level, as in Colorado, Connecticut, Indiana, Iowa, Minnesota, Mississippi, Nebraska, New Jersey, North Dakota, and Tennessee. For example, the Nebraska law requires that the county highway superintendent submit to the county board, the annual county road program which proposes a schedule of construction, repair, maintenance, and supervision of county roads and bridges, including Federal-aid secondary road projects, as well as a list of equipment and material purchases to be made by the county within the limits of the estimated county funds, for the ensuing year. It then becomes the duty of the county board to give notice by publication, of the date of a public hearing on the proposed program. Thereafter, the county board adopts an annual highway program which includes a schedule of construction, repair, and maintenance projects, and their order of priority.[6]

Highway programs are sometimes required as a part of the annual budget. For example, the budget report of the California Department of Public Works must include a section showing all proposed expenditures and obligations to be incurred, in each county group, for major construction and improvement, segregating the route of each highway to be constructed or improved, the county in which it is located, the number of miles involved, and a description of the type of work to be done.[7] In Colorado, the general highway budget summary is to be supported by explanatory schedules or statements classifying the expenditures by organizational units, objects, and funds.[8] In Florida, the budget is to be accompanied by a program of work to be undertaken during the ensuing budget year.[9] An interesting provision of the Florida statute is that the program of work may list projects, the sum total of the estimated cost of which may exceed the amount budgeted by 50 percent, in order to provide alternate projects in case any particular project listed in the approved program cannot be undertaken. The purpose of this

---

2/ Smith-Hurd Ill. Ann. Stats., ch. 121, 4-301; Burns' Ind. Stats. Ann., 36-2943; Code of Iowa 1958, 307.5 as amended by 1959 laws, H.F. 463.
3/ Smith-Hurd Ill. Ann. Stats., ch. 121, 4-301.
4/ Burns' Ind. Stats. Ann., 36-2943; Mich. Stats. Ann. 9.1097(14).
5/ N.D. Rev. Code of 1943, 24-0303.
6/ Rev. Stats. of Neb. 1943, 39-1503, 39-1508.
7/ Deering's Cal. Codes, Sts. & Hwys. Code, 143.1.
8/ Colo. Rev. Stats. 1953, 120-2-11.
9/ Fla. Stats. 1957, 334.21(3).

TABLE 1

STATE STATUTORY PROVISIONS RELATING TO LONG-RANGE HIGHWAY PROGRAMS, 1960

State	Authority Responsible	Type of Program	Number of Years
Alaska	Department of Public Works shall establish	Continuing, long-range program for highway construction and maintenance	Not less than five years, projected annually
Arkansas	State Highway Commission authorized to establish	Program of current and long-range planning for State highway system	
Connecticut	Any town at its annual meeting may provide for	Repair of its highways	Periods not exceeding five years
Georgia	Division of Planning (or other division designated by State Highway Board) with other engineering and design divisions of the Department, and the U.S. Bureau of Public Roads in matters involving Federal funds, shall prepare	Long-range biennial programs of improvements under Federal-aid urban, Federal-aid secondary classifications	Flexible programs as basis of biennial programs of improvement work. Board to arrange that the surveys and drawings and the appropriate specifications shall be made available from among the projects in such scope, amount, and classes as would provide at least a full year of work under the fund allocation available
Illinois	Department of Public Works and Buildings shall prepare, formally adopt, and publish	Long-range plan of its future activities for State highway system	
Indiana	State Highway Department shall prepare, formally adopt, and publish	Long-range program of its future activities with regard to highway construction	Biennial plan annually adopted from long-range plan
	Board of Commissioners of county	Construction plan for county highway system	Four-year program prepared at two-year intervals
Iowa	State Highway Commission shall adopt and cause to be published	Long-range program for primary road system	At least five years, brought up to date and republished at least once a year
Massachusetts	Division of Planning of Department of Commerce to assist in	Preparation and execution of long-range capital budgeting and programming of public works projects	
Michigan	Each County Road Commission and incorporated city and village shall submit to State Highway Commission for approval	Biennial highway and street programs, based on long-range plans, with standards and specifications for projects included	
	State Highway Commissioner includes in his biennal report to the Governor and legislature a summary of	Program of improvements scheduled for the next biennium by the State Highway Department, County Road Commissions, and incorporated cities and villages	
New Hampshire	Department of Public Works and Highways is authorized to	Cooperate with Department of Administration and Control in long-range capital planning	
Texas	Commissioners' court in certain counties adopt	"Master Plan" - survey by county engineer with view to determining needs for new highways	
Washington	County road engineer to file with Board of County Commissioners (within six months of June 1949) and board to adopt	Long-range county road program	For period of not less than 10 years

provision is to make the program of work of the highway department flexible by providing alternate projects for road construction and maintenance, without, at the same time, including an amount in the budget which is greater than the resources available for that purpose.[10]

OBTAINING DATA NECESSARY FOR PROGRAMING

A few States have in their statutes formally authorized the highway department to make studies or surveys of highway needs, in order to provide an objective basis for programing. Thus, the Michigan highway commissioner is authorized to make continuing studies of highway conditions and deficiencies, at regular intervals, in order to re-evaluate highway needs, and to thereby keep current the results of previous studies and reports.[11] The Michigan enactment further provides that all county road commissions and incorporated cities report annually to the State highway commissioner, the mileage and condition of each road system under their jurisdiction.[12]

10/ Fla. Stats. 1957, 334.21(5).
11/ Mich. Stats. Ann., 9.1097(9a).
12/ Mich. Stats. Ann., 9.1097(14).

TABLE 2

STATE STATUTORY PROVISIONS RELATING TO ANNUAL HIGHWAY PROGRAMS, 1960

State	Authority Responsible	Program Description	Determination of Priorities
Alaska	Department of Public Works adopts	Annual construction program which is included in detail in the long-range program submitted by Governor to legislature annually	Annual construction program establishes project priorities (may be amended as circumstances warrant)
Colorado	State Highway Commission to determine	Priorities for construction on State highway system annually	In establishing priorities Commission shall make use of sufficiency rating
	Boards of County Commissioners to submit to State Highway Commission	Priorities for construction of roads, streets, and highways annually	May use sufficiency rating
Connecticut	Selectmen may	Provide for repair of highways for one year if town fails, at its annual meeting, to make long-range provisions	
Florida	State Highway Board pursuant to tentative budget and work program prepared by Executive Director of State Road Department	Program of work setting forth all construction and maintenance projects for ensuing year under the budget	Board shall use results of sufficiency rating
Illinois	Department of Public Works and Buildings	Annually adopted from its long-range plan, and publish plan of construction for the next calendar year	Projects listed in order of urgency (deviations from adopted programs permitted in cases of emergency)
Indiana	Board of County Commissioners of County	Annual plan for maintenance and repair of county highway system to contain program, nature of work to be done, and estimate cost	Construction plan sets forth section of system to be constructed, year in which to be done, type of construction, and estimated cost
Iowa	State Highway Commission to publish	Annual program for next calendar year (as part of long-range program)	Lists definite projects in order of urgency, to include a reasonable year's work with estimated funds
	Board of Supervisors, subject to approval of State Highway Commission shall adopt	Comprehensive program for calendar year based upon construction funds estimated to be available	Board may have county engineer make written report designating in their order of importance the roads which, in his judgment are most urgently in need of construction
Maine	Head of Department to submit to Department of Finance and Administration	Work program for ensuing fiscal year, including all appropriations available and requesting allotments (Governor and Council review and may revise requested allotments before approval)	
Maryland	State Roads Commission shall, upon request, furnish Board of County Commissioners	Plan showing how county system may best improved as a concomitant to the State system, and suggest an annual program based on county funds available for construction	
Minnesota	Town Board shall render to annual Town meeting	Statement of improvements needed on roads, cartways, and bridges for the ensuing year, with estimate of cost	
Mississippi	County engineer must file	An annual program with the division of State-aid road construction in order for county to be entitled to State-aid, to be approved by State aid engineer	
Michigan	Township commissioner of highways to render to township board annually	An account in writing stating the permanent road and bridge improvements which should be made during the next ensuing year	
	Board of County Commissioners, on basis of county highway engineer's surveys	Annually determine tax, specifying roads upon which it is to be expended	
Nebraska	County Board to adopt	County highway annual program Schedule of construction, repair, and maintenance projects	Includes order of priority of projects
New Jersey	Counties and municipalities file with Commissioner for his approval	Annual work programs governing expenditures of State-aid funds	
North Dakota	State Highway Commissioner shall	Review the annual programs for each of the major systems to insure coordination of planning	
	County and City Authorities shall initiate	Programs for the road systems of their respective counties, to be approved by the Commissioner	
	State Highway Commissioner	Adopt a construction program for department for ensuing construction season, to contain projects and improvements and their order of priority	Priority given first to improvement of primary system insofar as is practicable
Tennessee	County Road Authorities shall submit to Department of Highways and Public Works	Annual program of improvements to be carried out under rural roads system charter to the status	
Wisconsin	State Highway Commission	Annually determines improvements to be made during succeeding year and notifies county clerks as to improvements in their respective counties	
	State Highway Commission	Prepares a future construction program, when it agrees with county on project under the State trunk highway allotment	

Employing a little different approach, the Georgia law authorizes the State highway board to employ inspectors whose duties shall include that of going into the several counties to inspect, measure, and gather information necessary for the compilation of such information as is deemed by the board to be necessary to facilitate sound long-range planning of highway construction and maintenance.[13]

With still another variation in it, the Arkansas enactment dealing with revenue distribution declares it to be the State's policy to stabilize the use of certain of its highway revenues, by providing for their distribution among the State, counties, and municipalities according to the relative ratio of use of State highways, county roads, and municipal streets. The highway department, accordingly, is directed to make a study of the use of these highways every four years, and to file a report of its findings with the Governor and the General Assembly, so that such changes may be made in the then-existing law as are deemed necessary to conform with the State's declared policy.[14]

PROJECT PRIORITIES AND SUFFICIENCY RATINGS

A few States have legal provisions concerning the factors which shall determine the order of priority of highway projects in the program. Some even go so far as to direct the use of the sufficiency rating device in this connection.

The variations are legion. Such provisions range from the Arkansas directive that, insofar as practicable, priority shall be given first to the improvement of the primary State highway system,[15] to one providing that the order of selection of county roads, in establishing the road construction program within the respective counties, shall be: first, those county roads presently used for school bus routes, mail routes, and milk routes; second, those used for two of the aforementioned purposes; third, those used for any one of the aforementioned purposes; fourth, those which may be used if improved or restored, for any one of the aforementioned purposes; and finally, any other county road if consideration is given to the number of farms or service units served by such road and the amount of traffic on it.[16] Although one may applaud the general notion of having criteria written into the law, we may well ask ourselves at this point whether those indicated, in whole or in part, represent an adequate approach to a scientific determination of priorities, even if some predetermined policy objectives should prevail. It may well be that, in addition to or in place of those specified, other standards or criteria need to be considered and written into the law.

It is perhaps pertinent, in this connection, to consider an Iowa statute. It provides that in planning and adopting the county secondary road program, the board of supervisors and the county engineer in each county are directed to give due and careful consideration to the following: (1) the location of primary roads, and of roads improved as county roads; (2) market centers and main roads leading thereto; and (3) rural mail and school bus routes. The stated intent of this provision of Iowa law is that when the program is finally executed, it will afford the highest possible systematic, intra-county and inter-county connections of roads of the county.[17] After consultation with the county engineer, the highway board provisionally is directed to select those roads which they consider advisable to be included in the program, and directs the engineer to make a reconnaissance survey and estimate of all these roads or of such segments of them as, in view of the public necessity and convenience, present the most urgent need for early consideration. Additionally, when ordered by the highway board, the engineer is to submit a written report designating, in their order of importance, the roads which, in his judgment, are most urgently in need of improvement. The board may order additional reconnaissance surveys and estimates when it deems them necessary or advisable.[18]

At least seven States have statutory provisions relating to sufficiency ratings. The

---

13/ Code of Ga. Ann., 95-1612.
14/ Ark. Stats. 1947, 76-309.1.
15/ N.D. Rev. Code of 1943, 24-0303.
16/ Mo. Rev. Stats. 1949, 231.460.
17/ Code of Iowa 1958, 309.25.
18/ Code of Iowa 1958, 309.26 to 309.30.

factors specified in the law of each of these States are summarized in Table 3. These seem to group themselves into those relating to safety and service characteristics, physical condition, and other elements.

TABLE 3

STATUTORY FACTORS TO BE USED IN ESTABLISHING HIGHWAY SUFFICIENCY RATINGS, 1960

State	Safety and Service Characteristics	Physical Condition	Other Factors
Colorado	Traffic volume; composition of traffic	Width of roadbed; pavement type	Other construction factors as deemed necessary
Florida	X[1]	Structural adequacy[1]	
Illinois	X	X	
Indiana	X	X	Purdue University studies, data, and information
Iowa	X	X	
Louisana			Most urgent needs[2]
Nebraska	X	Surface condition	Economic factors

1/ The determination of rating accorded these factors shall take into consideration the volume of traffic using the roads, and the minimum engineering standards required to safely accommodate such volume of traffic; age of roads; width of pavement and shoulders; number and degree of curves, both horizontal and vertical; ridability; and maintenance economy.

2/ In fixing priorities, board shall consider condition of roads and relative urgency of improvements considering in their order of general needs, traffic volume, accident records, technical difficulties in the preparation of plans and procurement of rights of way as well as unforeseeable emergencies such as floods. Department is directed to have prepared, at intervals not to exceed two years, a sufficiency rating of its highways to aid in establishing priority on the basis of most urgent needs.

Let us consider a few specific laws. The Colorado Statute directs the State highway department to promulgate and adopt rules and regulations for a practical system of rating roads, streets, and highways, based upon sufficiency rating studies, for the systems under its jurisdictions. In establishing construction priorities, the State highway commission is to make use of a sufficiency rating which takes into consideration traffic volume, composition of traffic, width of roadbed, pavement type, and such other construction factors as the commission deems necessary, in order to adequately compare existing highway facilities with the known desirable standards for highways.[19]

In the Florida law, the sufficiency rating is defined as the objective rating of a road or section of a road for the purpose of determining its capability to serve properly the actual or anticipated volume of traffic using the road.[20] The Florida State road board

19/ Colo. Rev. Stats. 1953, 120-13-36.
20/ Fla. Stats. 1957, 334.03.

is authorized and required, under the law, to adopt a system of sufficiency ratings of roads in the State highway system. It is to include, but is not limited to, the consideration of three factors—structural adequacy, safety, and service. The statute further provides that the determination of rating according to these factors is to take into consideration the volume of traffic using the roads, and the minimum engineering standards required to safely accommodate such volume of traffic; the age of roads; width of pavement and shoulders; number and degree of curves, both horizontal and vertical; ridability; and maintenance economy. In addition to these required factors and considerations, the board is authorized to prescribe, by regulation, other factors or considerations to be used in obtaining sufficiency ratings.[21] The board is to use the results of the rating of roads in determining priorities, not otherwise provided by law, when preparing the budget and work program.[22]

The Indiana statutes define sufficiency rating to mean any rating which assigns a numerical value to each road section, reflecting its relative adequacy based on an engineering appraisal of structural condition, safety, and traffic service. It provides that the sufficiency rating principle be applied, as far as it is practicable to do so, in determining the projects to be included in the long-range construction program.[23]

The Iowa State Highway Commission is directed by law to have published annually a sufficiency rating report showing the relative condition of the primary roads.[24] The statutes of Illinois, Indiana, and Iowa provide that the relative urgency of proposed improvements be determined by consideration of the physical condition, safety, and service characteristics of the highways.[25] Indiana also provides for the utilization of studies, data, and information made available by Purdue University.

