

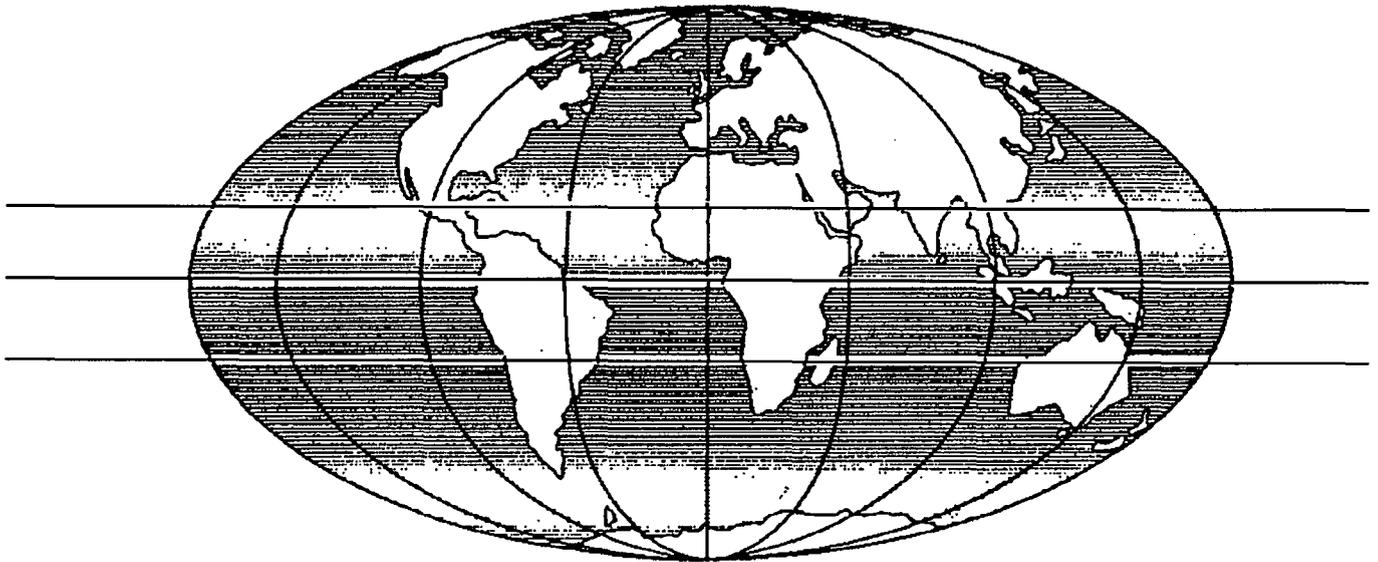


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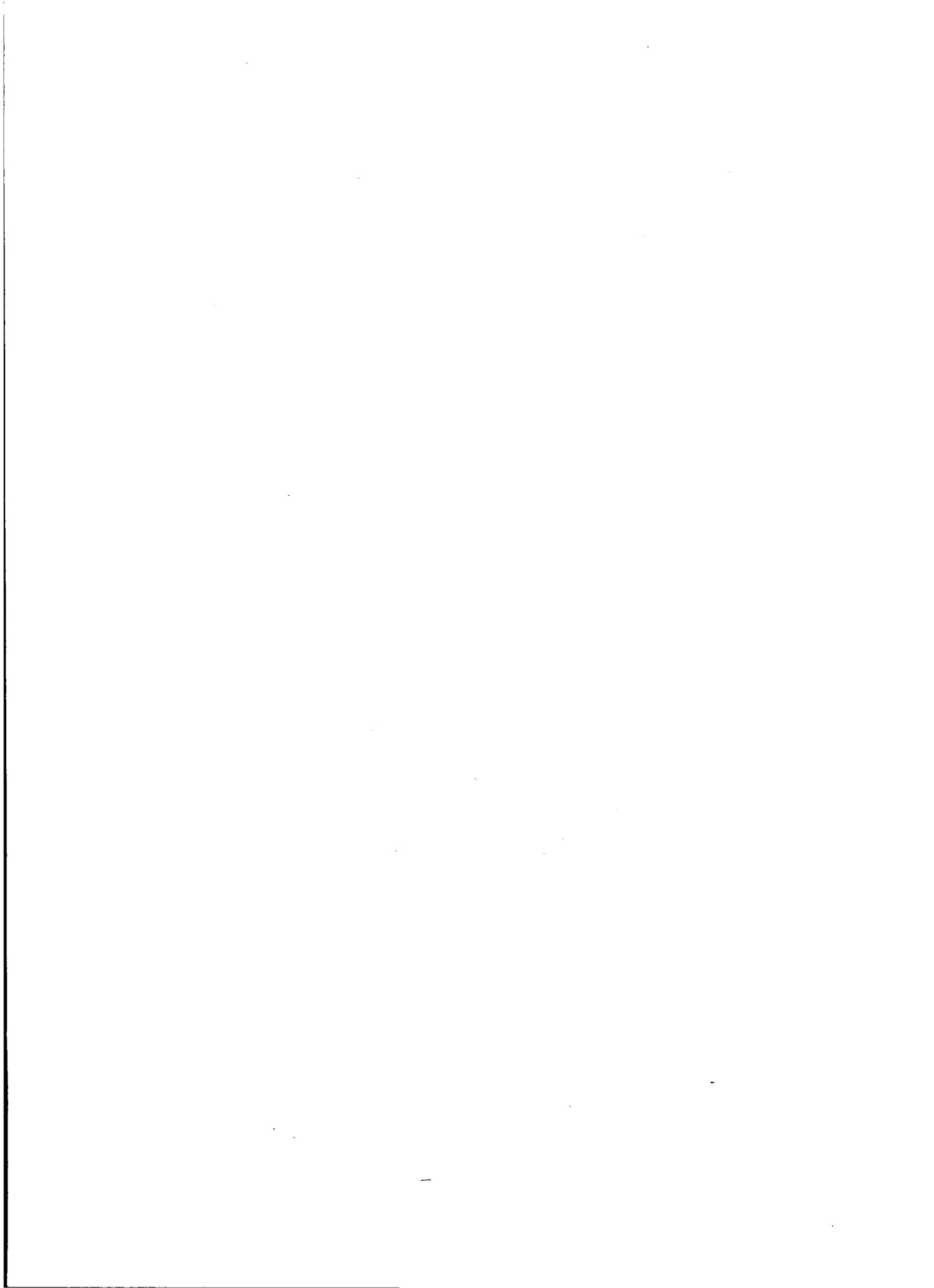
**TITLE Road maintenance projects
: reassessing objectives**

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ROBINSON, R, D BROOKS and K O'SULLIVAN, 1987. Road maintenance projects: reassessing objectives. In: UNECA. *Fourth African Highway Maintenance Conference, Harare, 7-11 December 1987*. Addis Ababa: UNECA.



