

A Concept of the Maintenance Management Problem Insofar as It Has Been Established by Preliminary Investigations in Great Britain

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In recent years much thought has been given by highway authorities in Great Britain to the improvement of the management of highway maintenance, and individual authorities, especially the County Councils, have introduced new schemes aimed at greater administrative efficiency. The County Surveyors' Society, which represents the highway engineers of rural authorities, has had for some time a committee on highway maintenance, but this is mainly a forum for the discussion of problems of immediate interest and has not so far sponsored extensive research studies. It is recognized that there is a need for a coordinated effort and a major step towards this has been the setting up in September 1967 of the joint Committee on Highway Maintenance by the Ministry of Transport and the Local Authorities (the Marshall Committee), the terms of reference of which include a study of the management of maintenance in all its aspects.

In the Road Research Laboratory, we had already planned to make a long-term study of maintenance, but the start has been delayed by other commitments. Now, with the impetus of the Marshall Committee, we have made a start and are cooperating fully with the Committee by undertaking a part of its field work. In the long term, we shall also be working in cooperation with the rural and urban highway authorities. This paper gives a simplified view of our concept of the problem in Great Britain and of the present organization of highway maintenance.

THE REQUIREMENT FROM A SYSTEM OF MANAGEMENT

It is worthwhile here to restate the obvious—what one basically requires from a system of management. It must be capable of insuring that:

1. The aims of the organization are carried out and that unnecessary work or expenditure is not incurred;
2. The right quality and amount of work are carried out to meet its purposes;
3. Value is obtained for the money spent.

THE RIGHT WORK

A highway consists of a very large number of different parts, playing different roles—engineering, safety, aiding movement, amenity, etc. Their relative importance varies with the importance of the highway, whether it is a national interurban route, a very minor rural road, a residential street, etc. At present, one tends to do something about maintaining everything because it is there, and to go to the extreme, one maintains in good condition every highway whatever its value to the community, just because it is there. These questions are now being faced in Great Britain and some highway authorities are beginning to leave out maintenance of the less important features on roads particularly on those with low cost-benefit. One authority has suggested maintaining only a reduced width of the pavement on such roads, to demote them to single-lane roads with passing places. Another has abandoned white line maintenance and grass-cutting on verges but the latter is troubling farmers because of the weed problem.

THE RIGHT QUALITY AND AMOUNT OF WORK

There is probably little scope for cutting out maintenance functions completely but a great deal in controlling the quality and amount of maintenance, i. e., insuring that the standards of maintenance carried out are no more and no less than are required for the usage and importance of each type and class of highway. One can of course regard cutting out functions as reducing them to a zero standard of maintenance.

Our first priority task, we considered, is to study the standards of maintenance over the whole range of conditions in Great Britain, in order to suggest, in the first instance, subjective maintenance standards. From here we will go on to study objective standards, based upon engineering and safety requirements, etc. Many are already in existence but there tends to be a gap between what is objectively required and what practical considerations including finance, allow. At present objective standards tend to be used only for new construction or in special circumstances such as roads with excessive accident rates. Such standards have been determined for the condition of pavements (expected life can be estimated from the permanent deformation of flexible pavements, from the amount of cracking in concrete pavements, and from the temporary deflection under a standard wheel load), skidding resistance, riding quality, visibility and sight lines, etc. Once standards of maintenance are set, on whatever basis they are determined, then the level of expenditure on maintenance is fixed, within ascertainable limits, and over or under expenditure, due to other faults in the system, is more readily apparent.

VALUE FOR MONEY

Having set one's standards for maintenance and thereby set one's theoretical expenditure level, it is then time to examine the way in which functions are carried out on site to raise productivity and reduce expenditure. Under this rather broad heading, we include not only the use of work study techniques to raise productivity, optimize gang sizes, select the most effective plant, and reorganize the control of gangs but also economic studies such as cost-benefit studies on materials to insure maximum effectiveness. These will extend back to materials used in the basic design of the original construction to see whether the overall cost-benefit of construction and maintenance can be improved. Of course much has already been done using work study but comparatively little on economic studies.