The Louisiana Department of Highways, in fixing priorities on a project basis, is to consider primarily the condition of the roads, streets, and structures making up a part of the State highway system. Also to be taken into account is the relative urgency of the improvement considering in their order, general needs, traffic volume, accident records, technical difficulties in the preparation of plans and the procurement of rights-of-way, as well as unforeseeable emergencies such as floods.[26] The department of highways in Louisiana is directed to have prepared, at least every two years, a sufficiency rating of its highways for the purpose of aiding in establishing priority of improvements on the basis of the most urgent needs.[27]

The Nebraska law provides that the relative urgency of proposed improvements on the State highway system shall be determined by a sufficiency rating established by the department of roads, insofar as the use of such a rating is deemed practicable. The sufficiency rating is to include, but not be limited to the factors of surface condition, economic factors, safety, and service.[28]

INTERGOVERNMENTAL COOPERATION

A number of State statutes that deal with the highway programing process, directly or indirectly, contain provisions that provide for certain types of intergovernmental cooperation in the process. For example, the chairman of the State road board in Florida and the State highway commissioner in North Dakota are similarly authorized and have the responsibility for the coordination of the total highway program within their respective States. This coordination includes the designation of the highway system, the development of construction standards, and the review of the annual programs for each of the major systems, to insure coordination of planning and gene-

---

21/ Fla. Stats. 1957, 335.07.
22/ Fla. Stats. 1957, 334.21.
23/ Burns' Ind. Stats. Ann., 36-2943.
24/ Code of Iowa, 1958, 307.5 as amended by 1959 laws, H.F.463.
25/ Smith-Hurd Ill. Ann. Stats., ch. 121, 4-301; Burns' Ind. Stats. Ann., 36-2943; Code of Iowa 1958, 307.5 as amended by 1959 laws, H.F. 463.
26/ La. Rev. Stats. 1950, 48:192A.
27/ La. Rev. Stats. 1950, 48:192B.
28/ Rev. Stats. of Nebr. 1943, 39-1337.

ral conformity with the law. In North Dakota, programs for the road systems of the counties and cities are to be initiated by the respective county and city authorities and approved by the State highway commissioner.[29] The Florida local authorities are authorized to cooperate with the chairman of the State road board.[30]

Boards of county commissioners in Colorado are authorized to use a highway sufficiency rating method in determining priorities for the construction of roads, streets, and highways under their specific jurisdiction. In this connection, the Colorado Department of Highways, upon request of the counties, shall furnish detailed instructions regarding the performance of such studies and their use in the establishment of priorities for construction and shall keep the counties informed as the latest developments and techniques regarding them.[31]

A variation is in the New Hampshire law, which provides that the New Hampshire Department of Public Works and Highways is authorized to cooperate with the department of administration and control in long-range capital planning to meet the needs of the State, as requested by the Governor and council and subject to their approval.[32]

Upon the request of the board of county commissioners of any county in Maryland, the State Roads Commission shall furnish plans and plats showing how the county road system may best be improved as a concomitant to the State system. The plan shall suggest an annual program of construction based upon the county funds available for construction and further suggest the types of roads to be built and furnish estimates of the cost thereof.[33]

Iowa law provides that in the preparation of the county secondary road program, the board of supervisors shall meet and consult with the township trustees as to the improvements needed for the secondary roads in the various townships.[34] The board has statutory authority, subject to approval of the State highway commission, to adopt a comprehensive program for the next calendar year, based upon the construction funds estimated to be available for that year. This has been interpreted to mean that the highway commission has authority to approve or disapprove the program only in relation to whether or not such construction program conforms to the standard plans and specifications and manner of construction.[35]

The Illinois statute authorizes the Illinois Highway Department to make investigations to determine the reasonably anticipated future need for Federal-aid and State highway purposes, including the making of traffic surveys, the study of transportation facilities, research concerning the development of several areas within the State and contiguous territory as affected by growth and changes in population and economic activity, and the collection and review of data relating to all factors affecting the judicious planning of construction, improvement, and maintenance of highways. It also provided that such investigations may be conducted in cooperation with counties, municipalities, the United States, sister States, agencies of any such governments, or other persons, in pursuance of agreements to share the cost thereof.[36]

ADVANCE ACQUISITION OF HIGHWAY RIGHTS-OF-WAY

The acquisition of highway rights-of-way, substantially in advance of its actual use for highway construction purposes, is a device that may facilitate the programing process. It will also save large sums of highway funds in the process.

The acquistion of lands in advance of its use for highway purposes is authorized in

---

29/ N.D. Rev. Code of 1943, 24-0208.
30/ Fla. Stats. 1957, 334-11.
31/ Colo. Rev. Stats. 1953, 120-13-37.
32/ N.H. Rev. Stats. Ann., 228:6.
33/ Ann. Code of Md. 1957, art. 89B, 77.
34/ Code of Iowa, 1958, 309.10.
35/ Atty. Gen. Op. March 26, 1958, which further found that the purpose of this legislation was to provide local self-government with a plan of checks and balances, the board to confer withthe township trustees and adopt a sound program, with a final check and approval of the program by the highway commission, re: Code of Iowa, 1958, 309.25 to 309.30.
36/ Smith-Hurd Ill. Ann. Stats., ch. 121, 4-303.

Title 23, U.S. Code, and Federal reimbursement will be permitted for lands acquired up to seven years in advance of construction need, under the present Federal-aid laws. Additionally, the statutes of 19 States now explicitly authorize the acquisition of land for future highway use.[37] Six other States sanction the use of this device, without benefit of a specific statute on the subject, by virtue of a favorable court decision.[38]

The idea of establishing what has been identified as a right-of-way revolving fund is growing among the States seeking to alleviate their right-of-way difficulties. It is also of assistance in the programing process. This technique generally contemplates the setting aside, either from highway funds or from general funds, of a sizable resource with which to acquire necessary lands, early in the planning process, just as soon as the location and nature of the highway improvement become apparent. When regular highway funds for the project become available subsequently, the revolving fund is reimbursed for the advance previously made. The only cost to anyone of this device is the debt service, real or theoretical, of the revolving funds. The intent of the legislature in establishing such revolving funds is to provide the money necessary to protect future highway rights-of-way from rapid land development and, in special cases, to acquire improved property in cases where existing substandard improvements might have to be removed and replaced by new and costlier structures.

This device is being used in at least 10 States.[39] During the past year, Ohio and Utah took a big step forward in highway right-of-way financing and programing, by passing new laws permitting the borrowing of substantial amounts of State pension funds for advance acquisition of highway rights-of-way. In Ohio, it is estimated that approximately 1 billion dollars of State pension funds are now available, and under the law, up to 10 percent, or approximately $100,000,000, can become available as loans for highway right-of-way acquisition, subject of course, to certain types of agreements being executed with the appropriate State agencies involved.[40] The law has recently been upheld by the high court in Ohio.[41]

CONCLUSION

This paper has summarized briefly the state of the law with respect to highway programing. There is really not a great deal of law on the statute books, and what there is might well be improved upon, in terms of the actual need for a broad and flexible legal authorization in this field.

There are elements, which, in the aggregate, can be taken to characterize the highway programing activity at its best. Many of these have already been enunciated, perhaps not in so many words, but in substance. And because they have been mentioned perhaps in a context not as specific as we might desire it, these elements may need to be carefully extracted from the rest of the substance that has been presented. If it were possible, then, to end up with a limited number of these elements, carefully identified, it would be a not too difficult job to formulate a suggested provision of law that embodies them. This could then become available for the consideration of those States that might be interested in strengthening their own legal structure on this point. It could also constitute a rallying-point for effective effort tending toward upgrading of the whole highway programing process.

37/ Arkansas, California, Colorado, Florida, Idaho, Indiana, Louisiana, Maryland, Nebraska, Nevada, New Jersey, New York, North Dakota, Ohio, Oklahoma, Texas, Utah. Virginia, and Wisconsin.

38/ Arkansas, Illinois, Iowa, Kansas, Mississippi, and Missouri.

39/ California, Indiana, Maryland, New Mexico, New York, Ohio, Utah, Washington, West Virginia, and Wisconsin.

40/ Ohio Rev. Code, 5501.112.

41/ State ex rel. Preston v. Ferguson, Ct. #36283, March 30, 1960.

Discussion

Morf.—In looking through Tables 1 and 2 in your paper, where you are abstracting the essential provisions, I was hunting for a certain word, which to me is an important attribute of a program. That is the word "publish." I find it in only three instances in these two tables, in connection with Iowa's and Indiana's long-term program, and in connection with Illinois' short-term program.

Levin.—That is very interesting. Apparently Morf is strongly of the opinion—and I would certainly agree 100 percent that publication is an important component of the programing process.

Morf.—The publication of a program is the commitment to it. So long as you have a list that you keep in your drawer and refer to from time to time, this to me is an administrative list, but it is not a program.

Donnell.—I would like to disagree. A program does not have to be published in order to be a program that the State highway department is going to use.

Levin.—Morf, do you think that publication should be required by law?

Morf.—It is an indication of the validity of the program's status if it includes the word "publication." If it does not, it becomes an administrative list.

Levin.—Of course, Alaska says, "The Department of Public Works shall establish ..." Just what does "shall establish" mean?

Morf.—I grant you there are many shades of meaning, but I believe that there is in fact a considerable difference between what is nominally a public record but in itself very obscure, and distribution of five or six thousand copies of a program for publication in the newspapers.

Hall.—I would like to raise a philosophical question. Is it not possible that things like standards or sufficiency ratings or priority programing are administrative or engineering items, and not matters for legislation, whereas the statutes that will provide for a revolving fund for advance acquisitions of rights-of-way are a legislative matter?

Levin.—You would rather not see such things as sufficiency ratings written into the statutes or required by statute, as some states do?

Hall.—It is a personal philosophical opinion that we should have as little engineering by law as is possible.

Kimley.—There is another term that Mr. Morf did not mention. He got the word "publish" in there. I would like to identify a little more in detail the term "long-range plan." Is that for two years, five years, ten years, or twenty years? Or more? In my opinion, the longer the range of the plan, the more valid it is for publication. The shorter the range, the less valid.

Levin.—Unfortunately, many of these statutes do not have any precise definitions of the terms they use. Some of them do. Some of them define in great detail what a sufficiency rating is, probably because the judges and the legislators and others would not have understood it without the definition. But they do not have any very sophisticated definitions of long-range planning.

Burnes.—The more of these devices you get into the law, the more you circumscribe the administrative prerogative of the administrator. Some of these things are administrative tools, like the sufficiency rating. So there is a question in my mind as to how much of this programing operation should be actually spelled out in legislative detail.

Levin.—What we now have, for example in Colorado, you would discourage entirely? You would urge Colorado to repeal what they now have? Or those other states that spell out such details?

Burnes.—I think so. It depends on the situation in the State, but, as a general rule, I do not think that this sort of thing should get into law.

Livingston.—I would like to comment. I wrote it into law. I accept the philosophical soundness of the premise that you should not write administrative provisions into any law. The law should be generalized, and the administrative provision should be left out. But Burnes just touched on the situation which sometimes makes you, from a practical standpoint, diverge from your philosophy.

We were having trouble of a type that many are aware of, and the only way we could take our programing and budgeting out of the arena of politics was to put them on the basis of engineering, making them a matter of statutory mandate, rather than trying to sell the idea. The statutory mandate overcame the political complexion of things. I believe that an idea is proved sound if it is successful—and this one has been successful.

Levin.—We have been wrestling with this very thing ever since we undertook the highway laws project four or five years ago. Do we try to encourage only a bare minimum of legislation?

Actually, a very strong case can be made for giving the highway department broad authority to build highways that are in the public interest, with authority to make any additional adminstrative rules and regulations needed to implement this basic authority, and letting it go at that.

But in some States this just will not do—for example, in the law governing contracts in Hawaii. We executed quite a law on that, but legally there is no sense in it, because Hawaii law defines contracts very well. We know when we have an offer and an acceptance. And yet in the highway field alone, the legislators, apparently because of the large sums of money involved, have felt constrained through the years to throw all kinds of so-called protections around the expenditure of this money. And they do so by tacking all kinds of qualifications on the execution of highway contracts. I am sure that what Livingston has said applies equally to that particular aspect of Hawaii law as it does to the subjects under discussion here.

So there is a grave policy decision that one has to make here, whether to include a lot of administrative provisions in the law, a few, or none at all.

Morf.—I feel somewhat the same way about the need for persuading people once, rather than once a year, and that there are certain bases for programing.

Table 3 has the title, "Statutory Factors to Be Used in Establishing Highway Sufficiency Ratings." If Illinois is in this table, it is in here by inference, because Illinois law says nothing about sufficiency ratings. It says: "in order of urgency." And it does not say how this order of urgency is to be established, whether by sufficiency rating, or by economic analysis, or anything else. It says: "in view of the safety and service and physical conditions of the highway."

This law does not commit the highway department. It happens to coincide with the major terms that are used in the sufficiency rating, but I do not think it says that you must use sufficiency ratings as we are using them now. I believe that Table 3 is useful, but I think that incorrect inferences are being drawn from its compilation.

Levin.—We will just take the term "sufficiency rating" out of the heading. As suggested it was assumed that sufficiency ratings were meant, because the statutes seemed to use about the same factors. But we should not presume to identify the stipulations of the law with a sufficiency rating when the law does not refer specifically to these ratings.

Livingston.—I would like to point out the very adequate description that you have given, where you adopt a philosophy by incorporating administrative provisions into the law, but then leave an out for yourself so that you do not get strangled by your own administrative provisions.

The paragraph reads: "Let us consider a few specific laws. The Colorado statute directs"—and this is lifted practically verbatim from the law—"the Highway Department to promulgate laws for the systems under its jurisdiction. In establishing con-

struction priorities, the State Highway Commission is to make use of a sufficiency rating which takes into consideration traffic volume, composition of traffic, width of roadbed, pavement type, and such other construction factors as the Commission deems necessary in order to adequately compare existing highway facilities with the known desirable standards for highways."

Notice the way that loosens it up, so that at any time we feel it necessary from an engineering standpoint, we can change that rating to compare with standards that are known to be desirable. So it is written into the law that we must use some kind of administrative tool, but we are left free to adjust that at any time we wish.

Levin.—That is a very good provision. The Colorado law is really in some ways a model.

Titus.—In that same paragraph, how would you interpret the words "make use of"?

Livingston.—Court determinations are often made on the basis of legislative intent, when the meaning is obscure. The intent, then, of the legislative body, or the committee, which wrote this provision, using an engineer's words, was simply that a sufficiency rating is only one of the tools necessary for programing, that it should not be the only item to be considered, but that it should be used.

In other words, we actually lift out of this data those road sections that have inadequate sufficiency ratings, and take note of other programing considerations in addition, in order to develop the program itself. So the law says only "make use of."

Granum.—This seems to me to go deeply into the question of making a choice of projects. Implied is a schedule of work, wherever it mentions long-range plans, but it does not necessarily require some of the other things that we have been discussing in the way of systematic programing procedures, with control features and so on. This may be an administrative matter.

But it is my belief that to be effective these things really ought to go together; and that if there is anything to be contained in the law, there ought to be some reference, it seems to me, to a systematic approach to choice of projects and the handling of them thereafter, or words to that effect.

Livingston.—I certainly concur. There is one other thing that is part of this basic law, which, because of the way a portion has been excerpted, has not appeared here. The law requires that the engineering for any projects which appear in an annual construction program shall have been done in the preceding year. This is another one of the devices for making the programing procedure systematic.

Granum.—Your law actually says that?

Livingston.—Yes, sir. And we are having a hard time enforcing it. There are many provisions of law that are mandatory on highway administrators, but are mandatory only in their wording, because there is no penalty for their evasion; except I presume, the impeachment of the officer for dereliction. Isn't this correct? I do not know.

Levin.—Well, it would not have to go that far. You could have a taxpayer suit which challenged some action of the highway department. In fact, it is conceivable that even in the acquisition of lands, the property owner could say, "You haven't followed the law in the derivation of this particular project, and accordingly you can't acquire my lands." If, after examination of the facts, the court felt that the failure to comply with procedural requirements of the statute was of sufficient importance to void the project, it might make the highway department start all over again.

Livingston.—Then no highway engineer in the United States is on safe ground.

Levin.—Well, apparently this has not been a serious legal deficiency, if you want to call it a deficiency at all. Courts seem to realize that the administrative process has got to have some flexibility, and they are willing to impart some by judicial interpretation. They do this every day.

