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A METHOD FOR CONSIDERING POSSIBLE ALTERNATIVES TO THE ORGANIZATION OF

RURAL ROAD MAINTENANCE AND ITS APPLICATION TO

A SUB-SAHARAN AFRICAN CONTEXT

June 1982

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Technical Note No. 1

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ABSTRACT

Classical approaches to improving road maintenance organization in Africa have largely failed, mostly because they did not deal with the large number of constraints and pressures external to the organization itself.

The following steps, based on the framework outlined in Staff Working Paper No. 375, are therefore proposed for designing rural road maintenance organizations under the conditions prevailing in a typical Sub-Saharan African country:

- (a) make the external environment more favorable to the organization (e.g., identify the road beneficiaries and enlist their political and/or financial support);
- (b) ensure better performance by the other organizations upon which rural road maintenance depends, or minimize such dependency (e.g., use alternative technologies such as the "lengthman" for routine maintenance);
- (c) improve motivation within the maintenance organization itself by using locally proved incentives, better relating training to the field reality, removing bureaucratic bottlenecks, or developing a local contracting industry to which certain activities will be entrusted; and
- (d) ensure that the lessons learned from road maintenance are taken into account in the design of new roads.

The paper emphasizes that there is no one solution for improving road maintenance organization, and recommends that designers and managers consider which among the many possible options best fit the prevailing circumstances.

Prepared by: Melody Mason (Consultant, PAS)

GLOSSARY

LIFP: Labor-Intensive Feeder Roads Program

MO : Maintenance Organization

MP : Member of Parliament

MT : Ministry of Transport

MD : Mechanical Department

PE : Provincial Engineer

PME : Provincial Mechanical Engineer

PRE : Provincial Road Engineer

TD : Training Department

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PREFACE

For a long time, the World Bank has been concerned with finding ways to better understand what lay behind successful organization of development projects and with developing methodologies which would help both project designers and project managers.

Staff Working Paper No. 375 on the Design of Organizations for Rural Development Projects was intended to start filling the gap by providing a framework allowing further experimentation. The widespread interest that the paper generated, and the overwhelming support it received among both academic circles and practitioners, in developed as well as in developing countries, convinced us that we should indeed experiment further with the framework. This was done by testing it against the reality of one of the most intractable organizational problems: the maintenance of rural roads in Africa. The results of these efforts are summarized in this PAS Technical Note which was written by a former colleague of ours, Melody Mason, a transportation economist, sociologist and organizational specialist.

Briefly stated, the design task consists in finding ways to organize road maintenance activities under the following conditions:

- (a) the concerned Ministry's recurrent budget is limited and unlikely to increase in the future;
- (b) equipment operates about one-third of the time and endless delays are encountered in procuring spare parts;
- (c) political interference is unavoidable and results in continuous requests for diversion of maintenance equipment for non-maintenance activities;
- (d) the large permanent work force is subject to civil service regulations affecting the hiring and firing of staff as well as reward systems;
- (e) the work force is poorly motivated and weakly supervised at the supervisory and engineering levels;
- (f) a variety of donor agencies each having their own standards, approaches and priorities, is involved in the road sector;
- (g) government shows a limited concern for road maintenance.

Melody Mason suggests that there are a number of options open to designers and managers to deal with each one of these factors though none alone can be expected to provide "the solution" to improving road maintenance organization.

To put her findings in a nutshell, if one determines, as all too often occurs in this sector, that neither intended beneficiaries nor Road Agency staff are really interested in road maintenance, it will not help much to limit the organizational effort to specifying which tasks should be done when and by whom, the reporting relationships, the budget procedures and the like. Instead, organization design of road maintenance also involves:

- (a) ensuring that the environment over which the organization has neither control nor influence be made more favorable to its purposes (e.g., by making the road beneficiaries better understand the necessity of maintenance, involving them in programming maintenance work and in enlisting political and financial support);
- (b) ensuring that other organizations upon which road maintenance depends (e.g., for maintenance equipment) will respond better, or, finding ways (e.g., through use of alternative technologies) to minimize such dependency;
- (c) improving staff and managerial motivation through methods particularly appropriate to the local environment, or by contracting out certain activities.

The options proposed to improve the external and internal environments of the road maintenance organization were derived from observation of the daily activities of field engineers, discussions with Provincial Engineers and senior government officials mostly in Sub-Saharan Africa, as well as from the experience of consulting firms and that of our colleagues in the Highways and Rural Development Sectors in the World Bank. Their encouragements and contributions are gratefully acknowledged here.

In conclusion, it is our hope that this paper will help highway designers, public works managers and other decision makers in the Transportation Ministries of our member countries better diagnose organizational questions concerning road maintenance and encourage the collaboration of engineers, socio-economists and organizational design specialists in devising the imaginative approaches that their solution requires.

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SUMMARY

i. Increasing attention has been given during the past few years to problems of road maintenance in Africa and other parts of the world, but increases in the standards of maintenance have not been easy to achieve, despite the resources devoted to such efforts. This paper has two objectives. First, it attempts to understand the reasons for the difficulties encountered in road maintenance in many developing countries. Second, it proposes a range of alternatives to help organize the maintenance of low-class or feeder roads, ranging from earth to semiengineered roads, since these roads generally form the major part of any road network in developing countries. Engineered gravel roads are also included where they serve essentially as feeder roads as opposed to forming part of the main road network. The paper is based on extensive discussions with field engineers responsible for road maintenance, mostly in English speaking African countries, and a review of their managerial and organizational initiatives. To focus more clearly on issues, the road maintenance organization of a hypothetical country -- a composite of the author's experience -- has been used as a case study.

ii. The paper originated from the disappointing results in many countries of comprehensive efforts to improve road maintenance organizations, even when funding was increased. This suggested the need to examine whether there were questions other than financial ones, that affected the ability of maintenance organizations to improve output markedly. Among the factors being considered are organizational weaknesses as well as diversion of resources to other nonmaintenance activities. Organizational weaknesses, in the Sub-Saharan African context as elsewhere, are commonly attributed to poor design of the organization, inadequate procedures and channels of communication, insufficient and inexperienced trained staff (particularly supervisors and engineers), and cumbersome bureaucratic procedures, especially with respect to procurement. The organizational weaknesses are compounded by financial constraints, restricting the purchase of replacement equipment, essential stocks of spare parts, materials, and so on. The response of most governments to these problems, generally with external assistance, has been to redesign the organization and increase training; the consultants hired to carry out organization studies have tended to concentrate on structure, reporting and cost control systems, numbers and qualifications of personnel required at each level and other resource requirements.

iii. The problem with this approach has been two-fold. First, the concentration on the role of management in dealing with questions internal to the organization has meant that external elements that can affect organizational performance have often been ignored. As

outlined in Staff Working Paper No. 375¹ and in the Annex, it is essential for designers of organizations to understand the environment in which the organization has to function. To what extent can a manager be said to control maintenance activities when he is subject to direct interference or irresistible political pressure to devote maintenance resources to particular nonpriority roads and nonmaintenance activities, or when he is subject to government procedures which limit his ability to spend his budget on necessary resources and lead to lengthy delays in maintenance operations? To what extent can a maintenance manager be effective when he is faced with a public who has little perception of the importance of routine maintenance and of preserving something for the future by taking appropriate measures today? The impact of such external factors can be such that effort to improve organizational performance through changes in structure can be completely neutralized.

iv. The second problem has been that the emphasis given to the primarily inward-looking management role has nevertheless often overlooked such crucial factors as management style and the level of staff commitment and motivation (that is, the "people problems") within the maintenance organization. The effect of the civil service structure on organizational performance (for example, the effect of low pay, job security, and bureaucratic promotion systems on staff motivation), the low level of cost-consciousness among staff, and the emphasis by society in general on access to, and distribution of, resources, as opposed to efficient use of resources, normally has been underestimated or ignored. Western concepts of management have often been recommended without realizing that their actual adoption required the maintenance staffs to share the designers' objectives, that is, to reduce costs, increase efficiency, and so on. Since these concepts are often new to developing countries, it might be more beneficial first to devise ways of making people want to be efficient and reduce costs.

v. This paper therefore proposes that more analysis of the organization and maintenance activities be carried out from the perspective of the managers at the successive levels of the organization. This will mean looking at the environment in which the organization has to function, both in terms of how external entities can aid or obstruct maintenance activities and how the environment can affect the internal management of the organization. The latter will mean consideration of such constraints as the civil service structure and procedures and the cultural attitudes and values of maintenance personnel. The final design of the organization should, therefore, minimize the obstacles by directly avoiding certain problems or by building in coordination between the maintenance organization and external entities. The

1/ William E. Smith, Francis J. Lethem, Ben A. Thoolen, "The Design of Organizations for Rural Development Projects: A Progress Report," World Bank Staff Working Paper No. 375, March 1980.

design of the organization should also capitalize on the potential support in the environment and on existing organizational strength both within and without the maintenance organization.

vi. More concretely, the paper recommends consideration of the following possible organizational alternatives:

A. Increasing involvement of local administrative levels in programming maintenance work. The purpose of this recommendation is:

- (a) to make the local community more aware of routine and periodic maintenance work;
- (b) to let the local community have more say in the relative priorities of roads to be maintained and at what level;
- (c) to make the local community more aware of the limited resources available and occasionally to elicit contributions from them for specific work;
- (d) to curb the pressure on the Maintenance Organization (MO) to divert maintenance resources to other uses, especially at the local level, and to channel prominent local individuals' requests for work on specific roads through local committees.

