

Highway Administration and Changing Times

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As a part of the theme of this session, which is concerned with the role of highways in the national transportation scene, your program committee wanted to have discussed some of the administrative aspects of highway transportation. In particular, it desired that comment be made on the problem of "Maintaining Effective Highway Administration." This is, I assume, subject to interpretation.

If one should take a restricted view of administration as pertaining largely to the process of organizational management, there is relatively little that could be said here that has not already been said well and in detail, in the now substantial literature concerned with management. Apart from the creation of adequate standards of performance of the special, technical and professional functions involved in highway affairs, the principles and processes of management would appear to be the same for a highway agency as for any other agency. Further, the possible implication that there may exist some easy or pat formula for an "effective" (meaning efficient?) management process could be misleading, for there appear to be many subtle factors involved in the achievement of a productive and efficient organization. And insofar as *maintaining* an effective organizational management scheme is concerned, an obvious first requirement would be to have one.

It is encouraging to note a rising and sincere interest, on the part of many highway administrators in the management process, as a part of the total job of producing highways and highway service. Across the country we find increasing attention being given by highway agencies to in-service training in the art and the processes of management. Various types of training programs, short courses, conferences and seminars are being given to improve the managerial know-how of personnel having administrative duties. And various types of instructional material are available.

If one were to try to capsulize a practical suggestion for the improvement or maintenance of effective organizational management it

might well be simply this: devise and conduct a program of training (appropriate to the needs and nature of each particular highway agency, of course) in the techniques and skills of management, so that all concerned are continuously aware of the need for attention to the everyday processes involved. The reason for this is the homely fact that organizations are made up of people—and the art of creating conditions such that people work well and productively together generally requires conscious attention just as much as does the development and improvement of technical skills.

Especially in view of the complexity of the task facing many highway agencies, this interest in the management process itself seems well justified, and to obtain and sustain competence in this aspect of the administration of highway affairs is important. But it is only one aspect. And if the efforts to produce highways and highway service are to be really effective in providing an appropriate share of the nation's transportation effort, there are other considerations which in the long view are probably fully as important as seeing that a highway department runs well. It is to some of these other considerations I should like to direct attention today. And, in particular, I should like to point up the increasing importance of competent planning in the process of administering highway affairs.

SOME ASPECTS OF ADMINISTRATION

Administration may be regarded from several points of view. One broad point of view is exemplified by a question which was asked of me some years ago by a visitor from a foreign country. His question was: "How are highway transportation affairs administered in the U.S.A.?" From this viewpoint we would think of administration as the social mechanism and institutional arrangements by which we accomplish some purpose in our society. In this case, the purpose is to provide highway transportation as an economic and social function. The end product is highway transportation service adapted to the needs and capabilities of our economy.

To detail fully for a complete stranger to our way of doing things would be a long story indeed; it would amount to a long instructional program. It would involve an understanding of our political institutions, of our social attitudes and economic philosophy, of the interplay of complex economic forces, as well as an appreciation of our status of technologic development in the components that combine to result in highway transportation.

Fortunately, I did not have to go into all of this with my foreign visitor, but it was necessary, for example, to describe the roles of our

federal, state and local government in highway affairs. And we need not review here the vast background that is implied. All of us who work here with highways and highway transportation recognize in general what is involved. But I would like to review briefly a few highlights of our scheme of providing highway transportation service, which are pertinent to some points I shall later wish to make.

PROVISION OF HIGHWAY TRANSPORTATION SERVICE

The characteristic components of any scheme or system of transportation we may take to be a fixed plant, the rolling stock, and the operational scheme.

In the case of highway transportation, we generally provide the fixed plant (travelled way, its appurtenances, and many of the terminal facilities) through agencies of government. Most of the vehicles and their direct operation are provided by millions of private operators who can exercise a high degree of choice with respect to routes, schedules, and type of vehicle. Operational controls, however, are imposed through government action: traffic guidance and control, vehicle and operator licensing, and economic controls through tax structure and regulatory laws.