R. Johnson.—It seems to me that whether these administrative techniques are included in

the law would be largely dependent upon the desirability of doing it. It would depend on the situation in the specfic State, because if there is a long tradition of the highway department being allowed to plan by use of these various techniques over a long period of time, without political influence, and a tradition of sound techniques, then there probably would be little need for a law to cover this sort of thing. On the other hand, if there is a history of political influence, it might be very desirable to get the specific administrative technique into the law.

That situation, it seems to me, is somewhat similar to the pros and cons of a civil service versus a merit system. If anything else has existed by virtue of long tradition, then the civil service law could be unduly restrictive. I think the same principle applies here.

Campbell.—You say in your paper that this job is not quite finished. Do you have in mind any other subjects to include in it?

Levin.—Well, I do not believe these tables, for example, are completely adequate. We are in the process of continuing the job, and in another month or so it will be completed.

For example, we have developed quite a comprehensive law on system classification, relating to the establishment, definition, and factors to be used in the derivation of highway systems, and a whole lot of material like this. But you ask yourself, "How much of this is pertinent to highway programing?" I wondered, "What is land acquisition for future use doing in there?" So you ask yourself the second question: "Isn't it all interrelated?" From this point of view, I think we will add a short section summarizing the system classification law, and then bring these tables up to date.

I do not think we quite went through all the States. We went through as many as we could, up to the point when I prepared this paper.

Granum.—With regard to developing model law in this or some other situations, it seems to me that Johnson's comments are quite pertinent. There are so many variations in the tradition, the history, the facts, the problems confronting the States, that you may find it exceptionally difficult to develop model law. Not that it would not be a desirable thing to work toward.

For example, Campbell's paper emphasized among other things the idea of having a parallel rating on economic benefits that would attach some importance in terms of priority decision. Now, should this be written into the law? Sufficiency ratings or some form thereof are written in some States. Should more sophisticated approaches, perhaps, be written into the law?

Levin.—I do not know. This is a policy matter that I think highway officials themselves should decide. I certainly agree that there are variations among States.

But perhaps one State has decided that they want to get something into their law on highway programing. There are a lot of pressures there that they want to counter, for the very reason indicated. So then they ask themselves, or ask us, or ask their sister States: "What do we put in the law on this? What would you consider the best kind of written statement?"

Now, fortunately, Colorado certainly has made an excellent beginning. In fact, reexamination may indicate that Colorado has everything in the law that could or should possibly be in there. And maybe all we need to do is hand out a copy of Colorado's law and then they can consider it.

This is what I mean by a model law, but sometimes I think we should not be talking of model laws as such. I am thinking of a law that suggests elements for consideration. It does not mean that any State has to accept all of them. It just means that one State has been thinking along certain lines and has the problem well thought out in a form which experts in the highway field think contains the essential elements of a particular subject.

That is the only purpose a so-called model law serves. It does a lot of thinking for all of us.

Wiley.—Only recently we had a study group going over the New Mexico Highway De-

partment and I was asked whether we should not write into the law the provision that we should use sufficiency ratings. Well, for the last seven or eight years we have been extremely successful in having sufficiency ratings used in programing, and I was of the opinion that to write it into the law might be the equivalent of saying, "We are going to make you do the very thing you have been doing." That might not sit so well. On the other hand, this might be the very time to get it in the law. I do not know.

Livingston.—If I were to rewrite that brief paragraph, I would eliminate the term "sufficiency rating," and would just say "an engineering rating." This would allow us to encompass the economic factor and the other. But this is the only thing I want to change.

Granum.—It looks to me as if you have enough leeway as it is.

Livingston.—I think so too. But if I were to rewrite it in the light of what has transpired, this is what I would do.

Administrative Requirements for Highway Construction Programing

W. F. BABCOCK

Many details of the programing of highway construction projects have been covered including methods of scheduling project construction through the various highway operations. This paper will attempt to summarize from a chief administrator's point of view certain basic administrative requirements for highway construction programing and describe what might be considered desirable responsibilities of the various legislative, policy making and administrative groups in the over-all planning and construction scheduling process. As a point of reference, it should be noted that the thoughts expressed are flavored in terms of the operation of the North Carolina State Highway Department, which has a responsibility for over 70,000 miles of highways. This over-all responsibility includes all of the primary roads, all of the rural secondary roads and approximately 30 percent of the city streets in the State. Within the corporate limits of the municipality, the Highway Department is generally responsible for the construction and maintenance of the major thoroughfares that carry traffic into and through these areas. The city has, however, a financial responsibility in the acquisition of the right-of-way for such thoroughfares.

In attempting to discuss administrative requirements for highway construction planning and programing, it might be desirable to first define what might be considered to be possible areas of responsibility of the various policy making and administrative groups.

THE LEGISLATURE

The adequacy and general level of service provided by the highway commission has a profound effect upon the economy and the development of the State. It is therefore axiomatic that the State legislature should have the ultimate responsibility for the determination of the amount and type of taxation to be levied for the maintenance and construction of highways. It must also determine the scope and magnitude of the highway operation as it relates to the city and county governmental operations. It should exercise control over the annual or biennial budget of the highway department. This control should consist of determining the amount of funds necessary for overhead, for maintenance, and should include appropriation breakdowns for construction of the various highway systems (Interstate, primary, secondary, and urban). The legislature should not become involved in any particular road project and should not develop arbitrary distribution formulas for road construction that make it impossible to provide a uniform level of service for all of the citizens in all areas of the State.

STATE HIGHWAY COMMISSION

The Governor of the State is responsible for the over-all administration of all State departments. The magnitude of the highway operation is such, however, that it is believed fundamental that the Governor should have a policy-making body, commonly known as the State highway commission. For purpose of continuity the highway commission should be appointive with overlapping terms. It should represent the public in all highway matters and have over-all responsibility for all policy-making decisions. Generally it should operate as a part-time body in the same manner that a city council operates as a policy-making body for many municipalities. It is believed that all basic policy determinations should rest with the State highway commission and that there should be a chief administrative officer whose responsibility it is to recommend

policy to the commission and to execute and administer the affairs of the highway department in line with the policies adopted by the commission.

The highway commission should have final responsibility for the adoption and recommendation of budgetary matters to the legislature. Their respnsibility should include the adoption of long-range highway needs studies and they should have final responsibility for the adoption of the short-range highway program. The activities of the commission should include the actual selection of projects to be included in any one year highway program. Once the highway commission has determined in the public interest those highway projects which appear to be most urgent and will provide the greatest benefit to the traveling public, the actual philosophy of the planning, design, and location of the facility should rest with the administration. Finally, the highway commission must have authority for the award of all contracts, the expenditure of funds to the various field divisions for maintenance and other activities. All policy matters and actions by the highway commission should be taken at monthly public meetings and be a matter of public record.

MANAGEMENT

It is believed that the efficient administration of the operations of the highway department can best be carried out by the development of two distinct levels of management which might be considered as staff functions and operational functions. Within this framework of functional responsibility there are three key positions, namely, the chief administrative officer, often referred to as the director of highways; the controller, or business manager of the highway operation; and the chief engineer.

The top level of management is referred to as the staff operation and consists of the chief administrative officer who has over-all responsiblity for the execution of the policies of the highway commission. To aid him in this activity, he should have several staff departments, such as personnel, public relations, central purchasing, legal, a department of secondary roads, (in North Carolina) and a planning department.

In addition, the chief administrative officer should have as his chief aid at the staff level, the controller of the highway department. The controller should be responsible for all financial operations, for developing proper audits and systems for the development of the proper flow and use of money on a business-like basis. The controller should be responsible to the director for making certain that all departments and activities are operating within the appropriate budgets. He should be responsible for reporting all expenditures and for carrying out financial policy matters as adopted by the highway commission.

The chief engineer is the deputy of the chief administrative officer and is in charge of highway operations. It is his responsibility to design, construct, and maintain the highway system. The chief engineer should have direct responsibility and authority over all operating personnel.

ADVANCE PLANNING

The matter of advance planning for highway projects is the key to efficient construction programing. The remainder of this report will concern itself with the organization of the planning operation and how from the administrative point of view the advance planning operation can be used to translate a project from the preliminary approval stage by the highway commission into the actual construction stage.

It is believed fundamental that there should be an advance planning department staffed to the chief administrative officer and that it should not be a part of the engineering or operational phase of the highway department. Those charged with the responsiblity for highway planning of individual projects or for the development of long-range highway plans should operate as a staff administrative unit and have no other responsibilities other than the planning function. In North Carolina, the entire planning operation is staffed to the chief administrative officer or director. The planning department is, however, broken down into two distinct units. One phase of the planning department headed by the State planning engineer is concerned with those studies normally made as required by the highway planning survey and is concerned

with the making of all types of traffic and origin-destination surveys. The other section of the planning department headed by the advance planning engineer has direct responsibility for the advance planning operations. This group reports to the director of highways and to a planning board which will be discussed in detail. The advance planning department is responsible to the director and the highway commission for the following activities:

1. The development of criteria as to the desirable levels of highway service that should be provided on the primary and urban highway systems. (In North Carolina all secondary road planning is handled by the department of secondary roads, staffed to the director, and operates under definite criteria set forth by the State legislature and the highway commission.)
2. Based on adopted levels of highway service as recommended by the advance planning department and as approved by the highway commission, it is responsible for the development of a long-range or 15-year highway plan which sets forth the needs on the various primary and urban systems and delineates the priorities of needed projects. This long-range plan estimates the amount of funds needed to provide the desirable level of service and is the basis by which the highway commission makes recommendations to the legislature as to the amount of funds that are required for highway purposes. The advance planning department is responsible for a continual review and up-dating of the long-range plan.
3. The department is responsible for making recommendations for a yearly construction program to be recommended to the planning board, the director, and finally to the highway commission.
4. When any construction project or group of construction projects have been approved by the highway commission, it is its responsibility to analyze the concept of the project, to call for such basic surveys and information as required and finally to make recommendation as to the specific details of the project as it pertains to a general corridor location and to the type and standards for the proposed facility, including locations and types of grade separation interchanges and other pertinent data that will later be used by the design department. They are responsible for obtaining estimates of costs of various alternate types of proposals that might be considered.
5. It is responsible for working cooperatively with all municipalities in the State in developing thoroughfare plans which are to be the basis for highway improvements in and around the urban area. (The 1959 Legislature of North Carolina, after a comprehensive study by many agencies, adopted legislation indicating that highway improvements in urban areas should not be contemplated until a comprehensive, over-all land development and thoroughfare plan had been adopted by both the city and the State as a basis for future highway improvements.)

ADVANCE PLANNING ORGANIZATION

The advance planning department is headed by the advance planning engineer. He has three staff assistants: (1) a rural transportation planning engineer who is generally responsible for the planning of projects on the rural portions of the primary highway system, (2) an urban transportation planning engineer who is responsible for working with cities and towns in the development of thoroughfare plans and is responsible for the general supervision of the planning of major primary and urban projects in and around the urban areas, and (3) a regional planner who is a qualified planner and is responsible for working with the urban transportation planning engineer in the cooperative development of thoroughfare and land development plans with cities and towns. He is also responsible for providing general planning guidance to both the urban and rural transportation planning engineers in terms of the over-all planning for the State.

These three key staff positions supervise a group of eight to twelve project engineers. The project engineers are assigned specific project proposals for analysis and recommendation. They work on the details of thoroughfare plans and the details of the long-range needs study. The project engineers are assigned specific projects approved by the highway commission and work up the basic concept of the project for submission to the advance planning engineer and finally in a complete report form for submission to the planning board.

The academic disciplines required for the advance planning department at the top level generally would be advanced or master degrees in the transportation engineering area. The regional planner should have an advanced degree in the general field of urban and regional planning. Project engineers for the most part are civil engineering graduates with some having advanced degrees in transportation planning. Other disciplines are also included within the framework of the project engineer operation, and they include planners, statisticians, specialists in land use and geography. In summary the organization of the advance planning department should provide the broadest possible scope in order that any proposed highway project will be analyzed in its broadest terms as to the economic impact that it may have upon the community rather than being analyzed only from the strictly engineering and traffic point of view.

THE PLANNING BOARD

As previously stated, the advance planning department reports to the director of highways and also to the planning board. The advance planning department is a staff department and makes recommendations but does not have final administrative authority on highway projects. The planning board is organized to analyze the recommendations of the advanced planning department and to provide a liaison between planning and design and engineering operations. It is also organized to provide liaison between planning, engineering, and the Bureau of Public Roads. The planning board consists of the director, the State planning engineer, the controller and the public relations officer from the staff departments. From the operation department, it includes the chief engineer and his four assistant chief engineers who are in charge of administrative activities, location, roadway design, and right-of-way activities, bridge location and design activities, and construction and maintenance activities. The Bureau of Public Roads is represented on the planning board by the division engineer, the district engineers and the planning engineer of the Bureau. The planning board meets each Monday morning to analyze the recommendations of the advance planning engineer who serves as secretary to the planning board. Final approval of a project planning report by the planning board normally moves the project from the planning stage to the engineering or design stage. As a means of summarizing the construction programing procedure and illustrating how it works in North Carolina, the following general procedure is followed.

CONSTRUCTION PROGRAMING PROCEDURE

In North Carolina the programing of projects is generally carried out on what might be considered an encumbrance procedure. The first step in the development of projects is the recommendation each year of a selected group of projects to the highway commission by the advance planning department, the planning board, and the director for their consideration. After thorough analysis of all of the high priority projects as shown by the long-range plan, the highway commission will then adopt in a preliminary stage a group of projects which will approximately equal one year's anticipated revenue of major Federal-aid and State matching funds and other State construction funds. These projects are generally approved for construction that will take place perhaps three or four years later.

This approved group of projects is then sent to the advance planning department for their recommendations. At this point the projects will be assigned to various project engineers who may call for certain types of origin-destination studies, aerial mapping or other types of basic traffic and planning data. For a rural type of highway project, such as a new four-lane, divided facility between two urban areas, the advance planning department will generally present to the planning board what is known as a "Stage A" report. This will recommend the type of facility and may set forth several possible corridor locations.

The planning board will then approve or send back for further study the preliminary concept of the project. If approved, perhaps two basic corridor locations may be flown for more detailed topography and sent forth to preliminary design to make an actual location study and to make estimates of costs.

When these studies have been completed, the matter will be referred back to the

advance planning department. The advance planning engineer will then make specific recommendations to the planning board as to the most desirable location and type of a project in a "Stage B" report.

After analysis of the project, the planning board will then generally adopt the project and if it appears that the project is going to cost a great deal more than was anticipated or if the concept of the project differs from the initial approval by the highway commission, or if there are questionable points about the project, the planning board may then refer the project to the State highway commission for their analysis with a request that they determine whether this project should be modified or approved for public hearing.

After approval or modification by the highway commission as to the general concept of the project, preliminary plans are prepared to the point that a public hearing may be held on the matter.

After the public hearing has been held and the results of the public hearing transcribed for the planning board and for the highway commission, the planning board and the advance planning department analyze the results of the public hearing. At this point the planning board will normally make final recommendations to the highway commission as to whether the project should go ahead as originally proposed or whether there are possible modifications as to the type or general concept of the project. Final decision will be made at this point by the highway commission to go ahead with the actual design and construction of the project. For routine, non-controversial projects, the highway commission may not be involved in the actual approval at the preliminary planning stage or public hearing stage. However, all major projects are referred back for final approval to the highway commission after planning board approval and after the public hearing.

After the public hearing and final approval by the planning board and/or highway commission, the project moves from the planning phase to the chief engineer's operation, who schedules the details of the design and right-of-way acquisition in the light of work loads existing in various areas of the State and in terms of the over-all master schedule for project design and lettings.

SUMMARY

In summary, it may appear that a construction project goes through many advanced planning stages in the North Carolina operations. It is believed, however, that the rather complete and detailed analysis made of the project by the advance planning department and the top level staff on the planning board will, in the long run, provide a highway facility that has been considered from all angles and will provide the best traffic and land use service to the public at the lowest cost.