ROAD MAINTENANCE PROJECTS: REASSESSING OBJECTIVES

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ABSTRACT

This paper explains the background to a change in emphasis in recent years away from capital projects and towards maintenance projects in the road subsector in developing countries. A study is described which has been carried out by the Overseas Unit of Britain's Transport and Road Research Laboratory to investigate the performance of past road maintenance projects and to identify reasons why success has sometimes been limited. A strategy is proposed to identify the fundamental needs in the road maintenance sector of individual countries. This should assist in the preparation of Terms of Reference targeted at key areas where investment will result in long-term improvements.

INTRODUCTION

The objective of technology transfer programmes is to develop institutions in developing countries with the long term objective of enabling them to become self-sufficient and independent of foreign aid. Such programmes are particularly relevant in the road maintenance field where problems tend to be institutional and managerial rather than purely financial and technical (World Bank 1981).

This paper discusses the technology transfer aspects of road maintenance projects and explains why they are critically important to projects carried out in developing countries in recent years. Published information on technology transfer problems in road maintenance projects is reviewed and the field experience of Britain's Transport and Road Research Laboratory (TRRL) is described. The need for recognition of the central importance of institutional and managerial issues is discussed and, based on this, a strategy is proposed to identify the fundamental needs in the road maintenance sector of individual countries. This should assist in the preparation of Terms of Reference targeted at key areas where investment will result in long-term improvements.

TECHNOLOGY TRANSFER PROJECTS

Donor agency policies

Most developing countries have placed considerable emphasis on extending and

improving their road networks during the post-colonial era as this has rightly been seen as an essential component of a comprehensive development programme. Developing countries are still spending over \$10 billion each year in the road subsector, mostly on new construction and improvements. In the past, both bilateral and multilateral aid donors have given enthusiastic support to such infrastructure development since economic returns were thought to be easy to predict, have a good chance of being realised and, if carried out by expatriate consultants and contractors, were relatively easy and cheap to administer.

Until the start of this decade, projects for road maintenance were seldom undertaken by donors because it was claimed that support of recurrent expenditure did not contribute to real long term economic and social development. However, research carried out by TRRL in conjunction with the World Bank in the 1970's (Abaynayaka 1977) demonstrated for the first time in a quantitative way the key importance that road maintenance had on vehicle operating costs. This, in turn, highlighted the dramatic effect that spending, or failing to spend, relatively small amounts of money on road maintenance could have on the economic return of a road construction project. At the same time, several donors were becoming increasingly alarmed about the poor condition of road networks in many developing countries indicated by the apparent fact that the level of deterioration was increasing (World Bank 1981).

Concern about the road maintenance problem led the World Bank to call a meeting in Paris in February 1980 to exchange views on the difficulties faced by developing countries and development aid agencies in the field of road maintenance, and to seek consensus, wherever appropriate, on ways to overcome these difficulties. The meeting was attended by representatives of most of the major aid donors and an eight-point action plan was discussed (World Bank 1981). One of the main outcomes of this meeting was that several of the donors attending effected changes in their lending policies to enable aid for road maintenance to be provided. As a result of this, over the last few years, there has been a change in lending policy with emphasis moving away from capital schemes and towards projects for road maintenance.

Construction and maintenance projects

The term 'maintenance' is used here to describe the management and execution of routine and recurrent activities. Periodic maintenance, rehabilitation and structural overlays are, in essence, similar to new construction projects and

their organisation and management can be undertaken in a similar way. Their performance, whether by contract or by force account, can be measured relatively easily in terms of quantity and quality. There are recognised yardsticks which can indicate whether construction work has been successful such as:

Was construction completed on time?

Was it to specification?

Did the cost exceed the estimate?

Road maintenance projects, on the other hand, are much more difficult to define and to assess, and often require significant management and institution development components. There are, thus, essential differences between construction and maintenance projects and these can be summarised as follows.

TABLE 1
Essential differences between aid projects for
construction and maintenance

	New construction, periodic maintenance, overlays and rehabilitation	Routine and recurrent maintenance
Duration	Tend to be short term	Long term
Technology transfer	Incidental	Crucial
Local capability	Relatively independent	Very dependent.
Contractor's organisation	Designed for rapid completion: independent of local organisation.	Integrated with, and dependent on, local organisations
Donor administration	Straightforward	Complex

Construction projects can be successful and completed to specification and time by contractual arrangements independent of local resource constraints. Maintenance projects, if they are to result in permanent improvements in performance, demand a thorough assessment of the existing institutional, managerial and technical shortcomings of the maintenance department. Failure to recognise this need in the past by donor agencies, consultants and recipient governments has resulted in many projects failing to sustain improvements or even to meet project

objectives in the short-term.

Maintenance management projects

Given the differences between construction and maintenance projects, it is clear that, although technology transfer may be a highly desirable part of a construction project, successful transfer of technology will be an incidental benefit. On the other hand, technology transfer is vital to the long term success of a road maintenance project. It is therefore appropriate to examine the effectiveness of the technology transfer programmes of road maintenance projects. In particular, the problems of implementing maintenance and pavement management projects will be addressed.