There are various ways to increase involvement at the local level and those involved may range from District or regional Councils or their equivalent to special road user committees of local representatives. The local councils or committees could then participate with the MO in programming maintenance work, with the MO reserving a certain amount of limited resources for priority routine and priority periodic maintenance activities. The MO should explain to the council or committee the necessity for these activities and allow them to select other priorities. If the council or committee decides that certain unclassified roads should be maintained because of their local importance, then the MO could accept their decision (with some possible exceptions) as long as the council or committee were able to say which classified roads not to maintain. This would help instill a sense of cost-consciousness and encourage the local population to think in terms of relative priorities and tradeoffs. Local representatives could be informed when funds, transport, or equipment were not available and could put more pressure on Government to obtain the resources. Alternatively, they could try to raise them locally. These resources would include, for example, funds for a spare part for a grader or truck, funds for hiring casual labor (or contributing labor itself), or the loan of transport from the cooperative or other source.

B. Raising more funds for road maintenance. A number of alternatives exist such as: (a) automatically allocating a certain percentage of road user charges to maintenance (unlikely in many African countries' present economic situation, but perhaps something to aim for); (b) financing maintenance activities through construction contracts while building the ministry's or local contractor's maintenance capacity; (c) including more maintenance activities in road construction programs; (d) donor financing of spare parts; and (e) maintenance of vehicles and equipment by commercial agencies.

C. Experimenting with methods for individual managers to increase staff incentives. One of the basic problems of foreign-aided work is staff motivation. Thus, far more attention has to be given to motivation problems, for example, through imaginative use of overtime and time off and rearrangement of work into team work with "jungle tasks," and so on. Whole tasks require more control of the team over the maintenance and repair equipment. One possibility to consider, therefore, is providing equipment units with their own managers (as fully equipped as possible), and giving specific tasks to perform and incentives for meeting targets. This approach would mean a certain level of duplication and underutilization of mechanical equipment, but the costs of duplication have to be balanced against the benefits of independent units (just how independent would have to be determined by trial projects).

The same argument could apply to the provision of workshops. At present, the typical maintenance organization consists of one central workshop for overhauls, one regional workshop for major repairs, and district or local workshops with only basic tools for simple repairs. Closer attention needs to be given to the type of facilities successful contractors have for the maintenance of their fleet, since they face the same trade-off of comparing the cost of underutilized workshop equipment and other resources with the cost of waiting for repairs to be carried out at a distant facility. Since government organizations are not as efficient as private contractors, it may well be less costly for the maintenance agency to have better-equipped district or local workshops. One of the reasons for the high costs of the present system is the limited capacity of staff in the maintenance organization to program and implement the complex task of bringing equipment from different units into workshops to be repaired, and once there, programming and implementing projects and returning equipment to units.

D. Examining ways to improve the performance of supervisors, especially at the lower level. One of the problems is that supervisors are taught too much in one training session and are expected to perform as highly in the real world, with all its uncertainties, as in the classroom. Supervisors may first need to prove their competence at a very low, clearly defined level, such as a very simple job only on culvert, ditch, and bush clearing, before progressing to more complex activities such as patching of paved roads, etc., and

resealing. This would be in line with task specialization mentioned above. The same principle of progressive training could apply to mechanics and inspectors. In addition, follow-up is necessary by the Training Department (TD) of recently trained candidates in the field, with emphasis on programming work.

E. Developing local contractors for routine maintenance (as is being done quite successfully in other countries, including the USA). An argument often cited against developing local contractors is the high failure rate, but this needs to be balanced against the failure of many of the attempts to improve the efficiency of the Mechanical and Maintenance Organizations. By developing local contractors, the maintenance organization relieves some of its scarce supervisor resources of activities such as procurement and delivery of supplies, organizing staff and equipment in the field, and motivating staff; in addition, it relieves the organization of some of the burden of procuring and maintaining equipment. Of course, the organization will still need to supervise contracts to ensure that works are carried out according to the terms agreed. In many African countries the relative lack of sophistication of local contractors makes it possible for the maintenance organization to exert a strong influence over them (as part of the training experience) and to control prices (normally unit prices are fixed by the maintenance organization in agreement with contractors who do not have the experience to cost out and submit bids).

F. Other possible organizational improvements would include:

- (a) more flexibility in choice of technology (for example, labor-intensive instead of capital-intensive) with different organizational implications, for example, the "cantonnier" or "lengthman" system;
- (b) consideration of which Government procedures (such as procurement procedures) might be streamlined, given the considerable impact they can have on every Government agency's performance; and
- (c) greater use of casual labor to give more flexibility to the organization, reduce the staff motivation problem, and spread the benefits of employment to a greater number of people rather than to only the present permanent employees.

vii. In discussing the above possible organizational improvements, the word "alternative" rather than "solution" is used purposely since there is no one solution or prescription to improving road maintenance organization. Rather, there are a series of options, some or all of which may help senior officials and maintenance field staff perform

their work better. Many of these have been tried out or suggested by Field Engineers, Provincial Engineers and other senior staff with whom the author collaborated during the last few years. If the reaction to this paper is to understand the problem but to disagree with the alternatives suggested in favor of other alternatives, then one of its objectives would have been achieved, that is, to pave the way for this kind of discussion. The time for such a discussion is ripe, since many professionals in this field, in member countries, on the Bank's staff, as well as with consulting firms, are becoming increasingly aware that the standard prescriptions for improving the structure of maintenance organizations are not really addressing the fundamental problems.

viii. The proposals put forward in this paper, both those that have already been tried and those that should be first applied on a pilot basis are based on the assumption that there exists a will in the country to maintain roads, that the financial environment is not too inimical, and that management really wishes to motivate its staff, improve performance, and decrease political pressure. If, in a particular country where our approach is to be applied, the desire is not there, or the managers are really not interested in managing, then the alternatives suggested for reducing political interference and improving internal efficiency will not be viable. One would then be forced to consider measures to "contract out" management responsibility and to make adequate allowance for the diversion of maintenance resources because of political pressure. Whatever the outcome, the important point is not to ignore such a situation when it arises at the organization design stage, but to recognize it and design the organization accordingly.

ix. The paper is divided into three parts. The first summarizes the main problems of road maintenance and is intended only for the reader unfamiliar with the subject. The second describes a typical road maintenance organization in Sub-Saharan Africa and the effectiveness of its road maintenance activities. The third examines the type of recommendations generally found in classic organization studies of road maintenance, identifies their main deficiencies in practice, and proposes additional organizational alternatives. The theoretical framework used for deriving these organizational alternatives is explained in the Annex.

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I. INTRODUCTION

1.01 Increasing attention is now being given to the problems of road maintenance in Africa and in other parts of the world, particularly as the benefits of road maintenance have become more apparent with the soaring cost of road construction and rehabilitation since the increase in oil prices.¹ In many countries, insufficient funding has been provided for road maintenance, but even with the resources allocated, the output of many maintenance organizations has been low and roads have continued to deteriorate. The problem appears to be inefficient organization as well as diversion of maintenance resources to other nonmaintenance activities.

1.02 Through the application of an organizational framework² previously used by the World Bank in the Agricultural Sector and summarized in the Annex, this paper examines the reasons for the difficulties encountered in road maintenance in many African countries. A typical road maintenance organization reflecting the author's experience mostly in English speaking Africa has been described as a case study to provide an illustration of the problems encountered in many parts of the world. Obviously, not all the problems are the same nor are all the ways considered here to improve road maintenance necessarily applicable to other countries. Nevertheless, if not the possible "solutions," at least the method we have chosen to analyze the problems of organization and management can be applied (as demonstrated in this report) to road maintenance in other countries.

1.03 The road maintenance organization described in this paper is responsible for about 35,000 km of classified low-standard earth and gravel roads with fairly low traffic volumes (fewer than, say, 50 vehicles per day). Although the paper is addressed to feeder roads, it is, obviously, not possible to totally ignore the other part of the network, since many of the problems relating to low-standard road maintenance also relate to main road maintenance.

1/ World Bank. "The Road Maintenance Problem and International Assistance." December 1981.

2/ "The Design of Organizations for Rural Development Projects - A Progress Report" op. cit.

II. ROAD MAINTENANCE ORGANIZATION: THE BACKGROUND

Road Maintenance Activities

2.01 Before we review road maintenance in our typical Sub-Saharan African country -- let's call it Zandya -- we need first to explain fully the activities in low-standard road maintenance and the resources, other than finance, required to carry them out. We will then review just how the Ministry of Transport (MT) in Zandya is organized to carry out those activities, to what extent it is actually carrying them out, and how they affect the road network.

2.02 Road maintenance is normally divided into three types of activities: routine, periodic, and emergency (or extraordinary). Routine maintenance involves cleaning of drains and culverts, cleaning and shaping of drainage side ditches and backslopes, clearing of road shoulders (including grass cutting and bush clearing), patching of potholes in gravel roads, and grading of earth roads. For some activities, it is important that they be carried out at the right time of the year. Drains, culverts, and side ditches should be cleaned just before and throughout the rainy season to enable proper drainage and thus protect the road from water penetration. Shoulder clearing, pothole patching, and light grading are year-round activities (when not too dry), while heavy grading, involving the reshaping of the road, should ideally be carried out just at the end of the rainy season. Thus, considerable planning is required to schedule routine maintenance activities to fit into the different seasons, and to ensure that as many resources as possible are utilized year-round and that they are sufficient at peak times. Routine maintenance consists of relatively unskilled activities, except for grading, which requires skilled operators. Grading is normally a machine-intensive operation requiring (preferably) teams of graders, water tankers (when dry), and, sometimes, rollers for compacting. Careful programming is needed to ensure full utilization of equipment and the timely supply of fuel to the road site. Activities such as drain cleaning and shoulder maintenance may be labor- or machine-intensive, although in most Sub-Saharan African countries they are labor-intensive.