The planning board, made up of all disciplines, has the opportunity to work with a given project through all of the planning stages. With the Bureau of Public Roads as a part of the planning board, practically all of the major problems are worked out initially before the project gets into the design stage. In this manner good liaison is maintained between the State and the Federal Government and each agency has had a hand in the development of the project. Thus, with this type of operation, major conflicts which often occur in the last stages of design are eliminated by a thorough initial analysis of the project in the planning stage.

It has been North Carolina's experience that the best approach to construction planning and programing is through the operation of a well-qualified advance planning department which has a thorough understanding of the needs of the State and has no other function other than the continuous analysis of long-range and short-range needs. And finally, through the medium of a planning board, the desirable liaison and coordination can be maintained between the planning function, the engineering function, and the responsibility of the Bureau of Public Roads in both areas.

Discussion

Wiley.—North Carolina is really courageous to put out a program like this for so many years ahead. I can see why the general public would receive something like this with a great deal of enthusiasm. And if the program can actually be followed, I think that enthusiasm will continue.

I would be a little fearful that the farther away in time you get from it, the more changes you will find may have to be made. But did I understand you to say that you have a program of actual priorities for the first few years?

Babcock.—Yes.

Wiley.—This program extends over a 15-year period?

Babcock.—That is right.

Wiley.—Is this an attempt to pick up projects which you estimate will become deficient during the period?

Babcock.—No, not really. I do not know how many of the rest of you have had the same experience, but we have had a situation for 15 years where you had a certain gas tax and a certain motor-vehicle tax, and a certain—automatic—diversion to the prison department. The whole process of budgeting consisted of making a general estimate of what the taxes would yield, then setting aside enough to support motor vehicles, prisons, and everything else, and giving whatever was left over to the highway department to use about as they saw fit. We think the levels of service that we have defined are reasonable and rational for North Carolina. And our whole point in doing this was to find out whether we had sufficient funds to do what we felt should be done.

If the legislature does not see fit to revise or revamp present tax laws to permit this level of service, it is our feeling that we should drop this level of service. In other words, if there is not going to be enough construction money, we would recommend to the commission that they do not consider paving any secondary roads with a traffic volume of less than a hundred vehicles a day, as contrasted with maybe 50.

In effect, we are saying, "If it doesn't look like it is possible to meet these needs that we have outlined, we are going to have to give up the widening of 18-ft rural collectors and put all emphasis on trunk system." This really is the purpose of this report.

Winfrey.—Babcock mentioned the fact that if the commission decides to improve the road from A to B, then that assignment goes to advance planning to work out the general level and the type of facilities and all that. How did it get to the commission in the first place?

Babcock.—It got to the commission in accordance with our priority list.

Winfrey.—Who presents it to the commission?

Babcock.—I do. With the city manager-city council form of operation, my job is to be the liaison.

Titus.—When the project then goes to the chief engineer, what leeway does he have to make changes in standards, design, etc.?

Babcock.—If he runs into a problem or his design engineers run into a problem that indicates that the planning board has not given the right answer, it comes back to the planning board. For example, last week the question of improving a mile or so of two-lane road that has to be four lanes coming into Raleigh originally went from the planning board as a four-lane facility for which we were attempting to get full control of access. That came to $3.5 million. Without full control of access, the project came to about $1.2 million. We held out for full control of access, but lost. We wanted a permanent median and got most of it, but it will come back if engineering determines that a major revision should be made in the concept because it is uneconomical.

Livingston.—Since the planning chief lost the argument for the $3.5 million job in favor of the $1.2 million project, will the redesigned project be adequate to supply the demand?

Babcock.—That is a matter of opinion. No, the problem in this case is that the highway leads into Raleigh, and it can be taken to six lanes, but you will never get control of access, because the area is all industry. We thought we would try to hold it to as tight a line as we possibly could and then by 1980 maybe we would realize that we ought to come in with a new facility that could be tied in with a revamped thoroughfare plan for Raleigh.

Granum.—Mr. Babcock, suppose that your studies should indicate the desirability of bringing your primary system up to date in ten years, rather than 15. Do you have some alternative figures that can be supplied as to what it would cost on an annual basis?

Babcock.—Our plan was based on roughly a 15-year projection of population growth and our 15-year projection of traffic volumes, and the level of service we thought should be provided in this period. If we try to do the job in ten years, we would be providing a higher level of service than was indicated.

Granum.—What is your design standard year? Is it 20 years after the date of construction that you are planning for as a design standard? Or is it current traffic or 15-year-hence traffic?

Babcock.—What we are designing for is a projection which is roughly 15 years ahead. For example, what we show as top priority projects today are those sections of highway that in the period 1960-1965 will have inadequate capacity. The next group will probably be satisfactory for the first five years but will start to break down between 1965 and 1970. The next group will break down between 1970 and 1975.

North Carolina is a rather large state, but rural, with not too high traffic volumes except in a few areas like Charlotte and Winston-Salem. When we shift from two lanes to four lanes, we are going to have built-in capacity that will last for a long time. That is why we are trying to wake people up to the fact that we now need four lanes on a third of the primary system.

Granum.—Then your design standard is based on the projected 20-year-hence traffic from date of construction, at least on the primary system. Is that right?

Babcock.—That is right. You mean projects in advance planning that we are designing now would be designed and go through advance planning based upon a 20-year future projection of volume.

Granum.—What is the design basis on which these costs are based? Is it for 20 years after the date of construction, or estimated date of construction?

Babcock.—It would be for 15 or 20 years.

R. Johnson.—Your standard of service really governs an adjusted design standard for the particular system that you have chosen?

Babcock.—Yes. That is the basic philosophy that we are trying to promulgate here. You do not design a rural collector road serving two communities of 500 people with a volume today of a thousand vehicles a day, to the same standard as that for the truck system. Most of the people on the collector road are traveling about five miles and going 35 miles an hour, with an occasional person who wants to go in a hurry. We are setting three distinct design standards for our systems to determine our needs.

Kimley.—It might be stated that the standards were approved by the commission.

Babcock.—That is right. First, the systems were approved, then the level of service, and then we find out how much these levels of service will cost. And this is what we came up with.

West.—You have made an estimate of the cost of this. How did you arrive at your construction and right-of-way figures for 1970, for instance?

Babcock.—We could not, very easily. The best we could do is make our best estimates of cost and right-of-way figures, and then just continue with a rough percentage increase based upon present trends.

In other words, we say in here that this estimate anticipates a moderate increase, but any major inflationary tendency would change it. If traffic, for instance does not increase, or population does not increase, the amount of money coming in would drop off proportionately. Also, we are going back to the legislature in March and try to do what nobody has done yet—to pull out of thin air the small-car effect on revenue and how much more we will need because of it. I do not know how we are going to handle that.

Titus.—Within any one system, do you apply the desired operating speed uniformly, without regard to terrain or traffic volume?

Babcock.—Generally, we will accept a slightly lower operational condition in the mountains. But in the Piedmont and the flat country, no. We will design it all pretty much the same. We drop it on our secondaries very definitely, and on our rural collectors. But on our trunk system we design for just about the same operating speed as the Interstate standard.

Titus.—Are your primary and secondary systems defined by law?

Babcock.—Is there a stipulated mileage for the primary system and a secondary system? No. The highway commission could decide to number a thousand miles of road tomorrow morning, and they would be on the primary system. Or take the numbers off and they would be on the secondary system.

Titus.—West Virginia has a primary and secondary system without setting mileage, but reserving monies for those systems.

Babcock.—We recommend to the legislature amounts for State construction. We have three appropriation accounts: State maintenance and construction primary, State maintenance and construction secondary, and State maintenance and construction urban. And these are definitely earmarked by the legislature for use on the designated system.

Titus.—The standards are set up by administrative decree for each system?

Babcock.—No, they are not set up by administrative decree. Nothing is. They are set by Commission policy.

Titus.—But not by law?

Babcock.—That is right. Let us say we get $50 million to put on the secondary roads. The secondary road needs are $624 million. Mitchell County has a need of $5,329,000. That is the percentage it gets.

In other words, it is a straight needs percentage for each county. One county down east gets $10,000 a year to improve its secondary roads. Another gets $2.5 million.

Hall.—As I understand it, you are making a distinction between levels of service and geometric design standards. You relate them, but there is a distinction in your mind.

Babcock.—Let me answer that this way. If a road is on the rural collector or a less important system, we consider it satisfactory if a man can maintain an operating speed of 30 to 35 or 40 miles per hour, so that road might not ever get a high priority, because it would never even approach the necessary capacity-volume relationship.

Paterson.—You have a deficiency of $505 million over the 15-year period. And I was just wondering how you are going to handle that? By cutting out projects? Or bond financing?

Babcock.—I will tell you what we have recommended: Get about half the prisoners off our back and take care of them out of the general fund, instead of the highway fund. Raise the automobile fees from an average of something like $11 to an average of about $15. Take one-quarter cent of the gas tax, which goes to the general fund, supposedly to defray gas station inspection fees, and put that money in the highway fund. Raise the gas tax one-quarter of a cent. That will pay for the road program.

Granum.—Does the program contemplate replacement of pavements over the future period as part of the maintenance picture, or the construction picture?

Babcock.—Yes and no. Actually, where there are temporary pavements which we think are going to need up to 3 inches of asphaltic concrete or something of that order, they are included in the construction. But we have a tremendous maintenance organization. We have a thousand or eleven or fifteen hundred people in road oil alone, so if the improvement required is just a matter of surface treatment or minor bituminous concrete construction, just an inch or 200 pounds, it is under maintenance.

The Public Relations Aspects of Highway Construction Programing

DONALD M. BROWN

The topic of this paper concerns the public relations aspects of highway construction programing, a specific part of the over-all public relations program of the highway departments.

Much is heard these days about public relations in the highway field; the subject is discussed at length in meetings wherever and whenever highway officials congregate. Almost everybody agrees that highway officials must have and must show a positive approach to public relations.

This certainly is an excellent development. We in the highway departments now realize the tremendous value of having public good will. We are consciously embarking on a public relations campaign designed to make it easier for a highway construction program to be carried to completion.

Probably, the point that is missed in these discussions about public relations is that it is not something that is handled separately and apart from other duties. It is a part of every decision, however minor. The highway administrator makes a decision affecting his public relations when he appoints a man to a job, makes an allocation of money, or drives down the street. Public relations is implicit in every action taken by a highway administrator. And the implication of every act must be studied for its effect on a department's public relations.

Publicity cannot be substituted for public relations, which in essence are made simply by the way one acts.

There have been a lot of definitions of public relations. Many of them are ludicrous, but many others are worthy of recognition. The following is the one I prefer:

"Public relations is the continued process of keying policies, services and actions to the best interests of those individuals and groups whose confidence and good will an individual or institution covets; and secondly, it is the interpretation of these policies, services and actions to assure complete understanding and appreciation."

To satisfy this definition, highway departments must make their policies and services fit the wishes, desires and hopes of the people—not only must they fit the wishes, desires and hopes of those who use the highway, but they also must fit the wishes, desires and hopes of the vast army of citizens who depend on highway services for a growing number of uses. The highway departments must also interpret those policies to the citizen so that he will have complete understanding and will accept them and appreciate them.

It is certainly difficult to determine policies to fit the wishes of the people and to explain them and to convince the people of the justness of your decisions. Some problems are involved.

Obviously, a preliminary to a public relations program is a good organization doing a good job. You can have a plethora of public relations men and your employees can be avidly public relations minded, but your public relations are going to be bad if you attempt to build on a bad foundation. The product has to be a good one before it can be sold.

So it is a waste of time to discuss a public relations program unless we have a product we are proud of. The highway organization must be a good one.

Even assuming that the product is a good one—that the highway department is doing a good job—it does not necessarily follow that the public relations program is a good one. The policies you adopt must be the ones which will, in the long run, satisfy the people who pay the bill. A proper and effective public relations campaign calls for

interpretation of the program and the policies to obtain complete understanding and appreciation.

Therefore, there are three essentials to the public relations program: (1) a good organization doing a good job, (2) policies which satisfy the needs of the people, and (3) an educational program which supplies the facts and explanations.

We are concerned here with a rather narrow but most important aspect of public relations in the highway field, the highway construction program. How do we pursue policies which satisfy the public? How do we sell and explain those policies?

It does not necessarily follow that highway department administrators, although they are interested in gaining and keeping the good will of the people, adopt and pursue highway construction programing policies which do gain the desired end. For they may not know what the public wants.

Or it may be that traditionally the organization has conducted its affairs in a manner which was not designed to gain and to keep good will; the organization has operated in a manner which works against the success of a public relations program.

It is not enough for the administrator to realize (with the vast changes taking place in our highway program and the vast growth in the scope of the highway program) that such an attitude is no longer tenable.

The administrator must change the thinking of the employees—if need be. He must educate them to his way. He must be assiduous in devising ways and means to make every employee understand that his policy is to satisfy and educate the people on the facts of the highway program.

I think it is necessary in a discussion such as this one to prepare the groundwork, for highway construction programing certainly has a terrific impact on a highway department's public relations. Probably more than anything else, highway construction programing is the key to highway policy. And the program has to be sold if success is to be achieved.

The people (who are the taxpayers and thus the possessors of the good will we are winning) are very interested in highway construction programing. That is where you are going to spend the money. That is where the new roads are going to be built. That is what the people are looking for. They are looking for road improvements and they want to know when their road is going to be improved. So public relations and highway construction programing begin well before the program is drawn up.

It goes without saying that the highway construction program must be a balanced one—one that can be sold with confidence. That calls for a lot of thought and consideration when the program is developed.

There have been attempts to place highway construction programing on an objective basis—or rather, an allegedly objective basis. Sufficiency ratings have been suggested and benefit-cost ratio analyses have been offered. Both suffer, among other things, from lack of acknowledgment of their political implications and lack of grass-roots interest.

I might interject here an observation that in the rural areas, people for the most part are road-minded. They take a road program seriously and they make their voices felt emphatically to their elected representatives. City people often do not concern themselves or make their views on road matters felt to the same extent or with the same emphasis as do rural people.

It probably is more important than anything else to highway construction programing to get and to keep the good will of the people. Without public support of that program, there will be no construction program. It is as simple as that.

In Washington, the state highway commission submits a biennial program for review by the Legislature. And the Legislature appropriates the entire sum of money to the highway commission on the assumption that the program is going to be followed during the following two-year period. The Legislature, of course, can appropriate money for each project and earmark it for that purpose alone. But over the years a good relationship has been built up with the people and with the members of the Legislature so that the lump sum appropriation is made. The legislator trusts the administrator.

Such a system would not long exist if the highway commission were to disregard the

wishes, desires and needs of people all over the state. As a matter of fact, it would exist only as long as it took the Legislature to meet and revise the system and to specify precisely where highway construction money was to be programed.

The California Legislature requires that a fixed percentage of construction money be spent in each county. This may be good or it may be bad, but it does demonstrate what the Legislature can do in the way of allocating funds for construction.

It might be said that there will be no highway program unless the people are satisfied. This does not say that education cannot change the wishes of the people. It can—and that's where the third essential of the public relations campaign comes in. There must be a well thought out selling campaign to educate the public on what your ideas on highway programing are. If it is a good product, it will be sold; but if it is no good, no amount of plugging will sell it. Highway departments are public agencies, subject to the legislative and administrative bodies of state government, and they're responsible to the wishes, desires and hopes of the people. They had better be responsive as well as responsible if they want to carry out their program.

If we consciously set out to get and to keep public support, we are going to have a better highway program—one which accepts the realities of life and one which is geared to gaining and keeping the good will of the people.

Certainly the time of the administrators and his aides may be saved by proper attention to public relations activities. There are going to be difficulties, but most of them can be avoided by intelligent attitudes toward selling the highway construction program. They can be avoided by creating a reservoir of good will.

How does one go about getting this public good will and selling the highway construction program? In Washington we start with a good program—one that considers the needs, desires and hopes of all the people of the state.

One of the mysteries of life is how highway programs are arranged. This should be adequately explained.

There probably is no substitute for personal contact between highway administrators and the people. Talks are an excellent means for making these contacts. Then there is the problem of money. For there are always more requests for highways than the revenue will support. Certainly the administrator and his top aides should be well versed in the revenue picture and this picture should be made clear to the public. Speeches are one way of doing this. Newspaper articles are another. Television presentation is excellent; so are annual reports.