In their publication 'The road maintenance problem and international assistance', the World Bank makes the following observation (World Bank 1981):

"A great deal of emphasis has been placed in many Bank-assisted projects on the application of modern management systems for planning, programming, budgeting, scheduling, control, and data collection, and it is difficult to avoid the conclusion that it has often been overdone. In some instances, the management information systems introduced by consultants have simply proved too complex to function or to be used beyond headquarters. In others, they were excessively dependent on computers that were unavailable or functioned poorly. More often, elaborate reports have continued to be produced at lower levels of the hierarchy, but there has been no effective system for checking them, and they have been little used, for lack of qualified headquarters personnel to handle them or for lack of interest. The effort seems to have been spread over too many systems, with too much detail, and with insufficient attention to the structural constraints on the ability of management to act."

Against this background, the Overseas Unit of TRRL were asked by the UK Overseas Development Administration to carry out a study of maintenance management projects to try and identify why problems arose with implementation and to recommend ways of overcoming these. The study consisted of two parts. The first reviewed available published and unpublished information on projects. The second part involved TRRL staff working alongside consultants engaged on contracts to implement maintenance management systems in developing countries.

It is inevitable that the results of this study are sensitive and, as a result, have not been published in full. In this paper, an attempt is made to highlight the main results of the study without indicating directly or indirectly which countries and which consultants were involved. An attempt has also been

made to draw conclusions from the findings and to recommend a method of assessing the type of assistance most appropriate to a particular set of circumstances.

PUBLISHED INFORMATION

The PTRC seminars

In July 1985 at the PTRC Summer Annual Meeting held at the University of Sussex in England, a one day seminar was held on road maintenance management in developing countries (PTRC 1985). The organisers were concerned that, whenever the implementation of maintenance management systems in developing countries was reported in journals or conference proceedings, consultants and developing country governments presented a picture of success that was not consistent with the observations of the World Bank quoted above. Not surprisingly, neither consultants nor governments wished to advertise failure and there was a belief that published papers either deliberately avoided mention of problems that had arisen on projects or, even worse, misrepresented the outcome of events.

Ten international consultants who had been engaged on maintenance projects were invited to talk frankly about the problems that they had encountered during implementation so that mistakes would not be repeated in the future. Unfortunately, several of the consultants chose to report and present bland success stories in the seminar, despite admitting privately that their projects had encountered many problems and that not all objectives had been achieved. However, some of the consultants were frank about problems that had arisen and were keen to share their experiences with others present. A further seminar was held the following year (PTRC 1986) and some additional information was obtained.

The following problems were raised by the various consultants in these two seminars. Extracts from the consultants' papers are quoted. Some information has been substituted in brackets to preserve anonymity.

Terms of reference

"(The client, the donor and the consultants) were all wrong to accept without question a concept which, be it said had been originally conceived by personnel in the (donor organisation) and in (the recipient ministry) who were long gone. The present personalities in all the organisations concerned are the third generation and therefore continuity has been a problem throughout."

"There is some doubt as to whether such a comprehensive programme was indeed appropriate to (the country's) needs. While it was true that practically all areas of highway maintenance required revision

and assistance of some type, with hindsight it can be said that a programme addressing all such issues, however structured and well planned, would be unlikely to succeed."

Client attitudes

".... top management did not feel that they had any need for technical assistance to improve their administrative procedures or that they needed institutional strengthening. The (donor) felt that they did have these needs, and consequently technical assistance was made a component of the loan The consultant was placed in an adversary situation from the very beginning of the project."

"The role of the consultants and technical assistance were ambiguous. (The client) never provided the managerial support necessary to implement the systems. The (donor and the client) both held the consultants responsible for the success of the programme, but in practice the consultants were powerless to effect change unless (the client) supported it at all levels. The consultants were ultimately only advisers. In these circumstances, a less comprehensive programme might have stood a greater chance of overall success."

"In addition, (the client) had clear prejudices and expectations about technical assistance. The first was the suspicion that the consultants could not be totally loyal This, in turn, led to them being excluded from the real politics of the maintenance department who disguised key issues. In addition, high technology solutions were expected even when the appropriate remedies were simply based on common sense. These expectations and general feelings of unease increased as counterpart staff salaries fell and consultant salaries increased in terms of local currency. Finally, the consulting staff could only offer advice, and there was no possibility of acceptance until (the client was) convinced of its appropriateness. This risk is taken by all consultants, but a different programme structure could have ensured that recommendations were considered promptly and accepted or rejected on merit instead of being ignored."

"Resistance to change in management practices was stronger than expected, even when procedures were being introduced for the first time. The status quo was fiercely defended and it was difficult to get new practices adopted, even where advantages were obvious."

"Resistance to change was perhaps the most difficult obstacle to overcome. The maintenance system had evolved over many years, and (local) staff saw their chief problem as lack of resources - equipment, materials and funds - not maintenance management. Thousands of jobs were involved. Promotion depended on a well understood system, and district loyalty was frequently stronger than headquarter's policy. These issues meant that it was unlikely a comprehensive revision of maintenance procedures could be achieved in so short a time."

Cultural issues

"The first is the fact that most traditional (developing country) societies are essentially gerontocracies: a man's authority goes with his age. Naturally, when localisation took place, it was usually young men who had the overseas, professional training, and were therefore rapidly promoted to senior positions. Thus their natural lack of confidence in making important decisions, because of inexperience, was further amplified by the virtual impossibility of giving an executive instruction to subordinates who were frequently older, and insisting that the instructions are carried out."

"The second characteristic of (developing) countries affecting management efficiency is that they are nearly all multi-(cultural). This means that to the difficulties of giving orders to older subordinates are added the problems inherent in giving orders to members of another (culture)."

"Any highway maintenance organisation is a complex pyramidal management structure, in the normal pattern taken for granted in an industrialised country. This type of management structure is utterly dependent on instructions being passed down the line, sensibly interpreted in detail at each level, and passed down, in the sure knowledge that they will be carried out. There is, of course, a disciplinary system to back up the orders, but this is normally taken to be a last resort only. However, the knowledge that disciplinary measures can, if necessary, be invoked is naturally an incentive for good operational efficiency, coupled with the more positive incentive of promotion depending on good performance. If traditional considerations make the incentives ineffective, management efficiency is severely impaired."

"In practice, of course, situations on the ground are frequently such that excuses can be found for inefficiency, which tend to obscure the basic problems of management. No attempt to deal with the problems will be truly successful which does not take full account of these traditional behaviour limitations."