TOOLS OF MANAGEMENT

Management cannot function properly without certain tools, the chief one of which is information and the means of transmitting it. We intend looking at the systems of management that we have in Great Britain to insure that we are getting the correct information back rapidly to the people who need it, that the information is as accurate as possible and that the essentials of it are stored in a readily accessible manner.

The information required is of two broad types: (a) an estimate of the total potential work load, and (b) a record of the work actually carried out and how it was carried out.

In both cases the information needed is varied, covering such things as quantities of materials, man-hours spent on the work, the amount of work actually completed, the quality of the work, and the cost. At present much of this information originates from the lowest level of management—foremen and "gangers"—and much of it is unreliable. One reason for this is that probably they do not appreciate why it is required and how it is used. We must codify and classify the information required so that it is easy to produce and to produce accurately. Any data-processing system is only as good as the quality of the data fed into it. Much of the information required will be produced in the form of expenditure against various accounting heads. While it is always necessary to remember that accounts are kept to show how public money has been spent, engineers cannot control expenditure unless accounts are rendered in a form which is meaningful to them. Too often in the past this has not been so. Our accounting system must meet the needs of the engineer and provide the information rapidly.

The system of management must provide for decision-making at the most effective level. This we will look at, not forgetting financial decision-making at "chief-officer" level and above. Their financial powers are continually eroded by inflation and central government is always slow to increase their powers to keep pace with it. We must provide methods to aid decision-making and insure that they are used, such as critical-path planning and programming, and electronic data-processing and storage. Too often they are regarded mainly as aids to the more glamorous work of new construction. A very necessary aid to decision-making is a method of assessing priorities. Little use is made in Great Britain of sufficiency-rating systems, partly because they involve a large amount of manpower to establish and maintain. We feel that in the first instance, a simplified form of sufficiency-rating applied to maintenance only is needed (most systems cover improvements rather than maintenance and in Great Britain improvements require financial approval and funding separately from maintenance). Management needs simple methods of measuring standards of maintenance and, thereby, the need for maintenance. For the roadside maintenance functions, this is usually fairly straightforward but, for the pavement itself, measurement is more difficult and often causes serious interruption to traffic. Our aim is to devise methods of measuring all aspects of the condition of pavements by machines traveling with the traffic and, if possible, at the speed of the traffic. This is possible with riding quality—the "bump-integrator" trailer has been in use for many years. We are achieving it with skidding resistance—a prototype machine for continuous automatic readings of sideway-force coefficient is being tried out this summer and will operate at up to at least 50 mph. We are experimenting with a traveling deflection beam but as yet it is slow and not really suitable for inserting into heavy traffic. It seems too that we may need some method of continuous measurement of the transverse shape of the pavement. Some mechanized method of measuring cracking in concrete may come, but at present it seems that visual assessment will be with us for some time yet.

MAINTENANCE MANAGEMENT IN RELATION TO CONDITIONS IN GREAT BRITAIN

We have in Great Britain a comparatively large number of highway authorities, the largest of which are probably small compared with the individual states in America. They are of several different types, with different responsibilities, and the range of size within each type is large. Table 1 gives the types and approximate numbers in England, Scotland and Wales.

All counties are highway authorities, and towns over 20,000 inhabitants can claim to become highway authorities. Other towns and rural districts can have highway responsibilities delegated to them, for administrative convenience. The largest rural county has 7500 miles of road and the smallest 115 miles. The largest urban authority

TABLE 1
HIGHWAY AUTHORITIES IN GREAT BRITAIN

Type	Number	Description	Apportioned Responsibilities
Rural counties	89	Geographical counties excluding urban counties	All roads
Urban counties	106	Major towns known as county boroughs	All roads, but with some exceptions have no trunk roads
Greater London	1	London and its suburbs	All roads
London boroughs	33	Local government divisions of London	Act for Greater London Council on all roads (with some exceptions)
Municipal boroughs	275	Large towns within rural counties	Act for rural counties on all roads (with some exceptions)
Urban districts	480	Small towns within rural counties	
Rural districts	10	Rural subdivisions of rural counties	Act for rural counties on some or all roads except trunk roads
New towns	18	Special development areas	All roads except trunk roads