Too, it makes the taxpayer happy to know that the people in his employ are aware of all the intricacies of highways and highway problems. And it makes him happy to meet with the men who run the highway departments.

Certainly close touch should be kept with legislators, for they reflect the opinion of the people and they can tell you whether or not a highway program will be acceptable.

Many states have interim legislative committees which investigate highway problems and other matters. These committees are a valuable tool in public relations in that they gather grass-roots opinion and help to formulate and to sell highway construction programs to their constituencies.

State highway departments indeed are fortunate when they have such a fact-gathering, opinion-sampling arm of the legislature to run interference for them.

Of course, the press is an excellent tool for gaining the good will of the people and obtaining their support for a particular highway construction program. Everybody reads the paper or listens to the radio and these media are most effective in publicizing the various aspects of the highway construction program.

It is a wise administrator who treats the press with respect, who is available to meet with them any time, who answers their queries honestly and intelligently. In short, it's a wise administrator who makes a friend of every newspaper and radio man when possible. Without newspapers and radio and television stations available to sell the construction program, a highway department is severely handicapped.

Public hearings on construction programs are another excellent device used to inform the public and to sell them on the merits of the program. Experts should be at these meetings to speak and to explain. Do not turn these assignments over to some minor functionary who does not know all the facts. If that must be done, the meeting should be cancelled.

In summation, to be effective a public relations program must be based on three fundamentals: (a) a good organization, (b) policies designed to seek and to keep the good will of the people, and (c) a publicity or educational campaign designed to present the facts.

Discussion

Wiley.—This is certainly one field in which we have been negligent to some extent, and a subject we really need to pay more attention to. The public is entitled to know what we are doing and why it is we feel we ought to do these things, and we ought to give them the opportunity, also, to tell us what they think we should do.

R. Johnson.—I would like to speak as a user representative in this whole area; in the area, if I may say so, of the educated and intelligent public, perhaps the most important public to the highway departments. And I would like to go back to what highway departments generally do, so far as demonstrating to the public their need for revenues in order to form a highway construction program.

Essentially, this is done through a needs survey that generally produces a rather large bill for the needs on the different state highway systems. This may, or may not, bear any relationship to the type of improvement that is possible with the present funds being expended by the state.

In other words, the usual needs study when presented in this way to the public represents a very sizable increase over present revenues, and perhaps it represents a sizable bonding program. The public may not be willing to take on the whole financial burden. And suppose the legislature decides that it cannot provide the entire amount, but can provide something less than the entire amount. Admittedly, all of the desirable progress toward meeting the needs cannot be made; but an important amount of progress can be made through this provision of a lesser amount of money.

The question is: How much progress can be made with these lesser amounts of money? The answer rests on how much less than complete adequacy of the whole road system the public can live with. Only the public can decide this. But in order to decide, the public has to know what comparative adequacy it can purchase for the varying expenditures. The public also needs to know how soon it can purchase this amount of adequacy for the particular expenditure that it is willing to go along with.

This is the kind of information on the long-range programing process that the highway departments have got to be prepared to supply. And then, after the highway department has provided this information, the public, the educated public, will want to know from time to time what progress is being made toward the achievement of the standards of adequacy sought in the particular period of time.

The highway departments have got to be prepared to demonstrate progress in these terms. If the highway departments are not willing to do all of these things, then they are asking the public to buy either a complete bill of goods, or nothing at all. I think this is a crucial factor in what constitutes adequate programing in a highway department.

Wiley.—This would perhaps require that in the presentation of such information we prepare not one projected needs estimate but a number of other alternates for programs that would fall somewhat short of what we might term complete adequacy. Would that be correct?

R. Johnson.—Yes. As you know, I recommend that you read Roy Jorgensen's paper, "Can the Highway Department Survive," given out at the AASHO planning conference. Copies are available through our organization.

We do not propose to know the answers by any means, but we can certainly see the problems in this particular area. I think there is a lot of food for thought and maybe some suggestions as to where the answers can be sought in that particular paper.

Granum.—I do not disagree with the objectives that Mr. Johnson and Mr. Jorgensen have outlined, but there are one or two statements I cannot agree with.

It seems to me as incorrect to assume that these needs studies have only one objective, and that is to sell somebody on a need for more money. They are designed to be as objective as possible, to determine what the needs and the goals are. I am sure that anybody who has ever had any part in making one of these studies would be most delighted if it would show the need for less money rather than more. And sometimes they come fairly close to doing that.

I think that it is up to the engineering profession to establish the economically justified requirements for the several highway systems. And I believe we have had a good exposition of that this afternoon from Mr. Babcock.

The alternatives available to the public are often presented in these needs studies in terms of time, rather than in terms of less adequacy. You have a choice, of course, to decide whether to scale down all of the standards on all of the systems; whether to scale some systems down appreciably while keeping the standards for the most important system at the level that engineering analysis, research, and judgment tell us it should be; or whether to stretch out the programs and put up with whatever we happen to have a little longer, until we can afford to pay for improvements.

We may not be very far apart, Mr. Johnson, in what we are talking about, but I believe that we should put these studies in their proper basic engineering perspective. They are not a sales document.

R. Johnson.—I am sorry that you got that impression. I meant no such implication. I realize that these needs studies are very objective, and I did not mean to criticize them on that score at all. The only thing I wanted to point up was the usual outcome of these studies. Because we do have a large backlog of highway deficiencies, it usually turns out that a lot more revenue is required.

Burnes.—I just want to add to Mr. Granum's observation that there are really two basic objectives of needs studies. As I see it, the first one concerns revenue, which entails highway policy review, perhaps. The other is internal—a needs study formula basis for not only a long-range program, but for the annual program.

SUMMARY AND SYNTHESIS

Formulating Highway Construction Programs- A Case Study and Summary

CLINTON H. BURNES

We have had a most productive meeting. The papers have been so consistently well prepared and the ideas so consistently sound that my assignment to summarize the thoughts expressed here during the past two days has indeed been an interesting one. We have dealt mainly with ideas rather than with methods or procedure. Even so, perhaps some of these ideas will lead to a broader concept of capital budgeting which, in turn, will lead to improved programing methods.

To summarize and to give substance to some of these ideas, I would like to cite a case study. It is one which contains many morals but we will be primarily concerned with a programing decision, a decision which shows what can be the consequences of programing procedure.

Once upon a time, programing in the mythical Alamosa State Highway Department was delegated by the Director to the Chief Engineer. Although the program was based to a large extent upon recommendations of the several district engineers, design recommendations and estimated costs were carefully reviewed by the Chief Engineer in the light of traffic needs and other available planning information. Upon completion of such reviews, the estimated program cost was balanced out against available matched money by Federal-aid categories. Another feature of the State's procedure was an allocation of total construction money to construction districts on the basis of relative need, or in the ratio of immediate needs in a particular district to total immediate needs based on a comprehensive needs study.

Work on the annual program began some 10 months before the construction season. Upon completion of a tentative program (which contained about 25 percent more projects than could be financed) the Director called a program conference. It was during this conference that the Director, together with the Chief Engineer, the Design Engineer and sometimes the District Engineers would decide which projects should be included in the annual construction program.

The general procedure was to discuss candidate projects, one at a time, on the basis of personal knowledge and recommendations. The final decision as to the selection of any particular project rested with the Director. This paper presents a case study of one such decision and its consequences. Let's look in on the conference briefly.

DIRECTOR. I have about 45 minutes left. What's next?

CHIEF ENGINEER. Route 21, from Allison to the junction of State Highway 211.

DIRECTOR. We can't do anything with that now, we are short secondary money as it is.

CHIEF ENGINEER. By improving this section of route 21, I think we postone some expensive work on route 3. We can siphon off traffic bound for the westside and downtown Metropolis by improving the section from Allison to route 211. Trips to the south of town will continue to use route 3. Eventually.....

DIRECTOR. That may be, but you've got this job set up for a 220-foot width of right-of-way with eventual 4-lane construction. Two hundred twenty feet of right-of-way on a secondary road! How can we justify that? We are being criticized now for all the money we are spending around Metropolis — all this 4-lane divided construction.

CHIEF ENGINEER. Eventually, I was about to say, we will need both these improvements. My idea is to start now on a long range area plan.....

The Chief Engineer then went on to explain his recommendations in some detail. Here were the facts (Fig. 1).

The secondary route, ABC, originally a local road, was added to the State system during the depession. Alinement was poor, the gradeline generally low with poor drainage, and upkeep of the bituminous treated surface was a drain on the maintenance budget.

The other route, section AD, constructed some 20 years ago, consisted of a high type pavement in good condition with 10-foot shoulders. The existing road was considered adequate for one roadway of a divided 4-lane design. With existing volumes already about 25 percent above practical capacity, improvement was rather urgently needed.

Since the distance on ABC was 1.5 miles shorter than the combined routes AD and DC, it was plausible that an improvement of ABC might draw off enough traffic to relieve the immediate pressure on the southern route AD, until such time as it could be reached in the program.

This idea, with a request to check its feasibility, had been passed on to the Planning Director by the Chief Engineer.

The planning report he subsequently received generally confirmed his original thought. It showed that:

1. Through trips destined to southerly suburban areas as well as those to in-town Metropolis could use an improved section ABC to advantage.
2. Conservatively estimated, in 20 years there would be twice the 1,700 trips now destined to the southern suburban fringes of Metropolis.
3. A 1.5-mile distance savings for these trips by route ABC would amount to a savings (at seven cents per vehicle-mile) of some $131,000 annually. This capitalized at 6 percent would justify a capital outlay of approximately $2.2 million.
4. Traffic remaining on section AD, approximately 2,500 vehicles per day, would result in a capacity index of less than 0.6 showing that improvement of section AD could be postponed for some years.
5. Section ABC would conservatively carry an average daily traffic in the neighborhood of 6,000 to 7,000 and perhaps 11,000 to 12,000 on the easterly 6 miles by 1970.
6. Rights-of-way should be acquired on section ABC to accommodate a 4-lane divided roadway design.

In view of these facts, the Chief Engineer recommended that project ABC be included in the construction program.

Even so, the Director still questioned the advisability of including the project at this time because it might lead to further criticism by rural legislators who felt that too much construction money was being spent in the metropolitan area. Let's listen in again.

DIRECTOR. How can you get volumes like that on a secondary road? How do we know that traffic will siphon off at Allison? How can we justify this job? Senator Smith and the Mayors of Littletown and Plainsville were in my office just a couple of days ago. They suggested that if we spend less money around Metropolis we could spend more outstate.

CHIEF ENGINEER. That's true, of course. And as to that criticism, we are spending less than one-fifth of our construction money in the whole metropolitan area where we find nearly 35 percent of our total needs. On the other hand if we accept the idea that we put our money where the needs are, we have to consider this project. As I mentioned a few minutes ago, we must do something on this section — maintenance costs are running nearly $3,000 per mile. So I.....

DIRECTOR. $3,000 per mile? On that section?

CHIEF ENGINEER. So I think that since the section needs improvement anyhow, we should look at the long range needs and plan in that direction.

DIRECTOR. But not 4-lane divided.

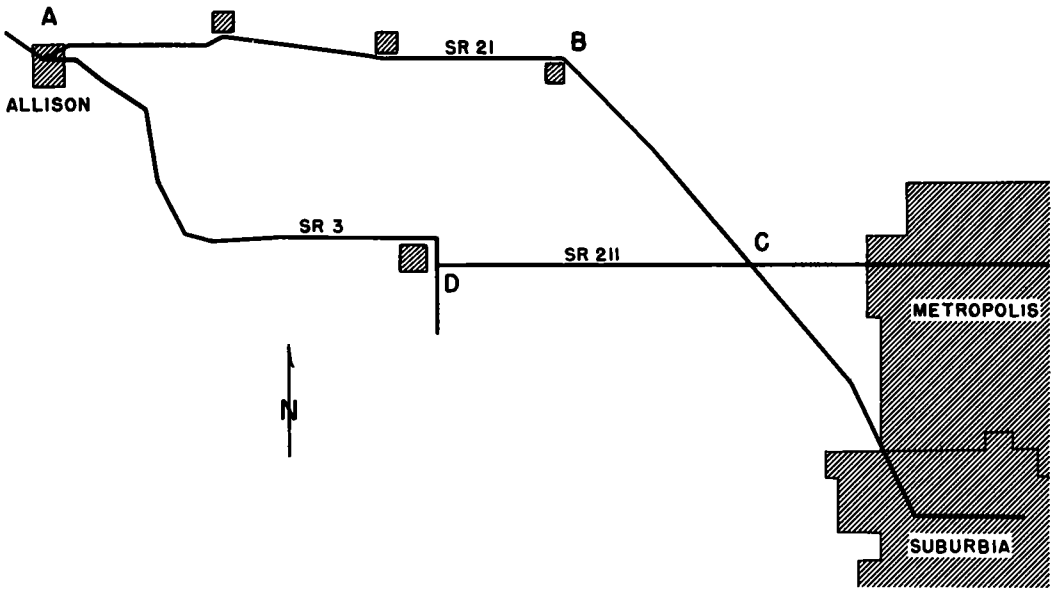


Figure 1.

CHIEF ENGINEER. That's what our planning data shows — long range.

DIRECTOR. Well, I don't — Oh! My 45 minutes has come and gone — O. K. leave it in but design it to regular secondary standards.

This, then, was the Director's programing decision — routine, perhaps — just one of several hundred made during the four days of program conferences. Its repercussions, however, were long-lived, as we shall see.

As time passed, design work proceeded on the project, and once more a conference was called in the Director's office. He mentioned again that rural delegations calling on him had been critical not only of the amount of construction scheduled for rural areas of the metropolitan county, but also of the number of miles of divided roadways already built, together with those contemplated.

As a consequence, the plans for route ABC were scrutinized for possible savings. After a prolonged session, the Director made his final decision (or so he thought). The plans were revised. Design speed was cut back to 50 miles per hour, permitting the use of a rolling gradeline and some saving in grading costs. Minimum secondary road geometrics were used, and pavement design called for an intermediate type surface.

The project, constructed in stages, was in due time completed. Traffic volumes increased immediately, and, at the end of five years, showed an annual growth somewhat above predictions. Inherent in this growth, however, were factors which required further and perhaps more complicated policy decisions on the part of the Director.

Because of the presence of some fairly severe sustained grades on the alternate route, section ABC gained in popularity as a truck route. As the proportion and numbers of over-the-road truck combinations gradually increased so did their owners' collective vocal opposition to the springtime load restrictions. This restriction was necessary for six to eight weeks each spring to protect the surface which, of course, had been designed to a secondary road standard.

It was true that the high type pavement on the route ADC provided an alternate, unrestricted route for over-the-road trucks during the breakup period, as the Director pointed out to delegations waiting to see him. Yet the consensus of these delegations favored route ABC.

The situation became embarrassing to the Director when the officials of the two small towns called upon him to inquire why he couldn't establish a higher axle-load

limit during the spring breakup. This new road was supposedly more capable of carrying heavier loads, they pointed out, than was the old road. What explanations, they inquired, did the Director have? Although it had hardly been five years since he approved the project for construction it became increasingly clear to him that something had to be done about strengthening the surface.

But this was not the only problem that developed. A critical features survey showed that the rather high percentage of restricted sights over the east one-third of section ABC were of sufficient magnitude to restrict traffic capacity appreciably. Projections indicated that capacity in this area would become a problem within 10 years; sooner with more intensive suburban development.

So after five years, the Program Decision had given birth to a very unhappy situation. For now the Director found himself forced to make some new decisions considering the following elements:

1. The project needed more adequate load carrying capabilities.
2. If continued as a single roadway the east 6 miles needed to be opened up to get passing sights.
3. If ultimately divided, the present roadway was satisfactory, since the rolling gradeline was adequate for one-way travel.
4. But, if divided, additional rights-of-way would have to be acquired.

Without declaring his future planning policy for this project, the Director began to investigate possible ways to relieve the immediate problem. This prompted studies to investigate the ways and means of increasing the load carrying capabilities of the existing surface. The studies showed that 4 to 8 inches of additional base would be acquired to increase the loading. The top width of the roadway was too narrow, however, to accommodate this additional lift and still maintain proper shoulder slopes. Despite this fact, the Director approved plans to prepare for the proposed lift.