" staff assessment seems to be the only real means of showing to the man and to his superiors that he is worthy of promotion. Without it, nepotism and favouritism could well be perpetuated to the detriment of staff morale and efficiency."

Staffing of teams

"A central difficulty, never fully resolved, was the staffing of technical assistance consultants. The initiation of the project was delayed for over a year. The consultant staff originally proposed for the project made other commitments. Low consultant salaries plus the worsening economic conditions (locally) made it difficult to attract qualified experts. Since the elements of the programme were interrelated, delays in filling positions and poor performance in those positions made it certain that the balance of the programme would be affected."

"That not all the aims of the study will have been adequately covered can be blamed largely on two misguided assumptions:

- three disparate individuals, one consultant, one (contract) expatriate and one national, will immediately form a workable team.
- The team leader would be able to study, design, modify and report on systems, while implementing them with the other hand."

Economic and financial problems

"If the (local) currency had not weakened so rapidly, the maintenance programme might have been able to accommodate the delays. However, the severity of the economic crisis and the consequential effect on (local) staff morale and efficiency had serious impacts on the project. It is not possible, of course, to guarantee financial stability over a project life or to develop a programme that can accommodate the changes in economic performance, but the programme would have benefitted by explicitly stating the local currency equivalents in (foreign currency) and specifying the need for monetary correction, if justified. In addition, it would have been useful to structure the programme so that it could be more easily redirected as new problems emerged and potential solutions presented themselves."

"The economy, relatively stable throughout the 1970's, began to seriously weaken soon after the maintenance programme was started. Falling prices for its exports on the international market combined with high interest rates made it difficult for the government to repay the foreign loans taken out by previous administrations. Government policies were ineffectual in resolving the key issues affecting the strength of the economy which resulted in high domestic inflation, unemployment and an irresistible pressure to devalue. When the government refused to devalue, a black market resulted and eventually official adjustment had to follow. This caused a number of problems, especially for project funding in local currency, since there was no official link to (foreign currency) in the programme documents. Although it was implicit in the programme design, nothing was in writing which made it difficult for (the client) to go back to the (ministry of finance) for additional local funding."

"The economic difficulties seriously affected counterpart staff morale, causing a preoccupation with issues outside the maintenance programme. Important counterpart contributions to elements of the programme were lost and deadlines missed. Project products were formulated without any collaboration between (local) staff and technical consultants."

"Bitumen and crushed gravel shortages slowed the deferred maintenance programme. All bitumen was imported, and this required scarce foreign exchange which was not promptly available, resulting in long delays. (Donor) finances could not be allocated to the purchase of materials, so elements of the programme dependent on this item themselves became delayed. Crushed stone was not always available in the quantities required even though equipment for its production was specially purchased. The crushing plants required considerable start up time. Government policy precluded double work shifts so nearly half of each work

day was devoted to getting the crusher plants operational. Operating time was curtailed further since half of the first and last day of each week was allocated to travel time to and from the crushing plant locations. Finally, inadequately trained operators misused the equipment resulting in frequent breakdowns that took days to correct. The resulting monthly crush stone production was only a fraction of that planned when the equipment was acquired."

Staff availability

"Staffing difficulties already identified caused the programme to change and many positions were never filled."

"The availability of staff for re-training and upgrading was limited by operational needs and turnover. There was a high percentage turnover of engineers, technicians and skilled operatives. In most cases, experience had been replaced with inexperience and there remained a continuing and substantial deficiency of establishment. The shortage of technically skilled staff was exacerbated by a policy of leaving posts open, ie unfilled, for staff who left the (client's organisation) to work overseas."

"The staffing deficiencies in the districts were such that some of the functions of project preparation could not be executed. There was also a considered imbalance between districts in the provision of engineers and technicians."

Staff training

"Much classroom training has been carried out, but there has been very little follow-up revision in the classroom, and on-the-job training and assessment."

"Problems in developing the major elements of the programme such as the maintenance management system and the equipment management system resulted in delayed training causing dissemination of proposals through the (client's) structure to be impeded. Training was correctly identified as a major issue, but in practice it was found difficult to co-ordinate the elements of training programmes in the method devised by the planners of the maintenance project."

"There was a lack of direct contact between the training centre management and that of the districts, a lack of 'follow-up' after courses, planned on the job training, and planned work experience. Graduate training was overambitious and instructors inadequately prepared. Optimum use was not being made of the existing training facilities."

Equipment

"The maintenance programme called for new equipment together with technical assistance. It was rather unfortunate that they actually came in that order. The new equipment and spares were quickly put into the three districts but into the existing traditional maintenance system. Immediately an effect was felt, and an improvement in performance was obvious. This lessened the chance that technical assistance would be successful. Change is so painful, why bother when new equipment alone has already achieved such an improvement? By timing the programme inputs in this way, the impact of the consultant's recommendations was less likely to have the desired effect on changing existing practices."

"A considerable amount and range of equipment was being acquired with (donor) assistance, but the counterpart staff were concerned that consideration had not been given to its maintenance and repair, and at their instigation the existing facilities in the districts for routine servicing and centrally for major servicing, and repairs were assessed. From a cursory inspection it was plain that the facilities were inadequate in every respect."

Computers

"Computer assistance was to be a key element in the programme. Inventory systems, cost schedules, programme evaluations, rental rates and so on all need computing services to be handled efficiently. In-house computer facilities were assumed to be adequate but in fact were deficient. Funds allocated for consulting staff salaries were used to purchase and ship a mini-computer and line printer capable of handling all reports, procedures and evaluations."

Data availability

"Data availability was underestimated and this was significant given the need to plan maintenance activities on current information. Frequently little or no data existed, and a specific resource had to be directed to their collection. It was more troublesome to collect certain data that, at least in theory, were available through existing channels. Sometimes they were the wrong kind of data, and frequently it took time to disentangle what was required from what had been collected. It was always difficult to do this with historic data, and it was not always possible to check with the person or organization responsible for their collection."

Post-project situation

"the programme of technical assistance for maintenance was not a success. The latest information indicates that economic conditions have deteriorated further following the departure of the consultant. None of the procedures developed and implemented during the study period are currently being used. The computer hardware acquired with loan funds is not in operation because (the client) does not have the personnel qualified to operate this equipment."