Now here is an interesting feature of the overall arrangements through which highway transportation is produced: although the cost of providing the fixed plant and the operational controls is probably roughly only of the order of 10 per cent of the total cost of the transportation produced, the collective actions of government (federal, state and local) in providing what we may call "highway service," play a significant role in placing ceilings on the potential performance of the transportation system, and in influencing the total cost of highway transportation. In other words, the policy controls with respect to the development and functioning of the highway transportation system result in large degree from the actions of government. Whether these policy controls are fully premeditated and coordinated, or just accumulate as the result of compromises in the democratic process, is beside the point. The point is that through the function of providing highway service (fixed plant, in amount, quality and routing, and the operational controls) significant policy control is established for the whole highway transportation system.

A collateral point, also relevant to our discussion of the administration of highway affairs, is that policy formulation and its imposition is one of the functions of administration. However, the nature and effect of guiding policy is subject to adjustment and alteration under the

impact of changing conditions and needs. As such, it is worthy of constant re-examination and analysis by all concerned with any part of the administrative process.

GENERAL FEATURES OF THE ADMINISTRATIVE PROCESS

Another viewpoint of administration may be gained from reviewing some of the general features of the administrative process.

In the process of accomplishing the objectives of any organized effort, three characteristic functions can be identified: the policy-making function, the executive or top management function, and the operating function.

In a private company, we often think of policy making as the function of a board of directors, or in public service, a function of the legislative body. In this sense, we are thinking of general or overall policy, with respect to which top management and the operating organization perform their functions. But we may observe in passing that there are various levels of policy, each adjusted to provide guidance or control within the scope of the next higher level of policy. For example, a state legislature may have authorized a route by fixing its termini; the highway department will then decide the location and apply design standards (technical policy).

Of particular interest, however, especially in connection with the provision of highways and highway service, is the fact that highway transportation policy is not made in isolation. In our scheme of things, policy results from a complex interplay of the views of many parties of interest, often with the legislature as the fusing pot. In this kind of setting, the highway department, through its top management, has not only a function but a duty to provide the information, analyses and recommendations, on the basis of which policy decisions can be made.

A RESPONSIBILITY OF HIGHWAY MANAGEMENT

The role of highway management in participating in the general policy-formulation process is worthy of serious thought. Just as, in private enterprise, management is in the most favorable position to alert the board of directors to the nature and probable effects of impending conditions that will influence the accomplishment of basic objectives of the company, so highway management is or can be in a position to provide the basis for rational adjustments in highway policy.

In view of the enormous expenditures involved in providing highway service, in view of the profound influence of the highway improvements

which will be put in place in the next two decades, and in view of the specialized knowledge that is required to analyze adequately the performance of new highway systems, a high responsibility is involved. Not only will it be more important than ever before to keep the legislature (and the public) informed of the status of present programs (in terms they can understand), but it will be incumbent upon highway management to present impartial estimates of the probable effects of future courses of action.

This role and this kind of responsibility are placing increasing emphasis on the type of activity which in the management process is usually called planning.

Among the several activities considered to be characteristic of the management process (organizing, planning, staffing, directing, controlling), planning is concerned with analyzing alternatives and selecting from them bases for action which can most likely achieve the specified objectives. In recent years much has developed to aid and improve the planning activities of the highway agencies. More adequate highway planning data have been forthcoming, new analytical techniques have been devised, and high-speed computers and other aids to analysis have become available. Simultaneously the skill and competence of the highway departments in longer-term planning has been greatly augmented. And the results of this kind of analyses and planning are becoming recognized as critically important for decision making in highway matters.

Thus far we have considered, however briefly, the concept of administering highway transportation affairs as a whole. We have pointed out that the policies which are established for the provision and control of highway service greatly influence the ultimate transportation service. We have implied that the process of policy formulation in highway transportation affairs is diffuse, and is subject to many influences. And finally, we have attempted to indicate that the planning function, being the function through which information on the nature and performance of the highway systems is accumulated, and the one where alternate courses of action are considered, can play a vital role in providing a basis for policy decisions.