2.03 Periodic maintenance consists of regravelling gravel roads, which normally involves the use of tippers to transport gravel from the gravel pit to the road site, graders to spread the gravel, water tankers and rollers to compact it, and sometimes bulldozers to gather and load the gravel. Programming of work has to be carefully scheduled so that the necessary resources can be moved at the lowest cost and used efficiently. In addition, programming of work on site is essential to coordinate tasks such as timely arrival of gravel on site as well as fuel for the vehicles and equipment, the availability of skilled staff to operate and maintain equipment and supervise the work, and laborers to perform the manual work.

2.04 Emergency maintenance can obviously not be planned, although it will be required most likely during, and just after, the rainy season. Emergency works involve the reinstatement of sections of roads washed away by floods or heavy rainfall, removal of landslides and fallen trees, repair of culverts, drifts, and bridges, and so on. Both skilled and unskilled labor is required, particularly masons and carpenters for drift and bridge work. Most maintenance authorities also perform other tasks; there is considerable dispute about whether such tasks are maintenance work or are rehabilitation or improvement activities. For example, graveling previously ungraveled roads, returning seriously deteriorated roads to their original design standard, putting in additional culverts or new side ditches, widening roads, building drifts and bridges, and sealing or cementing steep sections of road. These items are not strictly defined as maintenance and are not normally allowed for in maintenance budgets. They are, however, frequently carried out with maintenance funds.

2.05 Where transport or equipment is required for maintenance work, facilities will be needed to maintain and repair the fleet. This involves further programming, including a schedule of routine servicing and preventive maintenance and selection of broken-down equipment to repair first; availability of spare parts most frequently required, sufficient numbers of mechanics, workshops, equipment and tools, and a rapid communication system to obtain assistance for unexpected breakdown, will also be necessary. The nonavailability of vital pieces of equipment can completely disrupt work programs, such as grading, and badly affect periodic maintenance; the breakdown of such essential items as graders means that the regaveling unit will come to a halt, leaving other items of equipment and labor idle and increasing the costs substantially.

The Zandya Road Maintenance Organization

2.06 As road maintenance standards had steadily declined since independence, the government decided to transfer responsibility for road maintenance from the local councils to the centralized Ministry of Transport (MT). With an injection of additional staff, improved training, and a large fleet of equipment, the new organization initially performed quite well, but soon went into decline because of many factors discussed later in the paper (paras. 2.13-2.18). As a result, the road network in Zandya deteriorated, although other factors such as vehicle overloading and long delays in staged construction have also been contributing factors.

2.07 The decision to centralize road maintenance was based on the recommendation of international consultants financed by bilateral and international aid agencies. Following the classic organizational approach, the reorganization concentrated on structure and the logic and efficiency of its internal arrangement rather than on its suitability to its environment. A Maintenance Organization (MO) was set up to carry out maintenance activities, with a separate Mechanical

Department (MD) to maintain and repair vehicles and equipment hired out to the MO. A Training Department (TD) was also set up to provide trained manpower for both the MD and MO. As shown in Chart 1, TD and MD report directly to the Engineer-in-Chief of MT, while the head of the MO reports to the Chief Engineer of the Roads Department (Chart 1).

2.08 As for many maintenance organizations throughout the world, the province has been made the basic unit of management for both the MD and MO, with each province having anything from 3,000 km to 15,000 km of low class roads to maintain. The Provincial Engineer (PE), who reports to the Engineer-in-Chief of the Ministry and has been charged with co-ordinating road activities in the province, is the ministry's authorizing agent for the province, and is held financially responsible for all expenditures on roads, including funds allocated to the MO and MD, and to special projects, for instance, in the area of feeder roads.

2.09 Characteristic of the classic organization, there is a clearly defined and hierarchical managerial system with a pyramid type of structure (Chart 2). The smallest unit is the road camp headed by an overseer or foreman: one road camp will have an average of approximately 150 km of roads to maintain. The new departure from the classic type of organization is at the Provincial Road Engineer (PRE) and Provincial Mechanical Engineer (PME) level, since they have a dual reporting role to both the PE and to their respective Chief Maintenance and Chief Mechanical Engineers in the country's capital city. This gives the PE the authority he requires at the provincial level, although he is still dependent on resources allocated from Headquarters. The MD has a similar organizational structure (Chart 2): there is one large provincial workshop in the capital of each province, plus district workshops for carrying out minor repairs. The central workshop in the country's capital city is for engine overhauls and major repairs which normally cannot be carried out in the province.

2.10 The TD is responsible for providing staff at all levels up to senior superintendent for both the MD and MO; those trained include drivers, operators, mechanics, electricians, fitters, and inspectors. Training is carried out at the Ministry of Transport school, except for inspectors and superintendents who attend polytechnic courses under the Ministry of Education. The TD also has its own training brigade which rehabilitates roads in the Training School area. The TD programs the training courses with the Ministry's operational departments according to their requirements.

Effectiveness of Road Maintenance in India

2.11 Although the condition of the roads maintained by the MO varies from one province to another, a good level of maintenance throughout the country still has a lot to be desired. Availability

of vehicles and equipment is reasonably high and includes a large number of new vehicles and a large stock of grader spare parts. Training has been carried out for a number of years and more than 4,000 mechanics, drivers, overseers, foremen, inspectors, and superintendents have attended courses in the last ten years (including repeater and upgrading courses). The maintenance organization has also benefited from strong leadership by the ministry, not to mention some very able and dedicated PEs who have been able to achieve remarkable results in sometimes difficult circumstances. Nevertheless, Zandya's earth and gravel roads still have numerous ruts, potholes, and high surface roughness levels (resulting in higher vehicle-operating costs). This is in part due to poor road maintenance, although other factors such as inadequate drainage, overloading, and higher than projected traffic levels have also contributed to road deterioration. Water penetration into the pavement structure has frequently occurred because culverts, drains, and drainage ditches have not been cleared, cracks and potholes have not been patched, shoulders have not been leveled (preventing run-off and evaporation of water), and roads have not been regraded. Some gravel roads are in need of complete reconstruction because they have not been graded and regraded on time, and some earth roads have reverted back to bush because they have never been maintained.

2.12 A part of the problem with the road maintenance organization has been MO's dependence on vehicles and equipment. It is not unusual to find that maintenance vehicles and equipment are in working order only 60% of working time (normally taken as 200 days per year) and then utilized for maintenance work perhaps only 60% of the time available. This means equipment is being used only about 36% of total work time (admittedly, in some part of the world, it is even less). To compound the problem in some cases productivity of equipment (such as graders) while in use is also low.

2.13 The availability of vehicles and equipment has been low in the past, but some measures have been taken recently to bring the overall availability rate up to 60% (although doubts have been expressed about the reliability of this estimate). Low availability of equipment itself accounts for part of low utilization rates, since the breakdown of a few items of equipment often means that other equipment lies idle (for example, tippers for regrading units). The reasons for availability rates not being higher in Zandya are: (a) the lack of funds for, and availability of, spare parts, but with external aid a stock of spares is now being built up; (b) a substantial portion of the equipment fleet is beyond its economic life, but again, external aid is financing purchase of new equipment; (c) lack of preventive maintenance; (d) poor quality of maintenance work, partly because of insufficient numbers and inexperienced mechanics, although increased efforts are now being made to train far more mechanics; (e) operator abuse of maintenance and maintenance equipment; (f) inadequate workshop facilities -- both buildings and equipment; and (g) a wide range

of brands of equipment, which requires a mechanic to familiarize himself with many brands of the same vehicle or equipment. The problem of staffing mechanical departments is particularly acute in Zandya, since many trained staff leave for the private sector because the demand for mechanical staff is so high and because the private sector offers higher benefits.

2.14 Another reason for poor maintenance is low productivity of labor and equipment, even when resources such as equipment, labor, and fuel are available (para. 2.17). Low productivity has been due to many factors, one of which has been the shortage and quality of the supervisory staff. The country has made great strides in training more supervisors, although getting the supervisors to do their work adequately has often been a real problem. It is obvious when looking at routine maintenance, for instance, that the road camps are not being well supervised, nor is their work being routinely inspected. Consequently, there is little control within MO (although this does not apply to all provinces), resulting in reporting agencies breaking down or containing unreliable information. Because of the poor quality of supervision, it is difficult to judge to what extent there is a real shortage of supervisors since if the productivity of supervisors is low, more staff are required to do the same amount of work. Nevertheless, the ratio of one overseer to more than twenty laborers is quite high, although sometimes they are assisted by one or two headmen.

2.15 One of the major problems is that supervisory staff at the operational level are not programming their work effectively. Apart from the overall programming of daily and weekly work schedules, ordering supplies (whether fuel, gravel, barmen, or chippings) and arranging for the transport of labor and provision of equipment for periodic maintenance units requires considerable organizational capability, which is still a scarce resource in Zandya. Poor programming means that much time is lost waiting for supplies or equipment to arrive, and makeshift operations are carried out with less than optimal resources.

2.16 Cumbersome bureaucratic procedures do not help to improve efficiency. The Central Tenders Board procedure is often slow, and the procurement of spare parts, vehicles, equipment, and gravel can take months, even when the process goes smoothly. Unfortunately, few managers in maintenance organizations take account of these lengthy delays in planning their work. Up until recently, most spare parts have been purchased only as needed, and since many have to come from abroad and local dealers are often unable to stock many spares because of strict import quotas, there have been several months' delay in delivery. Insistence on accepting the lowest bid often results in the hiring of a local supplier or manufacturer who is unable to meet the requirements of the contract on schedule, because of his limited capacity. The PEs complain about the amount of paper work to be processed, and the lengthy time it takes for the Procurement Department

to fill requisitions. Other factors, such as releasing the maintenance budget only three months at a time, have caused the MO real problems since more funds are required at special times of the year. The argument for releasing funds on a three-month schedule is that if MO received all the budget at once, it would spend it all in the first few months.