" operation has been handed over from the (research division) to the Maintenance Division signalling its acceptance as a standard maintenance tool. With this move a potential problem has however occurred as there has been no parallel transfer of the key personnel trained by the consultants. It is also interesting to note that (the survey control unit) has not been set up as a separate entity though it is believed that the Department's Training Division has established a framework for the future training of survey staff. The teams that have been used to collect visual condition data for the network wide expansion of the system have been trained by (staff), who had themselves received one week's training from the consultants. With this level of training it is necessary for a centrally controlled unit to monitor continuously the quality of the data collected"

"On the departure of expatriate maintenance engineers, both civil and mechanical, as part of "localisation" programmes, relatively young and inexperienced local engineers were quickly promoted to fill the vacant posts. In some cases the management problems which they would expect to have to deal with have been compounded by political or security problems, and by the added attractiveness of the private sector, or even overseas employment, which have left the road maintenance organisations severely short-staffed at senior management level".

THE TRRL FIELD EXPERIENCE

Rather than describe in detail the TRRL field experience, a situation is described, which includes the main features of the projects. It is believed that this is representative of many projects to implement maintenance management systems that have been carried out in developing countries.

The implementation of the management system was divided into several phases to try and ensure that the introduction took place in a systematic way, with each phase being completed successfully before the next was attempted. This also enabled modifications to be made to the system to ensure that it was entirely appropriate for local conditions and that it met all the requirements of the client. Although the centrepiece of the management system was the suite of computer programs mounted on a microcomputer, most of the emphasis during the implementation stage was on training of local staff in field inspections and data collection. This was in accordance with recommendations made by both TRRL and the donor.

The following problems were encountered with the system implementation.

1. The system needed to fit in with the budgetary requirements of the client. In particular, there was a particular requirement for a split of budget based on the size of the area of road requiring treatment. This was felt by the consultant to be irrational. Although this requirement was met by modifications to the system, it resulted in a method of maintenance management and allocating funds that was thought to be unhelpful.
2. Staff in the districts who were concerned with maintenance considered themselves to be overburdened with bureaucratic tasks and overworked. Whether or not this was actually true is a matter of conjecture, but nevertheless it was a view that was firmly held. Given this situation, the introduction of additional tasks connected with the management system were unwelcome. In particular,

technicians who should have been responsible for leading the inspection teams were reluctant to leave their air conditioned offices and walk the road network for which they had a responsibility for taking measurements. It became apparent later in the study that, immediately after training the technicians had delegated the survey work to more junior, and possibly untrained, staff.

A further responsibility of these technicians was to supervise actual maintenance works. It was also clear that this did not happen, and a senior member of the client's staff stated, only partly joking, that "maintenance works were supervised by the driver!". Although it is easy to blame the technicians for their failure, if the district engineer had been doing his job properly, he would have been making spot checks of his field teams and realized that the proper supervisors were not on site. Similarly, lack of supervision by headquarters staff contributed to the inadequate performance of the district engineer. There was clearly a reluctance of staff at all levels to get out into the field. The result was that much of the field inspection, which was one of the key elements of the management system, was being carried out by staff who had not received training appropriate to the task that they were carrying out. Although this problem had been anticipated by the consultants, the choice of staff to be trained was made by the client and the consultant had little influence on the selection.

3. The consultants recommended at the start of the study that a system manager should be appointed. Although an engineer within the headquarters organisation was designated to this position, the task was in addition to all of his existing duties and he clearly believed that it placed an unrealistic burden upon him. Whether or not this was true, the result was that the system manager played little active part either in supervision of activities in the field or in checking the computer input process. The latter activity was delegated firstly to a computer operator and then to a junior engineer working, as a result, without effective supervision.

4. A particular problem arose because the client's project officer had a rather different view of what to expect from a maintenance management system than the consultant was proposing, despite this being clearly stated in the Terms of Reference and the Proposal. This led to considerable misunderstandings between client and consultant and contributed to the difficulties experienced by the project at various stages.

5. The final phase of the study was to extend the management system from the pilot district to the whole of the country. During the previous phases, the consultants, assisted by TRRL, made recommendations about how this should be done. There was clearly a political necessity within the country to achieve this extension to the whole country as quickly as possible and this was contrary to the consultant's recommendation that the extension should proceed district by district with the same level of training input that had been used in the pilot district. As a result, all of the district engineers attended the training courses by the consultant (although this exceeded the agreement under the contract with the consultant) with the intention that these would be able to train the inspection teams and data processors in the remainder of the country.

The consultants specifically recommended that, before the management system could be extended country-wide, it would be necessary to appoint a full-time system manager and a full-time training officer to supervise training of new teams and retraining of existing teams. The consultant also pointed out that the system could not be introduced at zero cost and that, for the system to operate satisfactorily, new staff would be needed to undertake the condition measurement surveys and computer input. The consultants had originally offered to extend their contract to undertake the supervision of the extension to the remainder of the network. Although the donor was keen to provide the additional funding necessary for this to take place, the client decided to undertake this work itself.

The countrywide extension was carried out by the client and enquiries by the donor received the reply that everything was going well and that there were no problems. Eventually, the client applied to the same donor for a further loan, this time for pavement strengthening. The donor asked to see the computer printouts based on the field inspections from the management system to indicate why and where pavement strengthening was needed. Unfortunately, the client was not able to produce these.

RELATING MAINTENANCE ASSISTANCE TO CURRENT CONDITIONS

To anyone concerned with road maintenance in developing countries, many of the problems quoted will, sadly, be very familiar. Not all of the faults described, however, are unique to this type of project. Some would have an equally disastrous effect on any project which requires a degree of goodwill and

cooperation for its effective implementation. The important point is that maintenance management projects cannot be insulated from conditions in the recipient country as can most construction projects. The sensitivity of maintenance assistance projects to the institutional, managerial and technical level of development of the recipient country will have a major impact on the permanence of changes attempted by the appointed consultant.

Given goodwill and flexibility from all parties, even an ill-conceived project will show immediate short-term benefits as the inefficiencies of almost all maintenance departments are so great. Few maintenance assistance projects last for more than two to three years and the apparent improvements achieved have disguised the lack of fundamental change.