CHANGING SCOPE OF HIGHWAY PLANNING AND RESEARCH

I should now like to turn to a different set of considerations. These have to do with the changing scope of the problems of providing for highway transportation, and the changing scope of the research needed to provide a basis for coping with these problems. The activity or

function of information development derived from research may be regarded as an essential and integral part of the administrative process. It is a prime responsibility of management and is usually closely associated with the planning function, where it is of immediate importance in mapping future courses of action. But just as important is the acquisition of pertinent, adequate and defensible information so that management can present to the policy-making body a basis for policy decisions.

As a basis for discussing the nature of research related to highway engineering—or indeed, related to engineering in general—it is pertinent to remind ourselves of the role of engineering in our society. While the activities in which engineers engage are so varied, and the range of subject matter so extensive that it is difficult to try to define “engineering” uniquely and adequately, most engineers would probably agree upon the key or central function of engineering. This key or central function of engineering as a professional activity has to do with the creation, in the real world, of feasible and operable systems* of facilities or processes, whose performance and cost can be predicted. Essential aspects of this creative process are planning and design (involving conception, analysis and predicting performance and cost), and direction or control of fabrication, construction or processing (involving the meeting of time and cost constraints). In both these aspects there is involved the exercise of intellectual skill and judgment in the synthesis of requirements and the compromise of conflicting requirements.

We may view engineering research as that effort related to the development of knowledge of, and the improvement of our understanding of, the systems whose performance must be predicted in order that feasible plans and designs can be made.

In an earlier day, in each branch or specialized area of engineering, the main focus was on the physical design of relatively simple units or operations; by and large, the knowledge was empirical and the predictive process was sometimes an uncertain extrapolation. In contrast, the economic, social and technologic development of our present society is creating an urgent need to analyze and design increasingly complex systems of facilities and processes (e.g., whole communication systems, transportation systems, manufacturing systems). Human factors and biologic processes are receiving, and will receive increasing considera-

* The idea of a system connotes something made up of interdependent elements. The trick in successful design is to have these elements work together to produce the desired result efficiently and economically. For example, bridge is a system of framework.

tion in planning and design. There is growing recognition of the need not only for more rational bases for planning long-range developments under conditions of change brought about continuously by additions to scientific knowledge, but also for predicting the effect or impact of these developments on our societal arrangements.

In the field of highways and highway transportation, there has been taking place an evolution along the same lines that I have intimated has been occurring in engineering generally. To highlight the trends, I should like to assume four periods or foci of attention with respect to the scope and concept of the system-amenable-to-design, and concerning which some attempt was made to infer performance. Obviously no neatly separable periods possessed of unique characteristics existed; practices and concepts changed gradually, and some techniques were present in some or all periods. Rather, I am attempting to identify a kind of central tendency in the changing scope of engineering design effort.

However approximate may be the setting of these periods, the identification of the changing emphases in the scope of the "system-to-be-designed" is of interest in that it provides a backdrop against which we can view with some perspective the kind of information needed for planning purposes.

The Limited-Improvement Period. In the decades up to, say World War I, the focus of technical attention was largely directed to the physical improvement of the travelled way—the roadway itself. But improvements were usually of limited extent; for many itineraries the traveller was fortunate if he had opportunity for continuous passage, and states of improvement (and maintenance) along such routes as could be identified as routes, often varied from nil to passable.

The concept of system as something to be designed was exemplified by a bridge or a pavement (a system of layers of earth-type materials, designed to resist weathering and support loads).

Correspondingly, if we look at the papers and books of that period, we find that investigations and studies of the period largely were concerned with materials, the behavior of combinations of materials, and with the techniques of building simpler structures. And the application of the existing knowledge was largely on an empirical basis.