2.17 Last, but by no means least, has been the problem of insufficient funds for maintenance, which was particularly bad during the last few years. Frequently, work was stopped in the third month of each quarter because funds only for the payment of wages were left. Thus, during this period wages were paid for very little work since there was no money for the hire of equipment or fuel to run it. Also, MD was unable to purchase new vehicles and equipment to replace uneconomic items, which necessitated higher levels of expenditures on repairs because of more frequent breakdowns. The road camps have been particularly affected, since they depend on transport to get to the roads. More often than not they have been without vehicles, and although laborers will sometimes walk to roads up to 5 to 6 km from the camp, a substantial portion of routine maintenance has been neglected.

2.18 Another problem which disrupts work programs is the diversion of resources from the maintenance organization. Vehicles and equipment are often commandeered for famine relief, for distribution of basic foodstuffs throughout the country, for transport of water, and for road construction and other projects. Funds allocated for maintenance are often spent on new road construction or improvement, usually seconding the best skilled manpower available, at the expense of periodic and routine maintenance programs. In any one year, this diversion of funds can be quite substantial. It is to the credit of the maintenance organization that it is able to respond to certain needs, especially famine relief and maize distribution, when other entities in the country cannot.

III. IMPROVING THE DESIGN OF THE ROAD MAINTENANCE ORGANIZATION

A. Deficiencies of Traditional Approaches to Organization Design

3.01 Despite the financial and technical assistance received from bilateral and international aid agencies since the early 1970s, the performance of Zandya's maintenance organization is still disappointing, with low levels of productivity, both for equipment and labor. Inadequate financial resources have certainly constrained activities, although during the last two years the MO has received a large number of vehicles and equipment for which it did not pay and which do not come under the hire charge system (they belong to MO, not MD).

The condition of the roads does not reflect the \$900 allocated for each kilometer of road. Therefore, of more concern than the financial issue is the adequacy of maintenance carried out with the resources available, which immediately raises the issue of whether the emphasis should be put on allocating more funds to the maintenance organization or whether a major effort should first be made to improve the efficiency of existing resources.

3.02 The recognition of performance problems because of organizational weakness usually leads to organizational studies, which tend to assume that all the activities necessary to achieve maintenance targets can be controlled by the organization and that the environment external to the maintenance agency can be ignored or avoided.³ As a result, maintenance organizations tend to be overplanned, and errors of design tend to be diagnosed as problems of management or implementation. But, in reality, the manager in the field is constantly dealing with factors beyond his control, or over which he has little influence. Since traditionally, organization design has concentrated only on the role of management and has ignored the external elements that can affect organizational performance and over which it has little or no control (such as excessive political pressures or direct interference, civil service salary levels, and bureaucratic procedures), the maintenance organization's efforts to improve organizational performance through changes in structure can be completely neutralized.

3.03 Even with the emphasis on the primarily managerial management role, insufficient attention has been given to the multiplicity of nonfinancial incentives (para. 3.29-3.33) available to managers to increase productivity. Instead, it has been assumed that by designing in detail the structure of the organization as well as its operational systems, by providing managerial training, and by specifying how many positions there should be at each level, the organization will function well and require no other organizational considerations.⁴ One of the reasons for structure receiving so much attention is that it avoids the "people problems," the question of management style, and the problems of commitment and motivation. Yet one of the key factors in how effectively any one program in Zandya works is the managerial style and creativity of the PE and the senior supervisory staff. The structure of the organization has little effect on such managerial strengths.

3.04 One example of how systems are introduced to try to improve organizational efficiency in maintenance organizations is the hire-charge system for the equipment fleet. In Zandya, the hire-charge system has not resulted in cost savings, partly because of the lack of cost-consciousness among local maintenance staff and partly because supervisors are not trying to get the maximum use out of equipment, so that money saved on hire charges can be spent on hiring more equipment,

3/ Staff Working Paper No. 275, *op cit.*

4/ R. Waterman, T. Peters, and J. Phillips, "Structure is not Organization" (Business Horizons, June 1980).

on fuel, on materials, and so on, even in times of severe financial constraints. One of the reasons for this lack of efficiency is that if money runs out the staff cannot continue working but still are paid. If work does not get done there has not been sufficient accountability (as in many civil service structures) and explanation about funds running out are too easily accepted. Widespread adherence to western concepts of productivity, efficiency, and individual achievement may be found in a number of industrialized countries but may be quite new concepts at the supervision level in a number of African countries.⁵ In the rural areas, values such as access to, and distribution of, resources⁶ and social interaction ("affiliation") may be more important.⁷ Access to, and distribution of, resources means here the priority given by society to making resources available to the community, such as education, health services, and roads and ensuring that within the community such resources are seen as being fairly distributed. For example, studies have shown that many cooperatives give more priority to obtaining resources and then assuring their fair distribution than to concentrating on the most efficient use of those resources. It is more important to them that resources are there and are seen as being fairly distributed.

3.05 The effect of civil service structure on organizational performance is generally not given sufficient attention in organizational studies. Civil servants are low paid compared with the private sector (except for unskilled labor) and bonus systems are not allowed. Financial incentives to staff are therefore not possible. The lack of alternative incentives in the maintenance organization stifles initiative and motivation and results in a sense of inertia. Whether one performs well or poorly often goes unnoticed. Promotions are limited at the lower levels and are usually based on educational qualifications not always relevant to the added responsibilities and not possessed by a large part of the labor force. The good people at the supervisory level often switch to other, more successful programs within the Roads Department. The job security traditionally associated with civil service employment encourages transfer rather than dismissal of poor supervisors, with the result that problems are merely shifted to another part of the organization. Finally, administrative systems have had difficulty in learning from past mistakes. For example, too often good management may be exercised by one excellent PE, but when he moves on, his managerial expertise is lost because the management learning process is not institutionalized.

5/ J. Moris, "Transferability of Western Management Concepts and Programs: an E. African Perspective. (Rockefeller Foundation, Education and Training for Public Sector Management in the Developing Countries; March 1977.)

6/ D. L. Leonard, "Reaching the Peasant Farmer: Organization Theory and Practice in Kenya" (University of Chicago, 1977); and G. Hyden, "Efficiency versus Distribution in E. African Cooperatives: A Study in Organizational Conflicts.

7/ C. C. Onyemelekwu, "Men and Management in Contemporary Africa," Nigerian Institute of Management.

Indeed, in large provinces even good PEs have difficulty maintaining control since the organization becomes too large and complex for one key executive to manage.

3.06 Another externality, which affects the performance of the maintenance organizations, is the general public's attitudes to, and perception of, road maintenance. This is a widespread problem, even in more developed countries. Activities such as cleaning of culverts, drains, and ditches do not seem as necessary to the general population because they make no significant difference to the look of the road itself, and the preventative effects are not realized. Nor is clearing of drains considered important by the general public despite the disastrous effect of blocked drains on the road. Yet when roads do eventually deteriorate because of water penetration there is a public outcry. Because the public confuses activities, such as graveling an upgraded road and rehabilitation work with maintenance, there is generally much more pressure for these activities than for many of the routine maintenance activities. In addition, education programs to convince the public in the rural areas of the need for road maintenance may be less successful in subsistence cultures, since people's horizons may be more limited, unless such programs are combined with measures to give the community some control of, and participation in, road maintenance to encourage their involvement and commitment.

3.07 Because of the problems inherent in the traditional approach to organization design, this paper proposes that more analysis of the organization of maintenance activities be carried out from the perspective of the external environment within which the manager must work. This will require the design of organizational linkages with institutions and individuals whose cooperation is crucial for achieving the objectives of the maintenance organization. Such a design must recognize that the participation of the institutions and individuals is always partial and conditional and is essentially a political process. Ways must, therefore, be found to induce their participation; namely, creating incentives which will meet their own aspirations.

4. Alternative Measures to Improve the Design of the Road Maintenance Organization

3.08 This section of the paper concentrates on various alternatives open to many African countries to improve road maintenance organization. The word "alternative" rather than "solution" is used purposely since there is no one solution or prescription (as consultant societies often propose) to improving road maintenance organization. Rather, there are a series of options, some or all of which may help African governments, senior officials, and maintenance field staff perform their work better, if they so wish. These alternatives need to be applied on a pilot basis to see in which particular set of circumstances they are most effective. A number of these alternatives are actually being tried out in Sub-Saharan Africa, were being considered

by field engineers, Provincial Engineers and other senior government staff with whom discussions were held, or were inspired from discussions with these officials.

Long-term Policy

3.09 When designing maintenance organizations, long-term policy and objectives need to be determined, not only by maintenance agencies but also by all those with a vested interest in road maintenance (the "stakeholders"), including those in rural areas. This has been done, e.g., in Kenya's Rural Access Road Program (RARP), in which local administrators, chiefs, politicians, and the like, have been involved in the road selection process, even though they do not fund any of the roads. Such involvement helps to ensure that any organization design serves the legitimate purposes of both those affected by the condition of the road network and those implementing maintenance activities. A specific time frame has to be agreed for achieving maintenance objectives (discussed below) but given the complexity of developing an effective road maintenance organization a long time period such as 10-15 years must be allowed for, as opposed to a normal project cycle of a few years. Alternative configurations of available and potentially available resources, and means of combining them, have to be considered along with an analysis of their likely costs, results and consequences. The alternative selected should be the most effective, not purely from an economic point of view but also in the sense that it will best capture the energy and commitment of those who will have to implement, and be affected by, road maintenance, that it will employ resources actually or potentially available, and that it will allow for those obstacles to road maintenance which cannot be removed, at least in the short run. It should also allow feedback since more people will be knowledgeable about what the maintenance organization is supposed to do.