The key to any improvement in this situation must be a recognition by lending agencies and recipient governments of the importance of the Terms of Reference fully taking into account the real situation that will confront the consultant. This in turn, requires the lending agency to analyse that situation in far more depth than would be necessary for a construction or rehabilitation project.

The result of such an analysis should indicate far more precisely than before where external assistance is most likely to promote permanent change and avoid the application of palliatives to problems which are a symptom of institutional and managerial faults rather than the cause of inefficiency.

ASSESSMENT OF CURRENT CONDITIONS AND PROJECT FORMULATION

A study has been carried out to test a questionnaire whose objective is to assist those responsible for the identification of maintenance projects in the road subsector in developing countries to assess the capability of local maintenance organisations and thereby ensure that selected projects address those areas where investment could result in sustained improvements. The questionnaire is included as Appendix A and was designed to assess capability in terms of 'institutional', 'managerial' and 'technical' capability. The interdependence of these aspects of a maintenance department can be better understood if the terms are described.

Legal/institutional capability. In developed, mature economies there invariably exists a legal framework which unambiguously defines the responsibilities of

government ministers and their departments to the government, employees and public. This is not always the case in developing countries with the result that considerable reliance may be placed on a senior office-holder's or minister's personal interpretation of his powers and responsibilities. A change in senior staff may result in a different interpretation and lead to confusion and lack of commitment amongst middle and junior management fearful of being 'out-of-step'.

Fundamental to the establishment of an efficient highway maintenance department is the presence of statutes which clearly define the department's responsibilities and provide for:-

- a) legal powers to undertake maintenance
- b) a rational and functional administrative structure
- c) the employment and training of staff of a sufficient calibre
- d) funds to undertake maintenance and for administration, salaries and expenses
- e) financial control

Managerial Capability. Where such an institutional framework exists, management can concentrate on efficient use of human and physical resources with a clear understanding of the role of the department and its goals.

Management is required to:-

- (a) Define activities
- (b) Plan and programme
- (c) Allocate resources to activities
- (d) Monitor performance

These are continuous interactive processes which provide information on where improvements can be made and their likely effects.

The above four broad categories would include the establishment and updating of inventories, measurement of the network condition, prioritisation of activities, economic analysis, monitoring of costs and the definition of staff responsibilities.

Technical Capability. Without technical resources, an institutional framework and management expertise are valueless. Sufficient numbers of competent staff at all levels are required by any organisation. Lack of competence, at any level,

will effect efficiency but it is particularly important at the lower levels of responsibility eg plant operators, technicians, mechanics and labourers.

Other requirements for efficient maintenance management are

- a) appropriate criteria for planning
- b) sufficient materials of appropriate quality with associated testing facilities
- c) effective quality control of all operations
- d) implemented inspection and monitoring systems
- e) access to research and information

The questionnaire

The questionnaire was developed on the assumption that there was interdependence between the institutional, managerial and technical capabilities as illustrated in Fig 1. This concept was first mooted by John Adair (1983) to illustrate the interdependence of the man, the task, and the environment within an organisation. He attempted to demonstrate that, for an organisation to be effective, satisfactory performance in one area cannot be achieved without complementary capability in the others. Sufficient of each element must be in place in the road maintenance organisation if improvements are to be sustainable. It may be that too much attention has been paid in the past to improvements in technical capability without first ensuring that institutional and managerial competence can support it. In many countries, straightforward relatively short-term assistance to upgrade technical capability may be appropriate, but only if institutional and managerial performance is sufficient.

The questions included in Appendix A are designed to be answered in the following way:-

Yes	(Good)	+1
No	(Bad)	-1
To some extent	(Indifferent)	0

It was hoped that, by coding answers in this way, it would be possible to analyse the results from the questionnaire numerically to obtain a quantified assessment indicative of maintenance capability.

In order to test the questionnaire, several British consultants who had been involved in overseas road maintenance projects were invited to complete the questionnaire based on the capability of the maintenance organisation being assisted before the project was undertaken. The consultant also provided a copy of the Terms of Reference for the project in question.

Questionnaires were completed for projects in ten countries with GNP's ranging from just over US\$200 to in excess of US\$3000. If the number of '+1' (good) scores in each category are added together and expressed as a percentage of the maximum possible total score, it is found that there are major deficiencies in all of the maintenance organisations investigated. This is illustrated in Figure 2 which shows that in no case did the aggregate score exceed fifty per cent. It is also clear from Figure 2 that there is no discernible relationship between the questionnaire score and GNP/capita.

It is, however, notoriously more difficult to effect institutional improvements than to introduce specific management or technical advances. For example, the problem of relatively low pay for government employees and poor motivation, particularly acute in developing countries, has proved to be intractable although it is clearly an important factor influencing the performance of maintenance departments. It is the authors perception that improvements at the institutional level are prerequisites to improvements in management and technical capability.

The results from the questionnaire tend to support this hypothesis, since most of the countries reported on failed to achieve a high enough institutional score to provide the basis for investing in managerial and technical improvements. An exception was a province in China which achieved a high institutional score indicating that investment in managerial and technical improvements would be worthwhile. By contrast, the lowest institutional score was recorded in southern Sudan where it is evident that the introduction of managerial and technical improvements is unlikely to be successful without prior investment in institutional improvements.

Considering again the relevance of the Adair model in Fig 1, it is clear that this does not fully explain the relationship between the three elements. The hierarchical nature of this relationship is illustrated in Figure 3.

Sufficient institutional capability is required to support and sustain managerial capability which in turn is a pre-condition for sustained improvements in technical competence.

Use of the questionnaire is clearly subjective and the answers obtained refer only to a particular time. As such, they will be influenced by the effects of recent maintenance or technical assistance projects which may only be providing temporary improvements in the capability of the maintenance organisation. However, it is believed that use of a questionnaire can greatly assist aid agencies and maintenance departments to define more accurately those areas of the organisation which are deficient and to ensure that aid to the maintenance sector is of the kind which has the highest chance of success.

