

SUMMARY AND SYNTHESIS

Formulating Highway Construction Programs- A Case Study and Summary

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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 postpone 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 depression. 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.

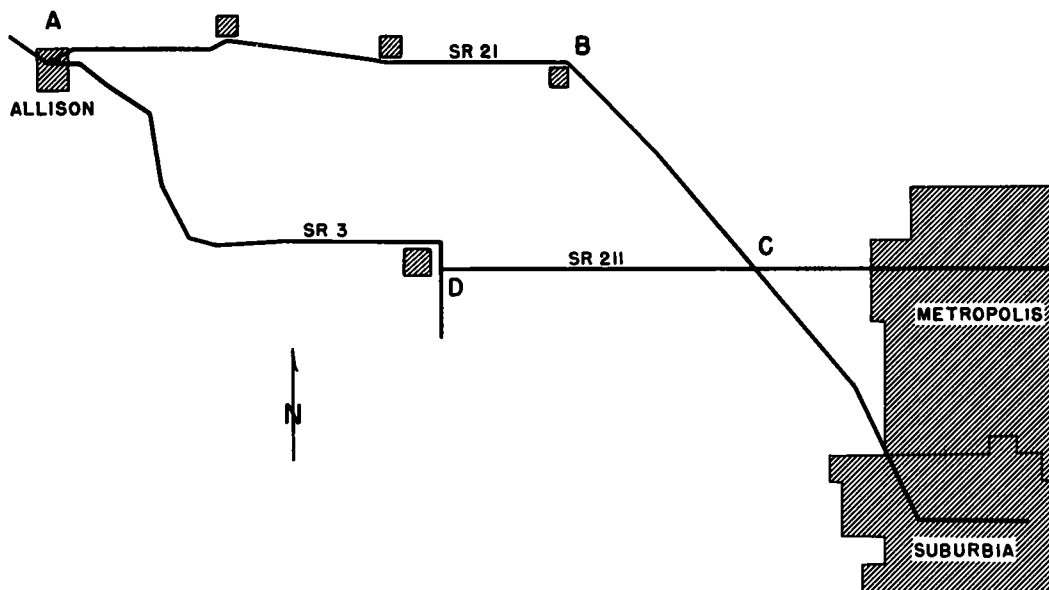


Figure 1.

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 programming 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 Dean³ 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 Pfiffner⁴ 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.