3.10 Governments need to have defined as a long-term objective the size and composition of the road network to be maintained. As the MO usually maintains only the classified road network, minor rural roads of major importance to the communities served by them are likely to be excluded, and, consequently, there is constant pressure from local government and MPs for the MO to maintain some of the more important (to the community) unclassified roads. Government and the communities need to decide whether maintenance of some of the less important classified roads can be dropped in favor of some unclassified roads. Long-term objectives should also focus on standards of road maintenance, for example, they should aim for optimal maintenance standards based on economic criteria,⁸ extend the scope of maintenance to include the gradual improvement of roads, such as installation of additional culverts, and the like (para. 2.04), taking into account

8/ As determined, for example, by the Bank's Highway Design and Maintenance Model.

likely financial constraints. Policy guidelines need to clarify what should be done about roads that have deteriorated but that are still meant to be maintained. Another objective the government should consider is the desirability of maintenance activities generating as many employment opportunities as possible, and the distribution of these opportunities throughout the country.

3.11 Strategy and Structure. The strategic planning process covers all technical and organizational aspects of the design of a road maintenance organization. The organizational features include not only the structure and means of control, but also the coordination patterns of the organization. The choice of an organizational form will depend on the strength of commitments (or lack thereof) by individuals or interest groups to maintenance goals and on the relative distribution of power between these two groups, which will affect the human, financial, and other resources made available. The road maintenance organization will have to establish coordinative mechanisms as far as possible with those who by their commitment to maintenance goals can positively affect maintenance activities. At the same time there will be factors capable of negatively affecting maintenance activities, therefore strategies have to be designed to avoid any major obstacles to road maintenance. Such factors include excessive political interference and the effect of the civil service structure on motivation. In some cases it will be necessary for the environment itself to be changed or be modified for the maintenance organization to be effective. What must be avoided is ignoring such obstacles in development of maintenance capacity, as has occurred so often under externally financed maintenance projects. A review of these obstacles and of alternatives to deal with them follows.

3.12 Political Environment. When road maintenance was centralized in Landya, the design of the maintenance organization was based on programs of work being carried out according to standard maintenance engineering criteria. No allowance was made for the highly politicized nature of the road sector (as occurs in other parts of the world) or for the inevitable political pressures and interferences that affect road maintenance activities. As a result, roads and bridges have been constructed or upgraded with maintenance funds, and maintenance vehicles and equipment have been used for other public works (and possibly private uses). "Requests" from MPs and other senior politicians, as well as from the Provincial Administrator, are channelled through headquarters staff and PEs, while the superintendents and inspectors are subject to client pressures both directly from local officials and indirectly through their superiors in the ministry. The extent to which these political demands represent the wishes of the majority of the clients living in the local constituency is not known and undoubtedly varies from one case to another, as does the extent to which such maintenance activities are necessary. Certainly, near elections there is strong political pressure for roads since, in order to be re-elected, MPs must struggle to obtain more resources for their constituencies.

3.13 Although some suggestions to curb excessive political pressures are proposed in the next section, undoubtedly there will always be political pressures that cannot be constrained or turned to the organization's advantage. (In fact, it could well be argued that the maintenance organization is the most suitable entity to carry out these public works.) Therefore, unless external agencies giving support for maintenance activities can persuade the government to provide a separate fund, upon which the MO could draw for "extra-maintenance activities," realistic figures for extra-maintenance work should be allowed for in their estimates of recurrent maintenance funding requirements. It is important not to ignore such activities are taking place and subsequently provide unrealistic funding estimates.

3.14 In the case of maintenance of feeder roads, programming work and performing maintenance activities require strong coordination links with the local environment, otherwise informal channels of communication will influence maintenance activities or the local population will feel frustrated and unsatisfied with the MO's efforts because their "felt needs" have not been taken into consideration. Political support for road maintenance needs to be gained at the national (such as the Ministry of Agriculture or Tourism), provincial, and local level (including administrative officials, chiefs, farmers, cooperatives). One of the main roles of the manager in the road maintenance organization is to identify, and obtain support from, individuals and agencies (such as local chiefs and cooperatives) interested in road maintenance and to involve them in the organization's activities through coordinative mechanisms.

3.15 Centralization or Decentralization of Feeder Road Maintenance. Historically, under the local council system (para. 2.06) maintenance of roads was determined by negotiation between the roads staff and various local representatives (particularly the Works Committee of the Council), including the chiefs. The role of the road officer was to balance competing client demands. This approach has been supported by the "representative school" which stresses detailed knowledge of local needs (which elected representatives are assumed to have but maintenance officials are not). The problem with this argument for road maintenance is that some activities, such as routine maintenance (with the possible exception of grading), will not be deemed as necessary by the local community and its representatives (para. 3.06) and, therefore, local maintenance organizations will tend to concentrate on re-graveling and improvement works. There is, however, always the possibility of educating them about the value of routine maintenance. There is also the problem (referred to in para. 3.04) of to what extent local authorities should follow clients' wishes (which may not be of high economic importance but of social and/or political consequence) as opposed to interests (determined by the professional's criteria and technical expertise).⁹

9/ P. M. Blau and W. R. Scott, "Formal Organizations" (1963).

3.16 By contrast, putting the responsibility for feeder road maintenance in the hands of bureaucrats (local or central) not directly answerable to elected representatives may result in an organization insensitive to local road needs; thus roads that may be of high socio-economic priority to local communities might be ignored. This appears to be a problem in the case of Zandya, although local councils that still have revenues for road maintenance also appear to show the same insensitivity in some cases. Diversion of funds to other purposes, such as the creation of jobs with the local councils and diversion of equipment and funds to private use, is a common complaint.

3.17 As an alternative, one might examine the suitability of involving other provincial organizations in road maintenance decisions. For instance, in addition to the Provincial Commissioner or Governor, where most of the power lies, and the chiefs at the local level, new opportunities might be offered at district levels, especially where government has organized special development councils composed, for instance, of representatives of the different government service agencies, MPs for the district, district administrators and community representatives.

3.18 Stronger links might be established between the central government-controlled maintenance organization and the local development councils, which could be made representative by increasing the number of elected members or by eliciting recommendations from separate road-user committees which could be formed at the sublocation level, comprising elected representatives, together with chiefs, agriculture cooperative and extension staff, or other local officials. If the idea of elected representatives is not acceptable, then local officials together with local appointees could form the road-user committee. There is also the possibility of making use of self-help local committees. The local road user committee could then be involved with the MO in programming maintenance work, with the MO reserving a certain amount of limited resources for priority routine and priority periodic maintenance activities. As part of the educational process, the MO should explain to the committee the necessity for these activities and only allow the committee to select other priorities. If the committee decides that certain unclassified roads should be maintained because of their local importance, then the MO could accept their decision (with some possible exceptions) as long as the committee were able to say which classified roads not to maintain. This would help instill a sense of cost-consciousness and encourage the local population to think in terms of relative priorities and trade-offs. Local representatives could be informed when funds, transport, or equipment were not available and could put more pressure on government to obtain the resources. Alternatively, they could try to raise them locally. These resources would include, for example, funds for a spare part for a grader or truck, funds for hiring casual labor, or contributing labor itself, or the loan of transport from the cooperative or other source. The possibility of raising local resources will

depend very much on the history of self-help projects in the area, and the interest of the local leadership. In some districts of Zandya, for instance, bridges and small sections of roads are being built through self-help projects mostly with money raised to pay casual labor.

3.19 Under the system in which a local committee is involved in the programming of work, when Headquarters or provincial staff receive an MP's or other prominent person's request to gravel certain roads, the request should first be approved by the committee. In this way, requests that serve only individual interests can be avoided. When agreed programs are curtailed and funds are shifted from one district to another, some explanation should be given to the local committees. Local awareness of road maintenance requirements may also create more local pressure on the road maintenance organization (in particular, to improve the MD's performance), as well as the provision of a programming and feedback system. The inclusion of small rehabilitation and improvement works is a carrot to create local interest in participating, and again, is something the MO is already doing in Zandya and will not cease from doing despite protestations from "the maintenance work only" school (usually foreign aid agencies). The proposals made here are an attempt to develop a strategy to deal with the political environment, which is already affecting the MO's activities, disrupting work programs, and diverting scarce resources. They are intended to show those designing organizations possible ways of taking into consideration the obstacles in the environment and incorporating in the design of the organization those who are interested in road maintenance.

3.20 In order for the system of more local involvement to work, the PE must allocate funds to the district for the maintenance of low-standard roads. This allocation should be based on the PE's knowledge of local conditions. In practice, Headquarters would allocate funds to the PEs who would then allocate them to the districts, thereby eliminating the role of Headquarters staff in decisions about rehabilitation, improvement or graveling programs for the low standard roads, or in the implementation of such programs. With respect to the low-standard earth and gravel roads, the Headquarters needs to take a staff policy, as opposed to line, role, providing professional guidance to PEs on technical, organizational, and other matters, as well as playing an advocacy role for feeder road maintenance at the national level. All requests concerning feeder road maintenance would then be channeled to the appropriate level, that is, the district and sublocation level.