CONCLUSIONS

The paper has presented evidence that road maintenance assistance projects have often failed to introduce sustainable technology transfer and effect permanent improvements in road maintenance department's performance. The evidence suggests that this is because the terms of reference for projects have failed to recognise the inter-dependence of the institutional, managerial and technical capabilities of the host organisation, and in particular the priority to be accorded to institutional capability.

Before maintenance assistance is contemplated, it is concluded that a thorough review of the recipient departments' capabilities is undertaken. A tentative approach to how this could be done has been described which attempts to ensure that such a review is systematic, quantifiable, and capable of identifying areas of inadequacy. In this way the most effective form of assistance, in the circumstances currently prevailing, can be identified.

Such an approach may well confront donors, recipient governments and consultants with an unpalatable dilemma. Although in some instances it will reveal that technical assistance, plant renewal or introduction of a 'management system' may be appropriate, it will often be seen that a more radical approach is required. Changes in administration, accountancy, finance, contract procedures, even the law may be necessary. Identification of such problems is the first requirement. Finding an acceptable 'modus operandi' to resolve them is crucial if the current costly deterioration of developing countries road networks is to be halted and reversed.

The current situation was summed up effectively in one of the presentations to the PTRC (1985) seminar:

"Most consultants are still on the learning curve in road maintenance projects; so are their clients and the donor."

It is the authors hope that the use of a checklist and recognition of the priority to be attached to institutional factors will move us all a little way along that learning curve.

ACKNOWLEDGEMENTS

The work described in this paper forms part of the programme of the Transport and Road Research Laboratory and the paper is published by permission of the Director.

Several of the consultants participating in this study asked not to be identified. To be equitable, we have therefore identified none of them. We nevertheless thank them for their participation and cooperation.

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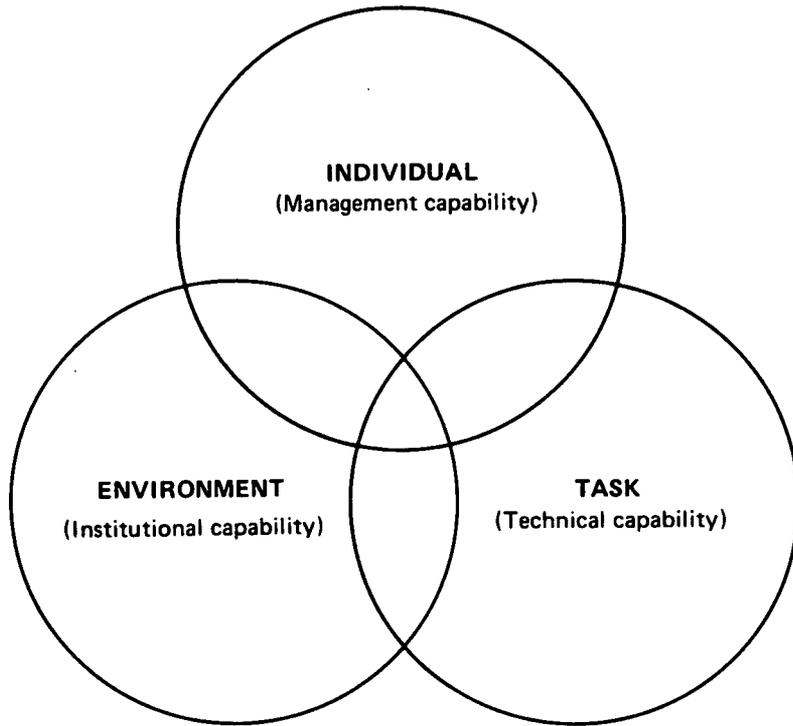


Fig. 1 Adair model applied to a maintenance dept.