TABLE 2
ROAD CLASSIFICATION AND SOURCES OF FUNDS

Type of Road	New Construction and Improvements		Maintenance	
	Central Govt	Local Govt	Central Govt	Local Govt
Trunk roads (including motorways)	100 percent	Nil	100 percent	Nil
Principal roads	75 percent	25 percent from counties	Indirect support	100 percent from counties including indirect support
Non-principal roads	Indirect support	100 percent from counties including indirect support		
District (minor urban) roads	Nil	100 percent from urban authorities	Nil	100 percent from urban authorities

excluding Greater London has over 1000 miles and the smallest only a few miles. Annual expenditure on highways (including new construction) varies from £14½ million in a large rural county down to £130,000 in a small rural county and from £4¾ million in a large county borough down to a few thousand pounds in small urban authorities. The figures for Greater London are 7,800 miles and £37 million.

Table 2 shows the road-classification system and sources of funds for highway new construction and improvement and for maintenance, excluding Greater London. Indirect financial support is by means of bulk grants to the local authorities to cover all services (schools, housing, sanitation, highways, etc.), the proportion allocated to each service being left to the discretion of the local authority. However, the highway element of this support depends on the mileage of principal and classified roads in each county's area.

In general, the county highway authorities find all the funds for highway maintenance for all roads in their own areas, including those in the non-county borough urban areas, from their own resources (rates and bulk grants) except for trunk roads and urban district roads. Non-county borough urban authorities contribute to the rural counties' bulk funds. Funds for urban district roads are found directly from rates levied within each urban highway authority area.

Table 3 gives the responsibility of highway authorities and their type. London Boroughs and New Towns have been omitted because arrangements in these authorities are not typical of the remainder of the country.

This system of funding all began in 1867. Previously direct support for the maintenance of all roads other than district roads had been provided from central funds. Now direct support is provided only for trunk roads. This new system has some effect on maintenance policy for principal roads in that it may tend to defer some major maintenance until such time as it can become part of an improvement scheme, e.g., widening, and so gain direct support.

TABLE 3
HIGHWAY AUTHORITIES' RESPONSIBILITIES

Type of Road	Responsible Authority	Agent Authority
Trunk roads (including motorways)	Central government	Rural counties and some county boroughs
Principal roads	Rural counties and county boroughs	Municipal boroughs and urban and rural districts which are highway authorities
Non-principal roads	Rural counties and county boroughs	
District roads	County boroughs and other urban highway authorities	

In general highway departments are organized on broadly similar lines. The chief officer or surveyor is directed on policy by a committee of the local government council. His own headquarters department is usually divided to provide separate engineers for planning and control of new construction and of maintenance. His area, except in the case of small urban authorities, is divided into divisions, the head of which is usually responsible for both new construction and maintenance, except that large new construction projects are often run from the head office through an ad hoc site organization. New construction tends to be carried out mainly by contract and maintenance by directly employed labor organized into gangs. The use of specialist rather than all-purpose gangs is becoming more general. With the exception of motorways, the different classes of roads are all maintained by the same gangs. Separate organizations are usually set up for motorways with their own gangs.

Any management system devised must therefore take into account the wide variation in size of highway authority and the different types. (The question of size may be resolved to some extent in the near future because a national study of local government organization is in progress and it may well recommend grouping of urban and even some rural authorities.) Some re-thinking may be necessary on the traditional role of the divisional surveyor, e. g., whether he should be responsible solely for maintenance or whether he is even necessary. However, in large rural authorities some outlying organization would always be necessary for day-to-day control of maintenance gangs. All-purpose gangs have already completely displaced the traditional county roadman. In turn the all-purpose gang is giving way to the centrally controlled specialist gang. Increasing use may be made of contractors for maintenance on functions traditionally carried out by directly employed labor, but this is less likely.

CONCLUSIONS

To sum up, in Great Britain we must start logically by getting the maintenance task right, i. e., by setting our standards correctly. Then we must get our administration and organization right so that we know what is going on and so that planning and controlling are done correctly. Finally we must insure that what is to be done on site is done in the most efficient manner. All three of these aims can and are being pursued simultaneously of course, but the emphasis we feel should be placed in the order given—it is false economy to carry out efficiently work that should not be done at all!

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