3.21 If these measures are considered not immediately applicable or turn out to be unacceptable to the government, how else can the maintenance organization use the environment to at least gain more resources and carry out more work? One alternative is to seek the assistance of local development councils, chiefs, cooperative officials, MPs, and other important local dignitaries in raising funds when there are none for hiring equipment or purchasing fuel and other materials such as gravel. In exchange, the MO can offer the use of the

otherwise idle labor force and equipment on mutually agreed road maintenance activities. Where transport is not available, the MO could request local officials, such as cooperatives, for assistance -- again, in exchange for work important to those concerned. As one of the PEs interviewed is already doing, help can be solicited from chiefs to stop practices detrimental to the roads, such as blocking mitre drains, which prevents water from running off the road. If water from blocked drains is causing damage to the farmer's crops, their complaints can be channeled back through the chief. Similar strategies can be tried to make the environment work for the organization, but they require imaginative, empathetic, and enterprising engineers, superintendents, or inspectors to initiate them, and the lack of such people is one of the biggest weaknesses of any organization. It may be possible, however, by constant retraining and seminar efforts, to create greater awareness of different strategies to follow (para. 3.38).

3.22 The Financial Environment. One of the most commonly cited reasons for the inadequacy of maintenance organizations is the lack of budgetary resources. For instance, in Zandya, budget allocations for road and mechanical maintenance declined or remained stationary in real terms in most years from 1974 to 1979, despite an increased workload, resulting in operations being halted for 3 to 4 months a year. Every time the economy goes into a serious decline, often precipitated by oil price increases, not only are road maintenance funds cut or not increased in real terms, but other financial restrictions are imposed that have repercussions on the maintenance organization. The most common restriction that affects road maintenance is the imposition of import controls, which particularly affect the supply of spare parts in the country. Because this particular problem may be temporarily eased through financing of an inventory of spares by foreign aid agencies, it is less central to this paper than the internal measures that governments may consider.

3.23 Recognizing that the Ministry of Finance's commitment to maintenance is likely to fluctuate, depending on the availability of recurrent financing and on the overall government policy toward increasing the total recurrent budget at the expense of the development budget, various measures can be suggested to government to increase maintenance funding.¹⁰ But, whether government agrees to increase the recurrent maintenance budget by so much a year, or whether a separate semiautonomous Maintenance Authority is set up, which receives a set percentage of road-user revenues (as in Haiti), will depend on government's continuing commitment to maintenance since at any time they can rescind original agreements.

3.24 An example of how financing arrangements can break down is the hire-charge system (para. 3.04). The introduction of a hire-charge

^{10/} For a detailed description of these measures, see World Bank "The Road Maintenance Problem", op. cit.

system for equipment in Zandya was meant to encourage the MO to make more efficient use of its fleet and thus reduce its overall equipment requirements. However, in the past it has resulted in a waste of resources because, although available, equipment has stood idle because the MO could not afford the hire-charge or the fuel to run the equipment. If the system had been more flexible, the hire rates would have temporarily excluded the depreciation component, while still including depreciation in a separate cost accounting system, and, with the lower rate, MO could have purchased more fuel and utilized the equipment to a greater extent. But this does not avoid the problem of funding for replacing equipment.

3.25 Other ways in which the maintenance organization could attempt to raise more funds for road maintenance are: (a) financing maintenance activities, such as reshaping of roads and restoring drainage ditches through construction and road improvement contracts, that is, every time a contract for a gravel road is let, a certain amount of other minor maintenance work on surrounding priority roads could also be undertaken by the contractor, and if the contract is donor-financed it may be possible to persuade the donor to finance the additional maintenance works; (b) including in special development programs, such as the construction of feeder roads, routine maintenance activities under the organization which is going to be ultimately responsible for maintenance (discussed in para. 3.50); (c) requesting donor financing for maintenance equipment and spare parts for the equipment's life expectancy (as under certain loans by the Canadian Aid Agency, CIDA), or donor financing for maintenance of equipment by private dealers (to relieve the MD of some of its workload) and financing spare parts as a project component of road construction projects (on the grounds of improving the maintenance capacity to maintain adequately the newly constructed road and adjoining roads). The rationale behind such an approach for donors is not the purpose of this paper, but one of the supporting arguments is that donors are financing maintenance anyway, through the far more costly form of rehabilitation projects. Also, the argument that donors should finance only development activities with a longer period of economic return will not be valid in the case of roads constructed under low-class programs, which are likely to deteriorate in a few years instead of lasting the projected 10 to 15 years.

3.26 These alternatives are only a few for the MT and donors to consider. It might well be that none are feasible, but they are primarily meant to illustrate the flexible approach any maintenance organization needs to take in order to obtain more funds. Other possibilities of raising money locally, should, of course, be considered, but in many cases there will be little prospect of raising money for maintenance of feeder roads through local organizations such as the local councils, since very little revenue is raised for any activity at the local level. The only possibility would be the introduction of a special cess (tax) on agricultural produce marketed, but that would be an extremely unpopular government decision. Voluntary funding is likely only in certain instances rather than on a continuous basis, since maintenance is a recurrent activity. Experience so far in Zandya has

shown that money can be raised for capital projects through self-help movements, but there is little willingness to raise money for continual operation or maintenance of facilities once constructed (except in swampy areas where villages performing the maintenance works are allowed to levy a toll from road users). That puts the burden back on central government, which means road maintenance must fight for scarce resources along with every other sector. If funding remains inadequate despite all attempts to obtain more, then naturally the maintenance program has to be reduced. The extent of the reduction plus the economic implications need to be made clear to all concerned. At present, however, even more important than the financing problem is the use of existing funds, for if they were used more efficiently road maintenance could be substantially improved.

3.27 Improving the "Controlled" Environment: Motivation and Incentives. As mentioned in para. 3.01, considering what resources the maintenance organization has, productivity is still low (especially for such routine maintenance activities as grading). One reason for the maintenance organization's poor productivity is that it operates within the civil service structure (para. 3.05). The problem is compounded by the fact that civil servants are allowed to own private businesses, except when this is in direct conflict with their work; therefore many government employees run small businesses. High-level civil servants generally own large farms and some are leading businessmen in their society. Undoubtedly, government-paid time is sometimes used for private purposes.

3.28 Some alternatives to consider are: (a) to try to reduce the amount of work carried out by force account by contracting out more work (paras. 3.39-3.41) to avoid the problem of working with unmotivated civil servants; (b) to do force account work but with casual labor instead of permanent government employees (paras. 3.42-3.44); and (c) to alter civil service regulations to introduce more market incentives or to bend the current rules as much as possible. The following is a discussion of some of the alternatives for consideration with respect to (c).

3.29 With a permanent work force, governments will need to find ways of motivating their personnel to increase efficiency. Unfortunately, little work has been done on this subject in the African context¹¹ and western management concepts may not be applicable. Considerable research assistance could be given by external donors and local universities by carrying out studies in various African countries to determine the conditions under which greater productivity is realized.

^{11/} Notable exceptions are D. L. Leonard's "Reaching the Peasant Farmer" and C. C. Onyemelekwu's "Men and Management,". See also, T. A. Lambor, "Motivational Factors in Work" (paper at 7th Conference); and Samuel Paul, "Strategic Management of Public Programs," Harvard University and Indian Institute of Management (forthcoming).

Short and simple surveys could be carried out in private industries, especially with successful road contractors. Even within Zandya's Roads Department, there is ample scope for surveying different road development programs (or parts of programs) that are successful and unsuccessful to determine the relevant factors leading to good performance. One area to study is the extent to which money is an incentive of workers when tied to production. Many private contractors provide bonuses to their workers for good work and it may be necessary for governments to consider seriously the introduction of bonus systems as part of the civil service pay structure, especially where large investments are concerned. Other factors to look at are the ratio of supervisors to laborers, how tasks are split up, how teams of workers are put together, and so on.

3.30 External donors have tended to concentrate on the project approach, which often limits them to assisting one sector, even one institution at a time. Therefore, the problems common to many institutions are not clearly recognized, or are identified but cannot receive the necessary assistance within the context of a project. Such areas as government remuneration and regulations require considerable assistance, especially budgeting and procurement procedures. Incentive systems incorporating bonus systems would necessarily have to be tied to easily measurable activities, such as kilometers graveled and number of culverts cleared. Better use could also be made of the promotion system (again requiring changes in government regulations), although in a context involving ethnic, linguistic, seniority, or other personal or social considerations a promotion system based essentially on merit may be more difficult to administer. Other incentive schemes require few changes in civil service regulations and are already used by a few managers in road maintenance. These are overtime or time off for performing specified tasks on schedule (as observed in Sierra Leone), recognition of good work in departmental newssheets, and competitions with prizes for the best work performed (for example, team and individual prizes for "mechanics of the year," with awards made at the annual national agricultural fair). Such incentive systems make it possible to put more group pressure on individuals to perform -- especially on mechanics to keep equipment running.

3.31 The research carried out so far in Africa and other parts of the world indicates scope for the sociotechnical approach to organization design, since workers appear to receive greater satisfaction from their jobs if social interaction is possible and if they are given a "whole" task to perform. Again, studies or experimentation are necessary to see to what extent the team approach can be applied to maintenance activities in a particular country. One possibility is to provide equipment units with their own mechanics, as fully equipped as possible, and to give specific tasks to perform and incentives for meeting targets. This approach would mean a certain level of duplication and underutilization of mechanical equipment but the costs of duplication would have to be balanced against the benefits of having independent units (just how independent would have to be determined by trial

projects). Teamwork will be possible only if mechanics and supervisors assigned to teams work on specified items of equipment thereby creating a sense of identification with their equipment and with mechanical teams looking after equipment in the field. Zandya's present system isolates different functions, so that different groups such as the road camps and grading and regravelling teams have no control over the mechanical units responsible for maintenance of their equipment and vice versa. Also, considerable programming skills are required to bring equipment from different units into workshops to be repaired and returned to the units.