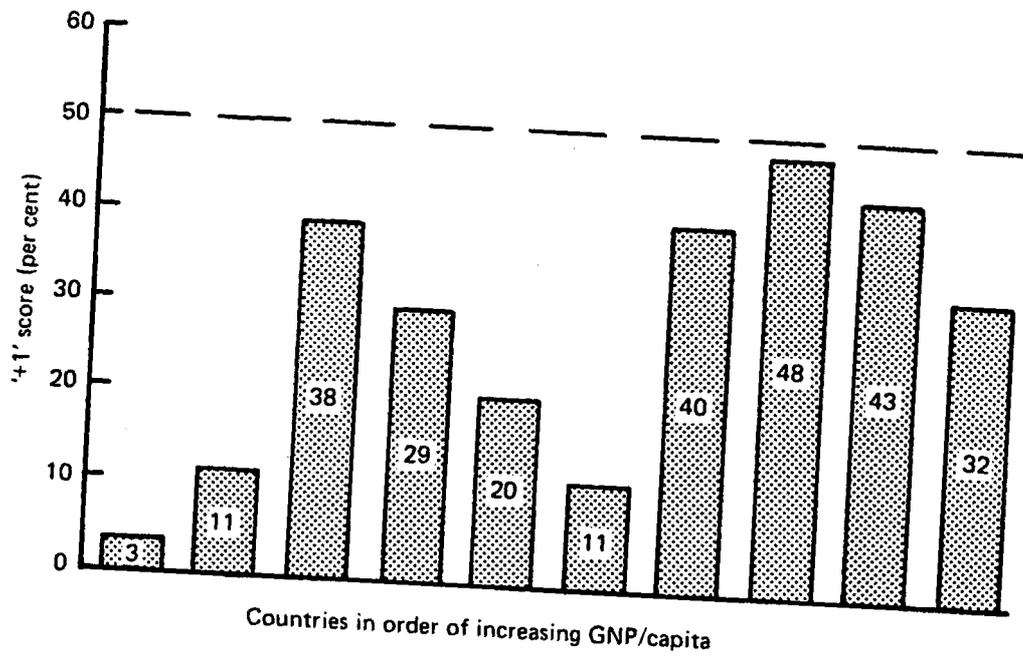


Fig. 2 Questionnaire results

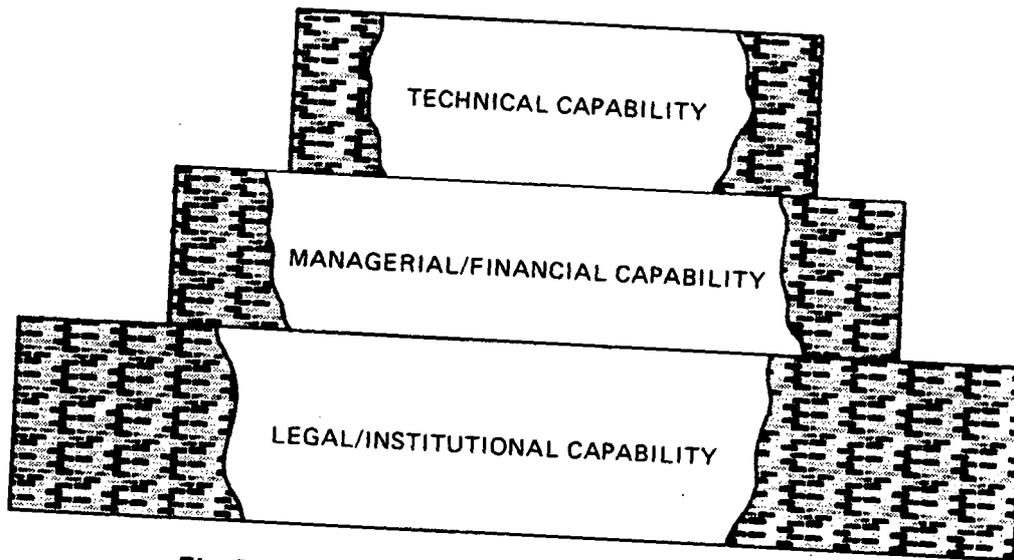


Fig. 3 Interdependence of institutional, managerial and technical capabilities

TRRL ROAD MAINTENANCE CHECKLIST FOR COUNTRY

1. INSTITUTIONAL CAPABILITY

1.1 Legal powers

- 1.1.1 Is the responsibility for road maintenance legally defined?
- 1.1.2 Are all roads the responsibility of the maintenance department?
- 1.1.3 Are the legal powers understood?
- 1.1.4 Are the powers adequate?

1.2 Administration

- 1.2.1 Is there an administrative structure capable of maintaining roads?
- 1.2.2 Is there an unambiguous chain of command?
- 1.2.3 Are responsibilities defined?
- 1.2.4 Are staff aware of their responsibilities?
- 1.2.5 Are decisions independent of the influence of nepotism, favouritism, graft or corruption?

1.3 Human resources

- 1.3.1 Are there sufficient personnel available?
- 1.3.2 Are they adequately trained?
- 1.3.3 Are they adequately motivated?
- 1.3.4 Is there an internal training scheme?
- 1.3.5 Are there operations manuals?

1.4 Budget

- 1.4.1 Is a budget awarded?
- 1.4.2 Is it adequate?
- 1.4.3 Can it be relied upon?
- 1.4.4 Are operations independent of foreign exchange constraints?

1.5 Financial control

- 1.5.1 Does full financial control reside within the maintenance authority?
- 1.5.2 Are accounts independently audited?

2. MANAGERIAL CAPABILITY

2.1 Inventory

- 2.1.1 Does it exist?
- 2.1.2 Is it up-to-date?
- 2.1.3 Does it cover location and classification of all roads and structures?

2.2 Planning and programming

- 2.2.1 Is work programmed according to defined priorities?
- 2.2.2 Are the costs and benefits of programmes assessed?
- 2.2.3 Is programming done within a plan designed to preserve or enhance the network in the medium/long term?
- 2.2.4 Are there specifications for work?
- 2.2.5 Are specifications achieved in practice?

2.3 Budgeting

- 2.3.1 Is there a regular and formal budgeting process?
- 2.3.2 Is this related to actual costs and the ability to disburse?

2.4 Cost control

- 2.4.1 Is work done measured and costed?
- 2.4.2 Are costs realistic in terms of overheads, equipment, materials and labour?
- 2.4.3 Is cost information collected centrally and used for budgetary purposes?
- 2.4.4 Is there a physical inspection and audit of work done?
- 2.4.5 Is productivity measured?

2.5 Plant and equipment

- 2.5.1 Is there a fleet of plant and equipment of the size and composition required?
- 2.5.2 Is the availability adequate?
- 2.5.3 Is the utilisation adequate?
- 2.5.4 Are the workshops and stores adequate to support it?
- 2.5.5 Is there an organisation capable of managing the fleet cost-effectively?
- 2.5.6 Is adequate financial provision made for replacement and repair?

2.6 Supplies

- 2.6.1 Are materials available as required?
- 2.6.2 Does an adequate system exist for ordering and stockpiling road maintenance materials?

3. TECHNICAL CAPABILITY

3.1 Planning criteria

- 3.1.1 Are the criteria upon which road maintenance planning is based constantly under review?
- 3.1.2 Do strong links exist between those responsible for road maintenance planning and those responsible for:
 - (i) design and construction?
 - (ii) traffic surveys and forecasting?
 - (iii) road safety?

3.2 Materials

- 3.2.1 Are the properties of materials used fully understood?
- 3.2.2 Are there adequate testing facilities?
- 3.2.3 Are materials of the right quality available?
- 3.2.4 Are appropriate materials always used?
- 3.2.5 Are testing methods appropriate and carried out at the appropriate frequency?

3.3 Quality control

- 3.3.1 Is quality control of products and materials adequate?
- 3.3.2 Is quality control on site adequate?

3.4 Condition measurement

- 3.4.1 Are roads inspected systematically to determine maintenance requirements?
- 3.4.2 Are physical measurements made of road condition to determine maintenance requirements?
- 3.4.3 Are condition measurements made using sophisticated or high speed instruments?

3.5 Field monitoring

- 3.5.1 Is there any systematic monitoring of:
 - (i) quality of work?
 - (ii) work methods?
 - (iii) material quantities used?
 - (iv) man-hours spent on job?
- 3.5.2 Do the results of any monitoring feed back into the future planning process?

3.6 Research and information

- 3.6.1 Is there adequate access to current work on road maintenance from other maintenance organisations or international research centres?
- 3.6.2 Is research on road maintenance currently carried out within the organisation?
- 3.6.3 Are new techniques and practices introduced as a result of research results?