To open up restricted sight distances, the Director also approved the cutting down of the more seriously restrictive summits on the east end of the project. Mind you, this work, combined with base reinforcement was planned and constructed six years after the project was initially completed.

Analysis at this point showed that the nearly $900,000 originally saved had dwindled to $250,000 as a result of the summit corrections and the additional base lift. There was not much doubt, however, that this section would need further improvement in surfacing to carry frequent legal axle loads. And to provide for such a surface would require additional shoulder grading amounting to some $350,000 to $400,000.

Base reinforcement sufficient to permit springtime legal axle loads together with surface and 75 feet of additional right-of-way would require an estimated $600,000. In all, the cost in capital outlay would require an estimated $2.8 million compared with the original planned cost of $2.0 million.

Rather than saving some $900,000 then, the Director's original decision would actually cost a conservative $800,000 before the project was finally made adequate. And this does not allow for increases in price levels.

This case exemplifies the long range aspects of programing decisions. It points out what may happen to carefully prepared staff information. It tends to confirm Drucker's idea that the emphasis on finding the right answer rather than first asking the right question is probably the most common mistake in management decisions.

Before we discuss this case in terms of ideas expressed at this Workshop, suppose we digress for a moment on the general subject of decisions. In his book The Practice of Management,[1] Peter Drucker points out that "Whatever a manager does he does through making decisions." He then goes on to distinguish between two types of decisions — tactical and strategic. Tactical decisions, he says, are those in which "the situation is given and the requirements are evident. The only problem is to find the most economical adaptation of known resources." Deciding a vacation schedule for a departmental section or division would be an example of tactical decision. Mostly,

---

1/ Peter Drucker, The Practice of Management, New York: 1954, Harper and Brothers Publishers.

tactical decisions are routine and are directed toward the accomplishment of an immediate objective of a fairly simple and self-evident nature.

Strategic decisions, on the other hand, are much more complex — they are truly management decisions. They go far beyond the simple answer-finding process, as Drucker indicates, to the matter of asking the right question in the first place. Both the questions asked and the answers found must effectively further the over-all goals of the entire enterprise.

Highway programing decisions properly belong in this strategic category. They involve the long term consequences of the investment of public funds, and should therefore be based on the best and most complete information available.

In the preface of his book Capital Budgeting,[2] Joel Dean says, "Making decisions on capital expenditures is one of the most demanding responsibilities of top management. There are few guideposts for determining either the amount or the kind of investments to make. Without such guides, decisions are made on the basis of ill-defined standards, and intuitive judgment. There is a need for an analytical framework that will systematize management's approach to this problem."

This conference is an acknowledgment that some such framework is also necessary in the capital budgeting operation of highway departments. One of the objectives of this conference is to determine philosophies, concepts, and procedures for sound advance programing.

It was mentioned earlier that the case study exemplified the long range aspects of programing decisions. There is no doubt that the programing procedure in the Alamosa Highway Department could be improved.

Now suppose that we as a group of consultants were asked to advise as to what improvement in their programing procedure might be made. What might we say to them? All things considered, could we develop a more supportable program than the one which is implied by this case study?

That we could be of assistance I am sure we all agree. That we could develop a sound programing procedure based on the ideas here presented, I am sure we can all agree. Let's look at some of them to see what we could suggest.

As I have read the papers prepared for this conference, as I have listened to each presentation, it occurred to me that the ideas could be summarized in three broad categories:

1. We need conceptual skill or ability to recognize the problems of capital budgeting, to understand its importance in highway management, and to assure that advance programing is properly organized and carried out;
2. Advance programing must be based on what has been called specialized planning information, in the form of factual surveys and other special studies; and
3. For operation we need a sound and orderly set of procedures, including a sound method for selecting candidate projects, sound budgetary practice and an effective method for scheduling and control, a method of coordinating, effectively, with other agencies, a sound public relations program, and, of course, an organization.

Now let's look in more detail at some of the ideas repeatedly emphasized during this Workshop.

First, at least three authors specifically stressed the need for conceptual skill and ability in carrying out the highway programing operation. For example, in discussing problems of highway programing, Martin pointed out the need for both a current budget and a capital budget. He pointed out also that all highway construction programs necessitated advance planning if the operation is to be handled economically. And, moreover, without such planning priority determination could not be deliberately weighed, nor could management, without a long-range plan, administratively make economical disposition of manpower and equipment.

Winfrey suggested that "within capital budgeting, there is a choice of many projects or properties to construct or to buy. This choice is what makes allotting money to construction projects a most difficult administrative responsibility." And, moreover,

---

2/ Joel Dean, Capital Budgeting, New York: 1951, Columbia University Press.

that capital budgeting is essential for either a family, a business or a highway department. "Each of these three economic units...," he says, "are required to practice capital budgeting – formulate a program of expenditures for long-term investment in physical property. They must allocate their limited resources to specific current improvements.

"How well the job is done depends upon their skills, conceptual abilities, degrees of exactness, and pains with which they examine all factors involved, present, immediate, future, and long range future."

"It is being realized in some highway departments," Holshouser pointed out, "that the lack of a long-term construction budget makes it virtually impossible to secure an effective and adequate current operating budget." He continued. "Assuming that the need for thorough planning, both engineering and financial, is recognized, such planning must be accompanied by an administrative ability to implement the plan properly. A good plan, of course, is worth little unless it can be placed in operation. And it does not go into operation automatically."

Joel Dean[3] suggests that the economics of capital budgeting is "the kind of thinking that is necessary to design and carry through a systematic program for investing stockholders' money. Planning and control of capital expenditures is the basic top management function, since management is originally hired to take control of stockholders' funds and to maximize their earning power..."

What these authors are saying, it seems to me, is that capital budgeting is a major phase of management planning, which Pfiffner[4] points out in Public Administration – "is in essence based upon research and factfinding. It involves study, gathering data, conducting investigations, and securing their true meanings, to the end that a plan of action is created. The ultimate aim is to define the purposes and objectives to be accomplished, to know all of the factors to be considered and the information to be brought to bear on getting the job done, and then to find out the best way to proceed."

Robert Katz has defined conceptual skill as the ability to see the enterprise as a whole.[5] He further points out, "the success of any decision depends on the conceptual skill of the people who make the decision and those who put it into action.... Not only does the effective coordination of the various parts of the business depend on the conceptual skill of the administrator involved, but so also does the whole future direction and tone of the organization."

Such conceptual skill underlies the recognition that sound advance programing is essential to the economic expenditure of public highway funds. It is obvious that without such recognition not much can be accomplished "in the way of providing requisite policies, adequate organization and staff or procedures to carry out the job."

Secondly, it has been pointed out, particularly by Donnell, that we need what has been called specialized planning information. For the most part this is the information developed by the Highway Planning Survey. Additionally, however, studies are made to determine where, and what kind of deficiencies exist on a system and the costs necessary to bring it, or any system of roads and streets, up to standards adequate for expected traffic during a specified period of time, such as 10, 15, or 20 years. Dean has suggested that capital budgeting is composed of three elements: (1) what the needs are, (2) how much money is available, and (3) what projects should be included for consideration. This provides a good framework for discussing ideas classified in this second category.

It was suggested by Lang that "how well we invest these dollars is the single biggest factor in how healthy our enterprise will be, not only tomorrow but for many years in the future. And, also, it controls how well we will be able to meet communication needs of the business."

Let us rephrase this statement for top management in the Alamosa Highway Depart-

---

3/ Ibid.

4/ John M. Pfiffner, Public Administration, New York: 1946 Ronald Press Co. Rev. ed.

5/ Robert L. Katz, "Skills of an Effective Administrator," Harvard Business Review, Vol. XXXIII, No. 1 (Jan.-Feb. 1955), pp. 33-41.

ment: "How well we invest these construction dollars is the single biggest factor in how adequate our highway system will be, not only for tomorrow but for many years into the future. And, also, it controls how well we will be able to meet the highway transportation needs of the public."

The specialized planning information which has been suggested as a basic need to highway programing provides essential guidelines for the wise investment of our highway dollars. John Mathews, Jr.,[6] suggests that where used, guidelines "must be specific enough to insure company-wide adherence to policy, yet general enough to permit flexibility, imagination, and initiative to flourish at operation levels."

In some instances either long-range or short-term guidelines are defined by the legislature. In these cases, highway programing procedure may be spelled out in legislative detail. Where it is found, however, legislative support is important because it generally assures sound highway policy. We have learned from Legarra that the "legislature has made it quite clear to the California Highway Commission, that it wants a highway program based on sound long-range planning. And just as important, it wants continuity."

Thirdly, the vast majority of ideas presented at this Workshop fall in the category of operations.

For effective operation Campbell and England showed that we need guidelines for selecting candidate projects. Ultimately the selection, as has been pointed out, must be based upon not only sufficiency rating numbers or other rating methods, but also on what we have called administrative considerations. Additionally, in view of the magnitude of today's highway programs Swanson pointed out that we need an effective method of coordinating highway construction schedules with agencies affected. It goes without saying that this is tremendously important in urban work.

Long lead-times, which are a characteristic of today's programs, make necessary the establishment of an effective method for scheduling and control of programed projects. Such an operation as discussed by Walker and Bidell is primarily directed to the coordination of pre-letting activities to assure that completion of a particular plan meets a specified letting date.

In discussing "Highway Programing Law", Levin pointed out that "only a handful of States have statutes relating, even generally, to long-range highway programs..." Furthermore, he said "the law relating to highway programing may be said to be a composite of elements relating to long-range planning, annual programs of needs, the cumulation of certain kinds of data for budget and finance purposes, the sufficiency rating mechanism, intergovernmental cooperation, highway system classification, the acquisition of lands for future highway needs, and perhaps some others."

Now obviously to carry out a highway programing operation an organization and a staff are required. It should be recognized, however, that there is probably no "best way" to set up such an organization. There are examples of good operations being attained by a number of different plans. Moreover, discussions of the subject of the programing organization, as well as its position in the hierarchy up to now have not been productive of anything approaching a universally accepted model organization.

Two different ideas about the positioning of the programing function and the staff to carry it out have been presented.

Babcock suggested that the planning operation should not be a part of the engineering or operational phase of the highway department. Moreover, it is believed that those charged with the responsibility for highway planning should operate as a staff administrative unit and have no other responsibilities other than the carrying out of the actual planning for highways on a long-range and short-range basis.

Holshouser describes a plan which "calls for a construction program expediter in the office of the chief engineer who would be responsible for the execution of the program. Since this person would play a key role if the department is to achieve the planned program, he should be in a high level position."

Recently, I described the function of the Wisconsin Division of Planning and

---

6/ John B. Mathews, Jr., "How to Administer Capital Spending," Harvard Business Review, Vol. XXXVII, No. 2 (Mar.-Apr. 1959), p.88.

Research.[7] The ideas apparent in the Wisconsin organization and those expressed in this conference are somewhat in contrast. The function and role of the organizations are, however, fundamentally the same.

In Wisconsin, "The Director of Planning and Research, as a staff member of management, is 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."

It is significant that this job guide, in a broad way, spells out both specific and advisory functions for which the Director is responsible.

Summarizing by the three categories previously suggested, perhaps we can say that these elements or factors are essential to sound programing procedure:

1. Conceptual ability — This is a kind of thinking which is essential to the understanding of capital budgeting — reasons for it, problems connected with it, and ways to organize it.
2. Specialized planning information — Such information is essential for establishing top management guidelines for long-range and short-term objectives.
3. Operational Procedure — For a sound operation — for an economical operation — a workable procedure comprising several elements is essential. We could say perhaps that first in importance is need of a supportable method for selecting candidate projects — one which consistently measures a relative urgency of need.

Such ratings (or measure of deficiency) are important because they point up urgently needed work. Projects rating high in urgency, however, need to be further tested against administrative considerations before they are finally selected for any particular program.

Another essential of highway programing is the development of a sound budgetary practice, a procedure which will insure control of the financial aspects of the program.

One of these functions is the preparation of highway programs. "Programing in Wisconsin is assigned to a section of the Planning and Research Division. Functionally, the job guide specified that...., 'The Chief of Programming..., is charged with advising the Director and furnishing functional guidance to the Districts, with preparing proposed annual and long-range programs, with system classification and layout, with the estimating of highway financial needs, and with administering studies and research related thereto.'"

However organized and however staffed, perhaps we can say that the entire planning and programing output should be designed to meet the legislative and departmental planning requirements. By now it is obvious that this output likewise is essential to sound capital budgeting policy decisions.

There is one phase of highway programing which, though it has been presented last on the program, is certainly of prime importance among the requirements of highway programing. This is the idea as expressed by Brown... "That the highway construction programs must be a balanced one — one that you can sell with confidence. That calls for a lot of thought and consideration when the program is developed."

Now, over-all, what have we been talking about here? What have we found in terms of ideas?

A most important requirement of programing procedure is an effective method for scheduling and control to coordinate pre-letting activities, particularly for long-lead time projects. There are instances where such control is carried out as an engineering activity and others where responsibility is assigned to Planning. Where it is assigned, however, is not as important as the fact that it is provided for.

To carry out highway programing it is, of course, necessary for management to provide programing objectives and guidelines. Recognition that advance programing is essential to sound management assures the establishment of an organization responsible

---

7/ Clinton H. Burnes, "The Three R's of Highway Improvement Programing," presented at the 51st Annual Meeting of the Mississippi Valley Conference of State Highway Departments, Chicago, Illinois, March 17-19, 1960.

specifically for planning and programing as well as a sufficient staff to carry out the operation.

To close this discussion, I would like to repeat some thoughts expressed by Harold Plummer in a paper on "Highway Administration Organization," presented at the 33rd Annual Meeting of the Highway Research Board, January 12-15, 1954. "In organization planning, as well as in other phases of highway work, administrative thinking has to be long range for best results. Long range or fundamental highway planning defines the specific objectives of the highway department. A similar plan for the organization and type of administration which can cope with the changing and ever-increasing problems and responsibilities is equally basic. Organization planning is management's principal way of facilitating the direction and control of the enterprise. Consequently, proper organization planning must originate with a clear conception of what the objectives of highway management are. Effective and progressive administration, like the physical development of the highway plant, requires broad goals, with guides for their achievement, and a means of measuring performance."

Now while Plummer did not specifically refer to highway programing, he did suggest that "administrative thinking has to be long range for best results." If the highway director in our case study had recognized his long range objectives around Metropolis, he would not have built a temporary highway. By the ideas expressed here our conference has amply demonstrated that highway programing is "a universal management problem involving all departmental activities, and that a sound program planning procedure is necessary to maintain a smooth flow of work, department by department."

One final quote, if I may, from William A. Bugge, "The public's trust and confidence in its highway executives must be preserved. We are obligated to use every tool at our disposal to conduct our highway affairs with a maximum of efficiency."[8] We hope that this programing Workshop conference has contributed toward that end.

Resolution

Schwender. —"Resolved, the conferees attending this workshop conference on formulating highway construction programs wish to acknowledge and express formally their sincere appreciation of the contribution of the Automotive Safety Foundation, the Bureau of Public Roads, and the Highway Research Board, in sponsoring this meeting.

"Further, we feel that the caliber of the discussion and the spirit that prevailed have resulted in a most stimulating and worthwhile period of study that will be of value to the states in their programing procedures."

(The motion was seconded by W. Johnson and adopted.)

8/ Manual for a Highway Management Seminar; American Association of State Highway Officials, and National Highway Users' Conference, 1957.

Appendix A

GLOSSARY

This glossary was compiled after the papers in this proceedings were presented at the conference. Therefore, the definitions given herein may be at some variance with the exact meaning intended by certain authors and discussants. The glossary, however, is presented as an aid to those readers who may wish a ready reference to the meaning of the many technical words and phrases associated with the programing of highway construction.

This glossary has no official standing, these definitions and concepts have not been reviewed or approved by any committee or organization. It is hoped that an appropriate group will follow through on this beginning and ultimately produce an authoritative glossary applicable to highway programing.

Accounting — The art of keeping track of financial income and outgo as between sources and classifications according to organization and functions.