3.32 The same argument could apply to the provision of workshops. At present, Zandya's maintenance organization depends on one central workshop for overhauls, one regional workshop for other major repairs, and district or local workshops with only basic tools for simple repairs. Closer attention could be given to the type of facilities successful contractors have for the maintenance of their fleet, since they face the same trade-off of comparing the cost of underutilized workshop equipment and other resources with the cost of waiting for repairs to be carried out at a distant facility. Since government organizations are not as efficient as private contractors, it might well be less costly for the maintenance agency to have better equipped district or local workshops.

3.33 Another incentive for better performance is the assigning of specific tasks to employees. Once an employee has mastered his specific task, it is important that he not be transferred (as is too often the case) since this only results in loss of morale and decreased productivity. Workers should, of course, be encouraged to seek more advanced training so that any transfer will be to a better position. If the job has a technical content or requires special training, so much the better, because it raises the social status of the operator -- and the incentive to perform well in order to retain that status. In the Zandyan context, a worker made to take work of lower status than his normal job (even without officially demoting him) loses face. This should, therefore, only be done as a form of punishment for poor performance (probably one of the most effective punishments and one which is in limited use already, for example, assigning drivers to work as flagmen because of poor performance).

3.34 Supervisory Staff. Without adequate staff to provide guidance and motivation, no incentive system will be viable. Supervisors working directly with laborers, especially at the overseer level, frequently comment that they learned techniques at training school but not how to manage people, perceived as the most difficult part of their work. This is because training takes place in ideal conditions in the training school and in the training brigade, with supportive colleagues, all the necessary resources, and close supervision by instructors. The enthusiasm of candidates entering training school is often remarked on, but somehow this spirit is dissipated once the trainee goes to the field, where he tends to be rather isolated from other parts of the agency, receives limited support and necessary inputs, and is often faced with managing too many maintenance workers.

3.35 One of the problems may be that supervisors are taught too much in one training session, and that together with the complexities of the real world as opposed to the training school, expectations are high about the work they can perform. Supervisors may first need to prove their competence at a very low, clearly defined level, such as supervising labor doing only culvert, ditch, and bush clearing before progressing to more complex activities such as grading and graveling works.¹² This would be in line with task specialization discussed earlier (paras. 3.31-3.33). The same principle of progressive training could apply to mechanics and inspectors. Instead of covering all aspects of mechanical work, mechanics should learn only about one or two makes of vehicle at first and gain experience with those before progressing to other vehicles and equipment. Trying to stretch newly-trained mechanics over the whole fleet only results in low productivity.

3.36 The TD in Zandya has been an excellent training institution and has produced large numbers of trained personnel. But it is also concerned about the performance of trainees in the field. Consideration should therefore be given to TD providing more support in the field after training programs are completed. By getting involved in the field, TD can adapt training programs to the problems supervisors meet in everyday work and advise on recurring managerial problems. TD support in the actual work environment is better than the training brigades', since many of the newly trained supervisors do feel isolated (particularly in the larger provinces). The addition of a cadre of "advisors" from the training school, responsible for helping the overseer or inspector in the field program and in supervising work, would provide the necessary follow-up and close supervision.

3.37 Whether more supervisors are required or not will depend on their productivity, but if there is a need, it should not be an insurmountable problem to train more maintenance supervisors (as well as instructors), since Zandya has such a large number of unemployed secondary school graduates as well as educationally less qualified personnel who have good leadership potential and maintenance experience, such as drivers, equipment operators, and artisans.

3.38 Whenever management training is discussed, very little attention is given to maintenance and mechanical engineers. Yet, as pointed out in para. 3.34, maintenance is more a managerial activity than an engineering one. Nevertheless, engineers with no management experience are assigned to maintenance and technical departments, and because of the pressure of the workload, there is little time for anyone to train them or even notice if they are performing poorly or well. This suggests that training schools, or institutions such as management schools,

^{12/} More detailed suggestions can be found in P. C. Ryall, "Training for Road Maintenance in Developing Countries", ORT, Ninth IRF World Meeting, Stockholm, June 1-5, 1981.

should design special courses not only to instruct engineers in programming, budgeting, and procedural systems, but also to instruct them in motivational management techniques: how to understand the environment in which they must operate, how to attempt to influence that environment, and how to set up formal or informal coordinating mechanisms. The MT could pool its resources to provide a management school. Many of its activities require considerable managerial skills, and involve substantial maintenance activities requiring the same programming and people management skills.

3.39 A continuing problem for the public sector in Zandya has been the lack of supervisors and engineers, together with a shortage of mechanics who are attracted to the private sector by higher wages. Through the efforts of the TD, however, these problems are gradually diminishing, but the problem of the quality and motivation of the staff still remains. Since the staffing of the organization with a large cadre of experienced people will take time, this has to be allowed for in the design of the organization, that is, the organization should be designed around realistic estimates of staff (and other) constraints, and in estimating the capacity of supervisors to achieve maintenance objectives.

Choosing Alternative Structures

3.40 (a) Contract Maintenance.

Since scarce resources must be maximized in countries like Zandya, it is necessary to develop maintenance capacity, not only within the maintenance organization, but also in the private sector. By developing local contractors, the maintenance organization relieves supervisory staff of activities such as procuring and delivery supplies, organizing staff and equipment in the field, and motivating staff; in addition, it relieves the organization of some of the burden of procuring and maintaining equipment. Of course, the organization will still need to supervise contracts to ensure that works are carried out according to contract.

3.41 In Zandya, the relative lack of sophistication of local contractors makes it possible for the maintenance organization to exert a strong influence over them (as part of the training experience) and to control prices (normally unit prices are fixed by the maintenance organization in agreement with contractors who do not have the experience to cost out and submit bids). Local contractors may not perform as efficiently as foreign contractors, but more important, in comparison with most government maintenance organizations in Zandya they have performed well. With the increase in funds in the last two years, re-graveling carried out by local contractors has been the only maintenance activity which has substantially improved. There is further potential for developing more local contractors not only to gravel and rehabilitate roads but also to carry out routine maintenance activities, especially since there are many entrepreneurs in the country and

an environment which does not discourage private enterprise. Any program to develop local contractors will meet with a high failure rate (although no more than by force account) and will take many years; therefore, this needs to be built into project estimates. Also, at least in the first few years, some guarantee of work must be given to new contractors, since in the past many efforts to encourage them have failed because the government could not provide them with sufficient work, and because they had not yet learned to diversify, they went bankrupt. Even in the United States, the trend is toward disbanding large maintenance organizations in favor of contract maintenance.

3.42 (b) Casual labor

With respect to its own organization, the MO must decide whether to retain its fixed work force or contract casual labor as and when necessary. The problem with a fixed government force is one of motivation (paras. 3.29- 3.33), whereas casual labor may be more financially motivated and can be dismissed if their work is poor. The greatest advantage to MO using more casual labor and keeping only a small, highly trained permanent labor force for activities requiring skilled labor (grading, bridge repairs, and so on) is that costs can be reduced in time of budget constraints, since at present the MO's permanent employees cannot be laid off. Casual labor can also be obtained at less cost than fixed labor if road camp, uniform, insurance, and other costs are taken into consideration. The real cost of permanent labor is even higher if one takes into account the amount of time the labor is idle because of lack of transport and equipment.

3.43 The disadvantage of casual labor is that each different group of laborers must be trained in maintenance techniques and their activities supervised. To what extent more supervision is required for casual labor as opposed to permanent labor is not clear, since, in Zandya, experiments have been carried out only with maintenance overseers not used to supervising casual labor. More research is needed on the supervision problems of casual labor employed in maintenance; much can be learned about the training of supervisors from the ongoing labor intensive feeder roads programs (LIFP) in Zandya. By carrying out regular annual programs of such simple activities as cleaning culverts, drains, and drainage ditches, and bush-cutting, repeated training can be reduced as the local population gains experience. Initially, while the MO slowly runs down its permanent work force through natural attrition, groups of casual laborers could work alongside, and thereby gain experience from, permanent employees, which could result in greater productivity. The success of employing more casual labor will determine the extent to which the permanent work force can be run down. Experimentation should be carried out and results carefully interpreted to determine whether to replicate this approach.

3.44 The other alternative is the length-man type of system whereby casual labor carries out routine maintenance work, with each worker contracted to maintain a few kilometers of road along which he resides. The success of this system will vary from one area to another, but different systems can be tried to suit local conditions. In some parts of the country, the best worker could be paid extra to supervise the work of others. The next stage is to transfer the system to the maintenance organization, but if some of the factors previously mentioned do not improve, the system could collapse through inadequate inspection and diversion of funds. The lengthman system has been used on rural feeder roads with fewer than 20 vehicles a day on well-constructed roads built by local labor. In Zandya, one attempt to replicate the system on existing classified roads with higher traffic has failed, because workers could not be induced to adequately maintain their section of the road. Unfortunately, the scheme was not closely monitored, and in this situation much depended on the quality of supervision, especially since the labor contracted to maintain the road had no previous construction experience. Nevertheless, the length-man system should be tried in various areas of the country with well-designed pilot projects. If found successful, it could be implemented by the MO on classified low-class and low-trafficked roads in areas where labor is available at the casual wage rate and as the permanent labor force is decreased.

3.45 Choosing an Alternative Technology with Different Organizational Implications: Capital vs. Labor-Intensive Maintenance

The major problem of applying capital-intensive methods to road maintenance is the low utilization and availability, and abuse, of equipment (para. 2.13). Typically, depreciation rates in Africa are several fold those in Europe and the United States. Depreciation is not, however, the major cost; low availability rates severely affect the productivity of maintenance units, resulting in increased costs per km, or a complete standstill of equipment units, which leads to further road deterioration. Essentially, the problems of maintaining a fleet of equipment are organizational and managerial, as well as financial, requiring more trained and experienced mechanics and supervisors, availability of spare parts, and replacement of aging equipment. If insufficient funds (including foreign exchange) are provided for spare parts, or import restrictions limit the supply of vital spares, a mechanical organization cannot perform its task no matter how good the management.