Rural-Road-Network Period. The period from World War I to World War II saw the development of identifiable (rural) road networks (e.g. federal-aid primary highways, various state primary and secondary road networks). Although the design and construction was by separate segments among which the actual standards and methods of

design and techniques of construction varied, there emerged concepts of minimum standards of design and criteria of operation. These standards and criteria underwent evolution which increasingly reflected interaction of vehicle and road, and over time reflected changing operational characteristics of the vehicles. Concepts evolved of continuous routes of large extent with increasing levels of uniformity of operating standards. During this period we note especially the beginnings of research in traffic engineering. Study of operational requirements led to criteria of geometrical design (as distinguished from physical or structural design); and study of traffic demand characteristics laid the basis for later thinking concerning planning for mass movement. During this period we note also increasing scientific emphasis in the study and use of materials and structures, and the development of a scientific approach to controlling the behavior of soil, in or on which most roads are built. Increased sophistication in the study of the economics of highway transportation provided a rationale by which the responsibility of users of the highways was related, however approximately and crudely, to costs of providing highway service (although this applied largely to the rural networks). Significantly, the Highway Planning Surveys laid an important basis for system and operational study.

Highway Systems Period. Since World War II we note increasing recognition of particular highway systems (e.g. the National System of Interstate and Defense Highways), each conceived as a specific, entire, interconnected network, designed to provide a predicted traffic service, and financed and scheduled more or less as an entity. During this period the notion of route has come to mean a continuous part of an operable network, regardless of urban or rural environment, or of jurisdictional boundaries. And we also note the institution of substantial mileages of controlled-access facilities, designed solely for high-volume and high-speed movement. Design not only takes into account the interacting operational characteristics of vehicles on a given system, but also the limiting characteristics of the operators of vehicles, to the extent that available knowledge will permit. And in addition to the emergence of more broadly based principles for rational design of facilities, we note the emergence of efforts for increasingly long range planning of systems of these facilities.

The range of attention which must now be given by the agencies charged with providing highway facilities and operations we find to be reflected in the research activity. We find increasing attention being given to study of economic factors which will have to be taken into account in long range planning of systems of facilities, and to study of

human factors which condition not only design but effectiveness of operation. And in passing we may note that studies of increasingly complex situations and phenomena have been made feasible by the use of high-speed computers and greater facility in the use of newer statistical techniques.

We are now witnessing, in response to certain problems of rising importance (e.g. the growth of great urban complexes, the interaction of transportation systems), the turning of increasing attention to the study of urban transportation, and to the interrelations of modes of transportation. Whether this is a prelude to a next period in highway transportation planning and design, or whether this is an indication we are in it, only the perspective of a decade or two hence can tell.

The Transportation Systems Period. In this next period, a key criterion for planning and design may well be that of optimizing transportation service for the economy. This would mean not only taking into account, for any given system and mode of transportation, the requirements of estimated potential traffic (operations), but also the interaction with other transportation systems and the interrelation between the new or improved system and other aspects of the economic and sociological structure of the commonwealth. For example, suppose we were concerned with the substantial improvement of the highway system in a large metropolitan area. In the planning and design of this improvement, we should like to be able to estimate with fair precision, (a) the probable effect of various alternate designs on land use and economic functioning in the area, and conversely the effect of probable new land and economic development on the operating characteristics of the improvement system, and (b) the nature and level of improvement which should be sought in consideration of probable and possible other types of transportation improvement.

Some beginning and small steps are being made empirically in this direction, but the development of rational criteria must await the accumulation of much additional knowledge, as well as the devising of analytic techniques by which they can be used in the planning-design process.

The briefest consideration of the subject matter as outlined above makes apparent the enormous range of knowledge that is pertinent to the production of highway transportation service, even today. Perhaps one of the greatest needs of the next several years is a synthesis of pertinent parts of existing and future knowledge into a composite set of analytical principles and criteria, on the basis of which improved predictions of system performance can be made.

CONCLUDING COMMENTS

And now, by way of conclusion, I should like to offer these comments. The expanding scope of the task of providing highway transportation, and of highway service (which greatly affects the cost and quality of that transportation), places a premium on our understanding and recognizing the nature of the process by which highway transportation affairs are administered. This includes not only the organizational managements aspects per se, but also the scheme by which policies are made and carried out. A key to providing a basis for wise policy decisions, in this complex situation, lies in competent and thorough analysis of proposed courses of action. This places great responsibility on highway agencies for providing information and defensible plans through attention to the highway planning function. And herein lies the challenge of our time, for highway engineers.