Adequacy Rating — A general term including such rating methods as sufficiency, deficiency, congestion, capacity and other methods used for rating the physical condition or suitability of a section of highway to render a desirable level of traffic service. (See Priority Rating and Sufficiency Rating)

Administrative Considerations — Those factors of an administrative nature which are integrated with a priority analysis in program development, and which relate specific projects and available funds to (a) obtain a balanced program by class of highway, by type of work, and by an equitable allocation of construction funds to a district or geographical area; and (b) provide for continuity of route improvement, for adequate lead-time for preletting activities and negotiations, and for commitments and local planning.

Administrative Requirements — Organizational and operational needs for proper administration.

Advance Contract Letting Schedule — A schedule generally prepared for one or more years in advance showing the expected time of advertising for highway construction projects which are anticipated to be let to contract during that period.

Advance Programing — The programing of highway capital improvements for a period of several years in advance of actual construction. (See Programing)

Allocation — The distribution or apportionment of funds or available other resources among the several political jurisdictions, highway systems, or organizational units or, broadly speaking, the apportionment of funds to a function.

Apportionment Formulas — Mathematical formulas which allocate or apportion funds among political or geographical divisions or among highway systems, by giving weight to such factors as population, area, or road mileage.

Arterial Highway — A general term denoting a highway primarily for through traffic, usually on a continuous route. (See Major Street)

Benefit — Advantage, profit, or gain resulting from an act or situation. In highways, it generally refers to the desirable consequences resulting to the general population and to the highway users as a result of a change in highway transportation facilities.

Benefit-Cost Ratio — The ratio of net benefits accruing to users and/or non-users of

the highways and the cost of such highways. The ratio is usually expressed as the quotient of the net annual benefits divided by the net annual highway costs, but may be expressed on any other comparable time basis.

Budget — An allocation of financial resources to organizational units or to functions within the highway department for a specific time period.

Budget Control — The administrative process of insuring that operations, at all times, are conducted in accordance with the budget plan previously adopted.

Capital Budget — A budget which provides for the financial support of highway construction of a permanent nature as opposed to a budget for operating expenses such as maintenance. (See Capital Improvement)

Capital Improvement — A physical improvement to the highway system of the type of property which will be long lasting in use, as opposed to the consumable supplies and maintenance items; land, bridges, and buildings are capital improvements, whether constructed through an original contract or through addition and betterment work. (See Highway Improvement and Capital Property)

Capital Investment — Capital investment is the amount of money disbursed for capital improvement; also, capital outlay. (See Capital Improvement)

Capital Investment Planning — See Advance Programing.

Capital Property — Capital property is that physical property or fixed assets in a highway department as represented by the land, highway structures, pavements, buildings, and equipment. It is the physical property that remains in use for periods longer than a year and which are subject to the concept of depreciation. (See Fixed Asset)

Community Master Plan — A plan, generally prepared under the direction of a planning commission, showing the most desirable future development of the land within a community including public services, and utilities.

Controlled-Access Highway — A highway where the right of owners or occupants of abutting land or other persons to access, light, air, or view in connection with the highway is fully or partially controlled by public authority.

Construction Priorities — The ranking of construction projects according to an accepted criterion of urgency.

Construction Program — The construction program of a highway department is a detailed listing of all of the capital improvements to a highway system that are proposed to be done in a given period of time. Construction programs may be adopted for a given year, or three-year, five-year, or other period of time.

Construction Program Schedule — A time schedule showing desired starting and completion dates of all major construction operations, that is, clearing, grading, structures, and paving.

Contingency Fund — An accessory fund which can be used at discretion of administrators to provide for emergencies, to take care of other unforeseen exigencies, and to give better balance to a program in terms of time schedule or geographic location.

Cost — The outlay of money or other resources necessary to acquire the material or benefit; for highways, construction cost is the total outlay for all elements and functions required to bring the complete highway and facilities into use.

Critical Deficiency — A deficiency in the geometry or structural condition of a road that urgently warrants remedial action in order to provide the desirable level of traffic service.

Current Operating Expense — Current operating expense is that expense created in providing for the functions of maintenance and operation of the highway system, including administrative expenses chargeable to such operations, all as distinguished from outlays of money for capital improvements. (See Capital Improvement)

Decision-Making Process — The analytical thought process through which a problem is explored and a consequent commitment to action is made.

Deficient Highway — A highway which fails in one or more of the established minimum standards of level of service to traffic.

Disbursement — Disbursement is the actual payment of money which reduces the cash balance of an organization. Disbursements are distinguished from expense because in connection with expense, it is not necessary to actually disburse money.

Economic Impact — The consequences to the social and economic life of the surrounding area brought on because of construction of a highway facility.

Engineering Economy Studies — The application of the principles of engineering economy to proposed projects to determine which course of action will prove to be the most economical in the long run when the differences between the alternatives are expressed in terms of money as a common denominator.

Engineering Manpower — The collective work capacity of an organization's engineering force.

Expenditure — Expenditure is the actual obligation which reduces one's assets. It can be a disbursement of money or it can be the incurring of an obligation to disburse money. It may also be simply the expenditure or the consumption of materials or of labor.

Expressway — A divided arterial highway for through traffic with full or partial control of access and generally with grade separations at intersections.

Factual Survey — Up-to-date facts about traffic, the status of the entire highway system under consideration, and the future probabilities — all as a basis for systematic analysis in an effective manner to prove the needs and their general timing, looking towards ultimate development of an integrated construction plan. (See Highway Needs)

Feeder Roads — Roads and streets primarily for access to residence, business, or other abutting property, and which connect with arterials or primary highways.

Financial Mangement — Financial management of a department is the combined acts of officials which control the allocation of money, the handling of fiscal accounts, and all other transactions and decisions which involve the receipt and disbursing of money.

Financial Needs — The amount of money a highway department will need in a given period of time to accomplish a stated objective; usually encompassing a given construction program plus expenditures required for maintenance and administration.

Financial Operations — All accounting and auditing work, payroll, invoicing, paying and recording all money flow from receiving to disbursing.

Financial Plan — A schedule of probable balances, revenues, borrowings, interest, collections, debt service charges, expenditures and expenditure distribution, viewed by months or quarters, in terms of the availability of funds for commitment, — the plan for matching the flow of revenue and the flow of needful expenditures.

Financial Resources — The money which the department or organization may have available in a given period of time.

Fiscal Capability — The ability of a political jurisdiction to provide revenues for its community needs in light of its economic resources.

Fluid Construction Program — A highway construction program in which day-to-day or week-to-week additions and deletions are made to the list of projects, sometimes immediately after initial program approval.

Functional Budget — An allocation or limitation of funds for a specific time period for specific functional purposes, such as, administration, construction, or maintenance. (See Budget and Objective Budget)

General Revenues — Monies received by the state or local government from general (property tax, sales tax, excise taxes) sources in contrast to taxes received by special levies on motor vehicles or fuels.

Generated Traffic — That additional traffic which is created by the attractiveness of a new or improved facility; such traffic not having existed prior to the improvement.

Highway Improvement — A physical alteration or addition to a highway facility which materially improves its physical structure and/or serviceability to traffic. (See Capital Improvement)

Highway Services — The services supplied by state and local governments to provide for the movement of motor vehicles. These services include the construction and maintenance of highways, roads and streets, and the incidental appurtenances, such as traffic signals, signs, markings, and illumination, which facilitate the safe and speedy movement of vehicles.

Highway User Revenue — That income to a government arising from the payment of fuel taxes, registration fees, license fees, and special imposts upon the vehicle or the user of highways.

Interest Rate — That percentage of a given sum which is paid for the use of money, or which is charged for the use of money in a given period of time. The given period of time is usually one year. Interest on bonds or notes is one form of interest, but also interest is intended to include the rental charge of money, whether actually paid or unpaid. In other words, it represents the rate of value of money or investment to any individual or organization.

Land Development Plan — A land use plan projected into the future; a plan for the development of land and its uses.

Lead Time — As applied to the programing of highway improvements, the time required for activities which must precede the letting of a construction contract; specifically, preparation of surveys, plans, and estimates, acquisition of rights-of-way, negotiations with utilities, municipal agreements and so forth.

Legislative Outlook — A forecast of the probability that the legislature will take a certain course of action.

Legislative Policy — A settled course that a legislature can be expected to follow. The policy is determined by past actions, statements, and principles. Policy is the basic guideline, usually of a comparatively fixed nature over a period of time, upon which the legislature bases a given decision in a particular situation.

Linear Programing — A mathematical method for selecting the best course of action, from a number of possible actions, in situations where the problem can be adquately described by a set of linear mathematical relationships.

Long-Range Program — A timetable for meeting specifically determined present and future highway improvement needs over a definite period of years, such a period extending as far as 20 years or more into the future. In the forefront of the long-range program may be a short-range program in which projects are quite firmly scheduled for perhaps two to five years: beyond this point the long-range program will usually schedule needed improvements on a less detailed basis, with more flexible timing and a recognition of the adjustments and re-analyses that the passage of time will inevitably compel. (See Short-Range Program)

Long-Range Planning — "The continuous process of making present.... (risk taking) decisions systematically and with the best possible knowledge of their futurity for some 10 to 30 years, organizing systematically the efforts needed to carry out these decisions, and measuring the results of these decisions through organized, systematic feed-back." (See Planning)

Long-Term Benefits — Benefits or advantages that result from an event but which

may not be immediately apparent when the event takes place. Such benefits may be social, economic, or otherwise, and generally continue into the future.

Major Street — An urban arterial highway with intersections at grade and direct access to abutting property, and on which geometric design and traffic control measures are used to expedite the safe movement of through traffic. (See Arterial Highway)

Management — The collective body of those individuals who make the decisions and determine the course of action of any enterprise or agency. Management might be one person or it might be a group of persons. Management is represented by those top level individuals in an organization who make the higher level decisions and determine the general policy and direction of an organization.

Managerial Act — A decision of top management in an organization.

Marginal Valuation — The appraisal of the consequences of doing or not doing something in that area where the benefits to be expected are approximately equal to their cost, each on an incremental basis.

Market Rate — The price or rate prevailing at a particular time and is accepted as generally being agreeable to both buyer and seller. There is a going market rate of interest on the use of money, on the price of labor, and upon the price of materials.

Money Value — The dollar worth of the benefit, the cost, or an act when such value can be reduced to dollar terms.

Objective Budget — An allocation or limitation of funds for a specific time period for specific objects of expenditure, such as, wages and salaries, travel, printing, office supplies, equipment, and communications. (See Functional Budget)

Operating Budget — An expenditure plan for some period of time covering the cost of regular or recurring operations related to anticipated revenue.

Operating Divisions — The branches of an organization which perform managerial functions.

Operating Expense — Operating expense, as distinguished from capital expense, represents the obligation or outlay of resources incurred by an organization in support of the ordinary, day-by-day functions, which do not result in capital investment.

Operating Function — The operating function of an organization is described as the main purpose, objective, or operations of an organization. The operating functions of a highway department are primarily constructing highways and maintaining those highways.

Operating Speed — The highest over-all speed exclusive of stops at which a driver can travel on a given highway under prevailing conditions without at any time exceeding the design speed.

Optimum Investment — That investment which offers the greatest over-all return.

Permanent Improvement — See Capital Improvement.

Physical Needs — The kind, extent, and cost of physical improvements necessary to bring a system of highways up to standards adequate for expected traffic during a specified period of time, as measured by an engineering appraisal.

Planning — The formulation of a scheme of action for the future, utilizing logic, rationalization, philosophy, mathematics, observation, measurements, controlled testing — in effect, all of the tools of scientific discipline.

Policy — The set of guidelines, benchmarks, earmarks, or objectives by which an organization or the management of an organization makes decisions day-by-day. Policy is represented by those principles of an organization by which, once the policy is known, the decision to an existing consideration or situation probably can be determined with a reasonable degree of certainty.

Policy Making Groups — Governmental units responsible for the establishment of general concepts for the conduct of governmental business.

Preconstruction Activities — Those activities which precede actual highway construction work, that is, route planning, location, design, soil investigation, and right-of-way acquisition.

Present Worth — A recognition in engineering cost studies that time affects the value of money or a favor, service, or consideration.

Priority Arrays — Tabulations, by road section, arrayed in sequence according to a priority rating of each section from the worst to the best condition.

Priority Planning — The measurement, rating, and ranking of projects by adopted procedures and standards both for physical adequacy and economic significance, balancing such ratings with each other and with administrative considerations.

Priority Rating — A numerical index applied to a proposed improvement project, denoting the urgency of its need for improvement, relative to other proposed projects; such rating being based on some form of methodical and impartial engineering and/or economic analysis. (See Adequacy Rating, and Sufficiency Rating)

Program Performance — Actual progress of total or specific construction programs compared to scheduled dates. Reports of such program performance are generally for selected routes, counties, or specifically scheduled contract lettings.

Program Planning — See Advance Programing.

Program Scheduling — See Construction Program.

Programing — A systematic process of setting forth a collection of things to do with due consideration given to priority and all other factors which determine the desirability of carrying out the act. Highway programing is the scheduling of the construction of highway improvement projects, and of the essential design, right-of-way acquisition and other activities which must precede such construction.

Public Relations — The continued process of keying policies, services and actions to the best interests of those individuals and groups whose confidence and good will an individual or institution covets; and secondly, the interpretation of these policies, services and actions to assure complete understanding and appreciation.

Public Relations Program — A definite program arrived at and carried out by management to win and to keep the confidence and good will of the public. Such a program involves establishing a definite public relations policy and appointing qualified people to carry out that policy.

Rate of Return — The dividends produced from and related to a capital investment for a specific period of time, usually a year, and expressed as a percentage of the investment.

Relative Need — The degree of urgency for undertaking a proposed project as compared with undertaking another project.

Resources — The resources of an organization are those financial, material, and human assets available to the organization in the fulfillment of its objectives.

Right-of-Way Revolving Fund — A stipulated financial resource which is authorized to be expended for the acquisition of highway right-of-way in advance of its current need for construction purposes, and to be replenished later from current highway funds when the project matures for construction.

Scheduling — Control and Adjustment — The mechanics of setting up highway construction programs for a period of years, the system for which must provide for control and for early adjustment of programs to changing conditions, scheduling of pre-contract engineering and other operations, as well as construction expenditure rates.

Service Life — The estimated years of useful life of capital property, measured from the date of its entering service to the date it is retired from service.

Short-Range Program — A timetable, usually extending two to five years into the future, for the scheduling of specific highway improvement projects. Ideally such a timetable may detail separately the scheduling of engineering, right-of-way acquisition, and any separate contract phases of construction. (See Long-Range Program)

Socio-Political Evaluations — The assessment and appraisal of considerations that derive from the broad community viewpoint, including the broad social and economic values.

Standards of Tolerability — Geometric or structural conditions which while not quite up to required standards for new construction, are sufficiently close to new construction standards so as not to justify reconstruction.

Stragetic Decision — Management decisions going far beyond the simple answer finding process to the matter of asking the right questions in the first place in order that the decision is "strategic" rather than "tactical." (See Tactical Decision)

Sufficiency Rating — A numerical index, empirically arrived at, which attempts to measure the structural and/or geometric adequacy (hence "sufficiency") of a highway section or a structure, relative to some predetermined standard of complete adequacy. (See Adequacy Rating and Priority Rating)

System Classification — The grouping of highways into distinct classes or systems according to the type of service, or function, they perform (functional classification); also and secondarily, according to the agency having jurisdiction (jurisdictional classification), or the source of dedicated funds from which they are to be financed (fiscal classification). Properly, jurisdictional and fiscal classification should follow and be based on functional classification, which provides an essential tool for the orderly planning and management of highway programs and highway department operations.

Tactical Decision — The decision directed toward the accomplishment of an immediate objective of a fairly simple and evident nature. (See Strategic Decision)

Temporary Improvement — A capital improvement of such nature that it is not expected to serve the usual length of time that such improvements normally would serve. It is put in strictly as an expedient with the expectation that within a short range of time it will be removed, having served its usefulness.

Thoroughfare Plan — A goal for the construction of a system of arterial streets usually in an urban area resulting from comprehensive analyses of population, economy, and society of the city and land uses.

Top Management — The executives responsible for making policy decisions.

Transportation Planning — The study and planning of the entire field of transportation; automobile, railroad, airline, shipping, mass transport, etc.

Urban Programs — That portion of the total highway construction program located within areas of urban-development.

Warrant — Justification as determined from established criteria, for certain action, such as improvement of a particular highway project, or installing a traffic control device.

Appendix B

SELECTED BIBLIOGRAPHY ON HIGHWAY CONSTRUCTION PROGRAMING[1]

Abelard, A.R., "Benefit-Cost Ratio Method of Computing Priorities of Construction." University of Colorado Highway Conference, Papers, pp. 46-49 (1949).

American Association of State Highway Officials, Committee on Planning and Design Policies, "A Policy on Road User Benefit Analyses for Highway Improvements." 152 pp. (1960).

Presents method for making simple and practical analyses for highway improvements based on benefit to road users. Applies only for alternates of location and design of same general highway facility.

Association of Highway Officials of the North Atlantic States, "The Highway Administrator and His Problems — Panel Discussion." Proc., pp. 80-97 (1955).

Program planning, legislative relationships, minority pressure groups and stability of tenure.

Automotive Safety Foundation, "Planning Tennessee Programming Study."

An investigation of new procedures and techniques in the development and presentation of long-range highway programs, conducted by: the Highways Division of the Automotive Safety Foundation with active participation by the Tennessee Department of Highways. Washington, 27 pp. (1955).

Baerwald, John E., "Establishing a Priority for Local Rural Road Improvements." Traffic Quarterly, pp. 223-246 (April 1956).

Traffic engineering services of Joint Highway Research Project, Purdue University, made an engineering analysis of rural highways under county jurisdiction for Allen County, Ind. Included classification of rural county highways into three systems of decreasing importance — county primary, county secondary, and local service system — and evaluation and ranking of county primary and county secondary highway sections in a decreasing order of urgency for improvements or reconstruction. Study forms basis of this article.

Baerwald, John E., "Improvement Priority Ratings for Local Rural Roads in Indiana." HRB Proc., pp. 38-62 (1956). References pp. 61-62.

Baldwin, Oliver F., "Planning Highway Construction to Take Care of Future Needs." Highway Engineering Conference, University of Utah, Proc., pp. 47-51 (1954).

How Wyoming anticipates traffic requirements for each primary road for, from 10 to 25 years.

Bartle, Richard, "Programming Public Works." California Institute on Street and Highway Problems, Proc., pp. 62-64 (1950).

Bellis, Wesley R., "Highway Traffic Analysis, Planning and Economics." New Jersey Highway Department. Lecture series...1947. 12 pp. Paper No. 6.

Highway improvement program; basic data required; analysis of data; highway economics by benefit-cost-ratio method.

"Better Roads Forum: Advance Programming and Planning." Better Roads, pp. 31-32, 34 (July 1954).

Many of contributors believe that highway departments are handicapped in

1/ Prepared by the library staff of the Bureau of Public Roads.

looking very far ahead. Rapidly changing conditions, lack of funds and shortage of engineering personnel make it difficult to plan definitely for very far into the future. Long-range programs of 10, 15 or 20-year duration are in force in some States, but they must be revised periodically to keep pace with changes in priorities and funds. Improvements in order of priority may be scheduled from 1 to 5 years in advance of preparation of detailed plans.

Bugge, W.A., "The Role of Public Relations in the Over-All Planning of the Highway System." Highway Research Abstracts, pp. 34-40 (Feb. 1958).
To obtain public support for the highway program, requires an understanding by people of highway program within various States.

Burnes, Clinton H., "Factors Basic to Sound Programing." U.S. Bureau of Public Roads, Washington, 15 pp. (1960).
Presented at annual meeting of Factual Survey Committee of the American Association of State Highway Officials, Detroit, November 25 to December 2, 1960.

Burnes, Clinton H., "Three R's of Highway Programming." Better Roads, pp. 19-20, 36+ (May 1960).
Recognition of necessity for systematic programing; role of planning and programing in administration; requirements for systematic programing.

Canadian Good Roads Association, "Factors in Long-Range Planning." Proc., pp. 75-97; 109-130 (1954).
Assessing public opinion concerning highway policy, by Wilfred Sanders; Economic and financial problems in building adequate highways, by A.K. Branham; Getting value for the money expended on highways, by J.P. Carriere; Basic factors in long-range planning of highways, by A.D. Margison; Highway traffic of the future, by Philippe Ewart; Vehicle design and road improvement are complementary, by W.J. Chenery; Causes and cures of accidents on highways, by W.A. Bryce. Discussion, pp. 130-133.

Carlson, H.E., "Adequacy and Priority Ratings for Rational Highway System Planning," Highway Research Abstracts, pp. 20-27 (April 1955).
Method of selectivity based on factual data makes for good public policy.

Cashen, Robert L., "Planning and Programmingthe Project." In Conference on Construction Operations, University of California. Proc., pp. 8-12 (1956).

Clark, A.C., "Better Construction Planning Needed in Our Growing Program." Roads and Streets, pp. 76-77 (Feb. 1956).
Long-range financing, earlier fund allocation, earlier lettings, simplified contracts, bigger contract size, are among steps suggested for accelerating highway work with maximum efficiency.

Clees, Elmer, "Factual Programming." Western Association of State Highway Officials, Proc., Highway Planning Conference, pp. 23-27 (1958).
Three phases of programming include (a) development of a long-range program, (b) preparation of an annual construction program, and (c) preparation of a Federal-aid program.

Coughlin, Robert E., "The Capital Programming Problem." American Institute of Planners Journal, pp. 39-48 (Feb. 1960).
Analytic framework set forth for formulating a capital program, given a comprehensive plan.

Davis, Harmer E., "Comments on Highway Planning and Research." California Street and Highway Conference, University of California, Proc., pp. 49-55 (1960).
Ultimate objective in highway engineering effort, response of planning and research to new problems, the limited-improvement period, rural-road-network period, highway system period, the transportation systems period and research, a part of the creative process, transition from research information to design procedures, changing conditions require continuing effort.

Dean, Joel, "Capital Budgeting; Top-Management Policy on Plant, Equipment, and Product Development." New York, Columbia University Press, 174 pp. (1951).

Donnell, P.M., and Tuttle, L.S., "Priorities Determination and Programming in Tennessee." HRB Bull. 158 (1957).

Donnell, Philip M., "Tennessee's Programing Study: First Year's Experience and Techniques for Updating." HRB Bull. 194, pp. 49-60 (1958).

Farrell, Fred B., "The Investment Analysis Approach to Estimating Highway Needs." HRB Proc., pp. 9-13 (1956).
Based upon premise that under a condition of sustained traffic increase over a period of several years there should be a corresponding increase in investment (cost-new less depreciation) in the highway plant.

Farrell, Fred B., et al., "Panel Discussion on Highway Programing." Highway Research Abstracts (Sept. 1955).

Fulton, W.J., "Priority Road Programming." Canadian Good Roads Association, Proc., pp. 85-100 (1955).
Outline of methods and tools used to plan and program highway work in Ontario.

Gordon, Grant P., "Programming of a Major Job." Conference on Construction Operations, University of California, Proc., pp. 54-61 (1956).

Grant, Eugene L., and Ireson W., Grant, "Principles of Engineering Economy." 4th ed., New York, Ronald Press, 574 pp. (1960). Selected references pp. 567-568.

Granum, James O., "Highway Program Evaluation." HRB Bull. 158, pp. 126-131 (1957).
Long-range highway program costs in various states, for construction and maintenance to provide adequate highways, are reviewed in relation to travel, population and motor vehicle registration.

Granum, James O., "Priorities for Construction." Arizona Conference on Roads and Streets, University of Arizona, Tucson. Proc., pp. 74-85 (1957).

Heier, John Joseph, "Planning and Programming a Billion-Dollar, Eight-Year State Highway Program." Ohio State University, Columbus, Thesis (B.C.E.) 125 pp. (1957). Bibliography pp. 85-87.
Events leading to bond issue and program; programming procedure for selection of projects; fitting programs to use various funds; advance programming; future program prospects; 1956 Federal-aid highway act.

Hennes, R.G., "Some Comments on Highway Benefit Analysis." Journal of Engineering Education, pp. 364-367 (Feb. 1958).
Principal problem of highway economist is appraisal of benefits. Decision to construct or improve highway is based upon estimate of resulting gains; so is selection between alternate routes or alternate types of improvement; and so is adoption of appropriate levels of expenditure (design standards).

Highway Research Board, "Economic Analysis in Highway Programming, Location, and Design." Workshop Conference Proceedings, September 17-18, 1959, HRB Special Report 56, 187 pp. (1960).
Theory, principles, concepts, and applications; current practices in economic analysis; the determination and measurement of highway costs; the determination and measurement of user benefits; determination and measurement of effects of highway improvements on others than direct users in the highways.

Highway Research Board, "Highway Needs and Programming Priorities." HRB Bull. 249, 75 pp. (1960).
The congestion approach to rational programming, by Evan H. Gardner; Advance programming methods for State highway systems, by James O. Granum and Clinton H. Burnes; A criterion designed to aid highway expenditure programming, by Charles M. Hummel; Estimation of county primary road system needs by sample survey methods, by Donald O. Covault and Harold L. Michael.

Jorgensen, Roy E., "American Highways — How to Measure Their Adequacy." Civil Engineering, pp. 84-88 (Sept. 1952).
Sufficiency ratings measure adequacy.

Jorgensen, Roy E., "Priorities and the Development of Annual Highway Programs." National Highway Users Conference, 31 pp. (1952).

LaPrade, D.B., "Scheduling a Road Construction Program." Better Roads, p. 38, 40 (Dec. 1954)

Schedule can be set up to aid in keeping annual program within highway department's available funds.

Livingston, Robert E., "The Sufficiency Survey Method of Determining Priorities for Construction Programs." Highway Conference, University of Colorado, Papers, pp. 41-45 (1949).

Livingston, Robert E., "The Use of Factual Data in Long-Range Planning." Western Association of State Highway Officials, Proc., pp. 60-65 (1958).
Emphasizes importance of applying industry's selling techniques to highway public relations.

McBrien, J.P., "The Second Order of Advance Planning for Local Areas." California Street and Highway Conference, University of California, Proc., pp. 25-29 (1959).
Discusses growing need for new kind of road-system classification raising the question of methods and priorities of finance.

McClough, R.W., "Statistical Requirements and Methods of Long-Range Road Planning." Canadian Good Roads Association, Proc., pp. 133-144 (1955).
Priorities, the present pattern, advantages of planning, enlisting public support, sound economic approach, planning by whom? Some basic assumptions, the planning period, three phases, traffic needs study, traffic patterns, sufficiency ratings, future traffic needs, engineering study, cost trends, the economic ratio, economic planning, the commercial concept, supply and demand, chain of causation, economic priorities, revenue and taxation.

McKenzie, D.W., "Capital Road and Street Improvement Programs." California Street and Highway Conference, University of California, Proc., pp. 67-70 (1960).
Emphasis is on California's programs.

McMonagle, J. Carl, "A Comprehensive Method of Scientific Programming." HRB Proc., pp. 33-37 (1956).
Provides highway administrator almost immediate programming on a factual and scientific basis up to limit of funds available for any construction period plus additional scheduling on same basis for any year in future for which data is available.

Martin, James W., "Programming Highway Construction." Kentucky Highway Conference, Proc., pp. 11-15 (1958).
Discusses highway planning in the highway department, with specific reference to the Kentucky Department of Highways.

Moyer, Ralph A., "Analysis of Highway User Benefits for Completing the Interstate System in California." American Society of Civil Engineers, Journal of the Highway Division, Proc., 14 pp. (Jan. 1956).

National Association of County Engineers, "Manual on Advance Road Programs." Washington, D.C. (Oct. 1960).

North Carolina Highway Commission, "North Carolina Highways, an Analysis of Long-Range Highway Needs." Prepared by Advance Planning Department, Secondary Roads Department, Raleigh, various paging (1960).
In cooperation with U.S. Bureau of Public Roads. Value of long-range planning; philosophy of long-range highway plan.

Oglesby, C.H., and Grant, E.L., "Economic Analysis — The Fundamental Approach to Decisions in Highway Planning and Design." HRB Proc., pp. 45-57 (1958).
Discussion of making best possible use of public funds available for highway purposes. Arguments are given favoring the "rate of return" method. References, pp. 55-56. Discussion by Joseph Barnett pp. 56-57.

Petree, Neil, "Does a Long-Time Street and Highway Plan Pay Dividends?" California Institute on Street and Highway Problems, Proc., pp. 22-42 (1950).
Includes round table discussion pp. 27-42.

Plummer, Harold L., "Advance Planning: the Big Payoff." American Road Builder, pp. 10-11, 26 (Dec. 1959).
Reflects efficiency in highway departments.

Porter, Urquhart, McCreary and O'Brien, "A Highway Improvement Priority Study." (Fresno County Highways, 1958-1980) pp. 35-61 (1958).

Reynolds, D.J., "The Assessment of Priority for Road Improvements." London, H.M. Stationery Off., 30 pp. (1960). Road Research Laboratory. Road research technical paper No. 48.
References: p. 31.

Sargent, John R., "Transportation Programming." Northwest Conference on Traffic Engineering, Proc., pp. 15-18 (1951).
Statements apply equally well to ten-year statewide highway program or a one-year program for signal installations in a single city.

Shattuck, I.S., and Rykken, K.B., "Highway and Thorofare Planning and Programming in Relation to Urban Planning and Development." HRB Bull. 31, 21 pp. (1949).
Importance of urban areas in highway planning according to various reports; scope of major thorofare planning in urban areas; the land use plan and its bases; example of Albert Lea, Minnesota; design of primary thorofare facilities; planning regulations for controlling highway access and roadside development and for protecting planned highways; adequacy of basic traffic surveys for planning purposes.

U.S. Inter-Agency Committee on Water Resources, "Proposed Practices for Economic Analysis of River Basin Projects." Report to the Inter-agency Committee on Water Resources by the Subcommittee on Evaluation Standards. Rev. May 1958. Washington, U.S. Govt. Print. Off., 56 pp. (1959).

THE NATIONAL ACADEMY OF SCIENCES—NATIONAL RESEARCH COUNCIL is a private, nonprofit organization of scientists, dedicated to the furtherance of science and to its use for the general welfare. The ACADEMY itself was established in 1863 under a congressional charter signed by President Lincoln. Empowered to provide for all activities appropriate to academies of science, it was also required by its charter to act as an adviser to the federal government in scientific matters. This provision accounts for the close ties that have always existed between the ACADEMY and the government, although the ACADEMY is not a governmental agency.

The NATIONAL RESEARCH COUNCIL was established by the ACADEMY in 1916, at the request of President Wilson, to enable scientists generally to associate their efforts with those of the limited membership of the ACADEMY in service to the nation, to society, and to science at home and abroad. Members of the NATIONAL RESEARCH COUNCIL receive their appointments from the president of the ACADEMY. They include representatives nominated by the major scientific and technical societies, representatives of the federal government, and a number of members at large. In addition, several thousand scientists and engineers take part in the activities of the research council through membership on its various boards and committees.

Receiving funds from both public and private sources, by contribution, grant, or contract, the ACADEMY and its RESEARCH COUNCIL thus work to stimulate research and its applications, to survey the broad possibilities of science, to promote effective utilization of the scientific and technical resources of the country, to serve the government, and to further the general interests of science.

The HIGHWAY RESEARCH BOARD was organized November 11, 1920, as an agency of the Division of Engineering and Industrial Research, one of the eight functional divisions of the NATIONAL RESEARCH COUNCIL. The BOARD is a cooperative organization of the highway technologists of America operating under the auspices of the ACADEMY–COUNCIL and with the support of the several highway departments, the Bureau of Public Roads, and many other organizations interested in the development of highway transportation. The purposes of the BOARD are to encourage research and to provide a national clearinghouse and correlation service for research activities and information on highway administration and technology.

HIGHWA
RESEAR
BOARI

SPECIA
REPOR
56-60, 6