3.46 Possible alternatives for Zandya to overcome some of its problems with capital-intensive methods are (a) to request donors to finance spares over the life of the equipment they finance; (b) to procure equipment over several years rather than at one time, so that the whole fleet does not age at the same time; (c) to take on more technical assistance for the MD; and (d) to contract out maintenance of part of the fleet, which in many cases is no more expensive in economic terms than the cost of an underutilized equipment fleet.

3.47 A further alternative to be seriously considered is keeping the size of the equipment fleet at the level at which it can be maintained by MD or more significantly at present, at the level at which MO can adequately utilize the available equipment. This implies the use of more labor-intensive techniques. The LIFP has considerable experience of labor-intensive programs in Zandya, from which many lessons could be drawn for road maintenance. As well as routine maintenance, other activities such as regravelling could be done by a mix of simple equipment (tractor-trailer) and labor-intensive methods where the haul distances are short. Longer-haul distances could be contracted out to private tipper operators. The arguments against labor-intensive methods are low productivity, requiring intense supervision, and lower quality of work. The latter need not necessarily be the case, especially if simple equipment is provided (for example, rollers for compacting). Supervision for labor-intensive techniques differs from that required for capital-intensive techniques only in that the former requires more supervision on site whereas the latter requires more supervision in mechanical workshops.

3.48 In times of fuel, financial, or foreign exchange shortages, labor-intensive maintenance could proceed while capital-intensive maintenance would come to a standstill (as occurred in Malawi during the 1979 fuel crisis). In addition, the cost of poor-quality supervision is less for labor-intensive maintenance than for capital-intensive maintenance. In the former, only the cost of underutilized labor is incurred while in the latter, high costs are incurred by broken-down equipment (because of operator abuse or poor maintenance) and by idle equipment in need of repair and fuel. Labor-intensive maintenance also increases employment and decreases consumption of fuel.

3.49 The Integration of Development and Maintenance. One of the problems the maintenance organization faces is limited coordination between its activities and those of the Construction and Special Projects Branches; it is not uncommon for the MO to be unaware of proposed design standards for certain roads until after they have been decided and therefore have no say in the decision making process. Road construction programs are implemented in isolation from the maintenance organization. Foreign aid financed projects may therefore be putting more work on the maintenance organization than it can handle.

3.50 Although the Bank and other external agencies often consider that money has been poured into road maintenance with little lasting result, the same could be said of some aspects of road development programs. Consultant services and other technical assistance, plus equipment, are provided for building roads, yet once the roads are completed, little of the experience and organizational ability is left behind, and often the roads fail prematurely because of poor maintenance. Millions of dollars are spent on consultants to design and supervise road construction, yet there is often not the same readiness to fund such assistance for building up the long-term capacity of an

organization or the local contracting industry to maintain a multimillion-dollar road network. More could be obtained from road construction programs by incorporating road maintenance components into them. For instance, when feeder road programs are undertaken a more lasting effect could result if, at the same time, a maintenance capability for the roads constructed and for the existing classified network connecting to them were developed within the organization ultimately responsible for their maintenance. Even if the extra cost of the maintenance components meant building fewer roads, it could be economically worthwhile since maintenance has such high returns compared with development. Too often road improvement programs completely bypass existing government entities such as the maintenance organization; subsequently, once the roads are completed, there is little in the way of institutional development for maintaining them.

3.51 Administrative Environment

Zandya suffers from the usual "red tape" that characterizes many developing countries' bureaucracies, inhibits efficiency, and occupies qualified personnel's time. The procurement and tendering procedures have held up construction of buildings, the acquisition of vehicles and equipment by the MD and, most seriously, the repair of vehicles and equipment. Strict tendering limitations have meant that the acquisition of spares costing little money has had to be approved by the Ministerial Tender Board, and some major spares costing thousands of dollars have had to be approved by the Central Tender Board, which takes weeks. Contracts awarded for the supply of particular spares have eliminated the need to continually refer to a Tender Board for approval, but problems still occur when spares are not available from the contracted firms. According to government regulations, the purchasing officer must obtain documentary evidence that such spares are not available, but this is not easily obtained since no supplier wants to admit failure in adhering to the contract. The MD is gradually overcoming these problems, as well as the problem of a general shortage of spare parts in the country, by holding their own stocks of spares obtained in bulk -- but at considerable cost. Thus, they have attempted to bring within their control the problem of spare parts, but it remains to be seen just how difficult they find the management of a complex supplies system.

3.52 The administrative framework of the government in Zandya requires considerable overhauling to eliminate the need for agencies such as the maintenance organization to be hampered by excessive paper-pushing and by lengthy procurement and other processes. The trade-off between the introduction of regulations to prevent corruption or misappropriation, and the need to let government agencies operate efficiently is hardly ever made. Indeed, those who draw up the regulations are often far removed from such operational agencies as the maintenance organization and either have little knowledge of, or do not consider important, the effect regulations can have on the efficiency of operational organizations.

IV. CONCLUSION

4.01 The foregoing recommendations are alternatives that can be tried out by many African countries with assistance from external donors. They are predicated on the fact that experience has shown that traditional organizational approaches have not always worked in practice over the long run. The recommendations are not proposed as "solutions" but as a basis for pilot projects or studies to determine if they are appropriate for the set of conditions described in this paper. Different combinations can be tried out, but the effectiveness of any will depend on the resources available in the country and those provided by external agencies. Above all, the environment in which road maintenance is to be carried out has to be appreciated before the design stage of organizational development can take place. If the environmental constraints put on the development of road maintenance capacity are not understood and allowed for in organization design, then the subsequent effectiveness of the organization will be severely hampered. Hence, it is our hope that at least the method we have chosen to analyze the problems of road maintenance organization and management can be applied in many Sub-Saharan African countries.

Chart 1: ORGANIZATION OF THE MINISTRY OF TRANSPORT (MT) WITH RESPECT TO ROADS

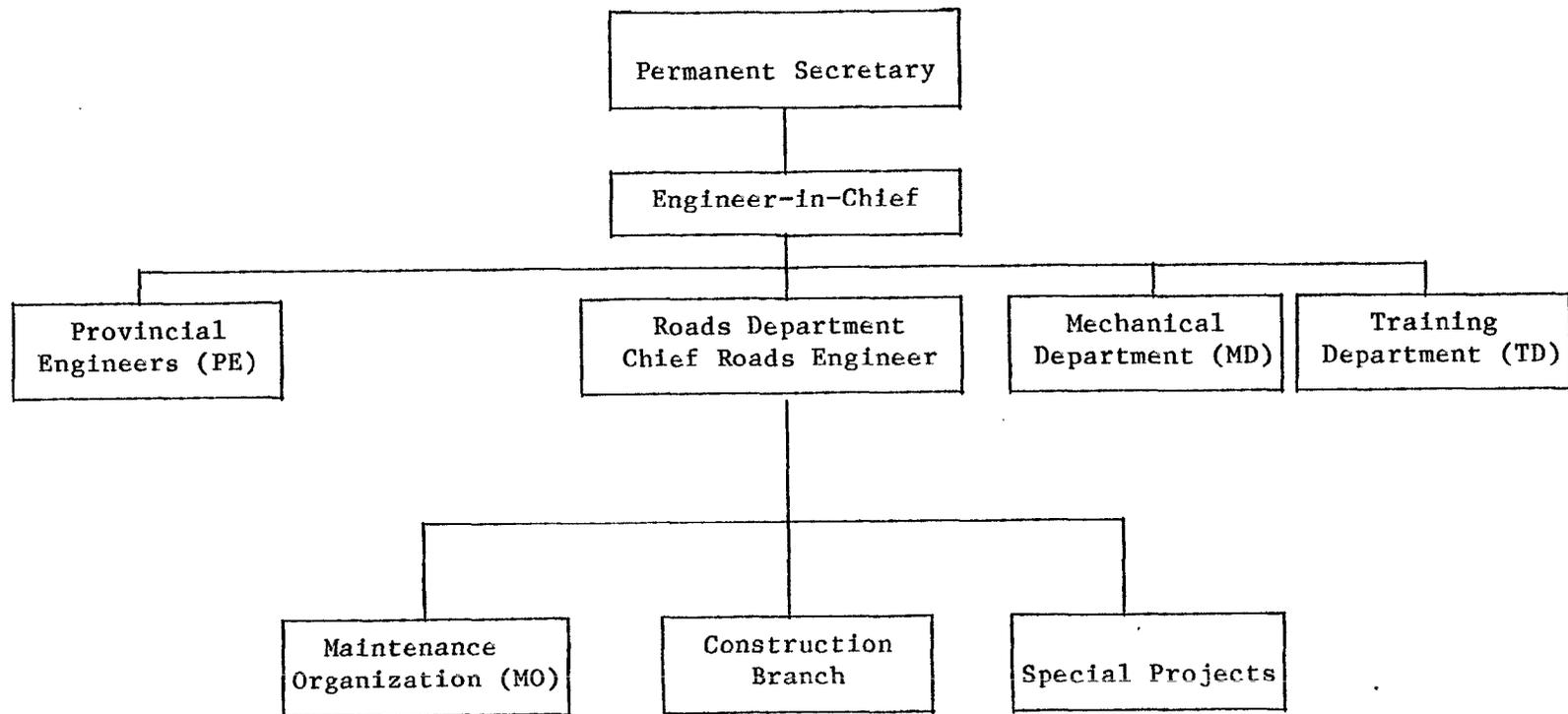
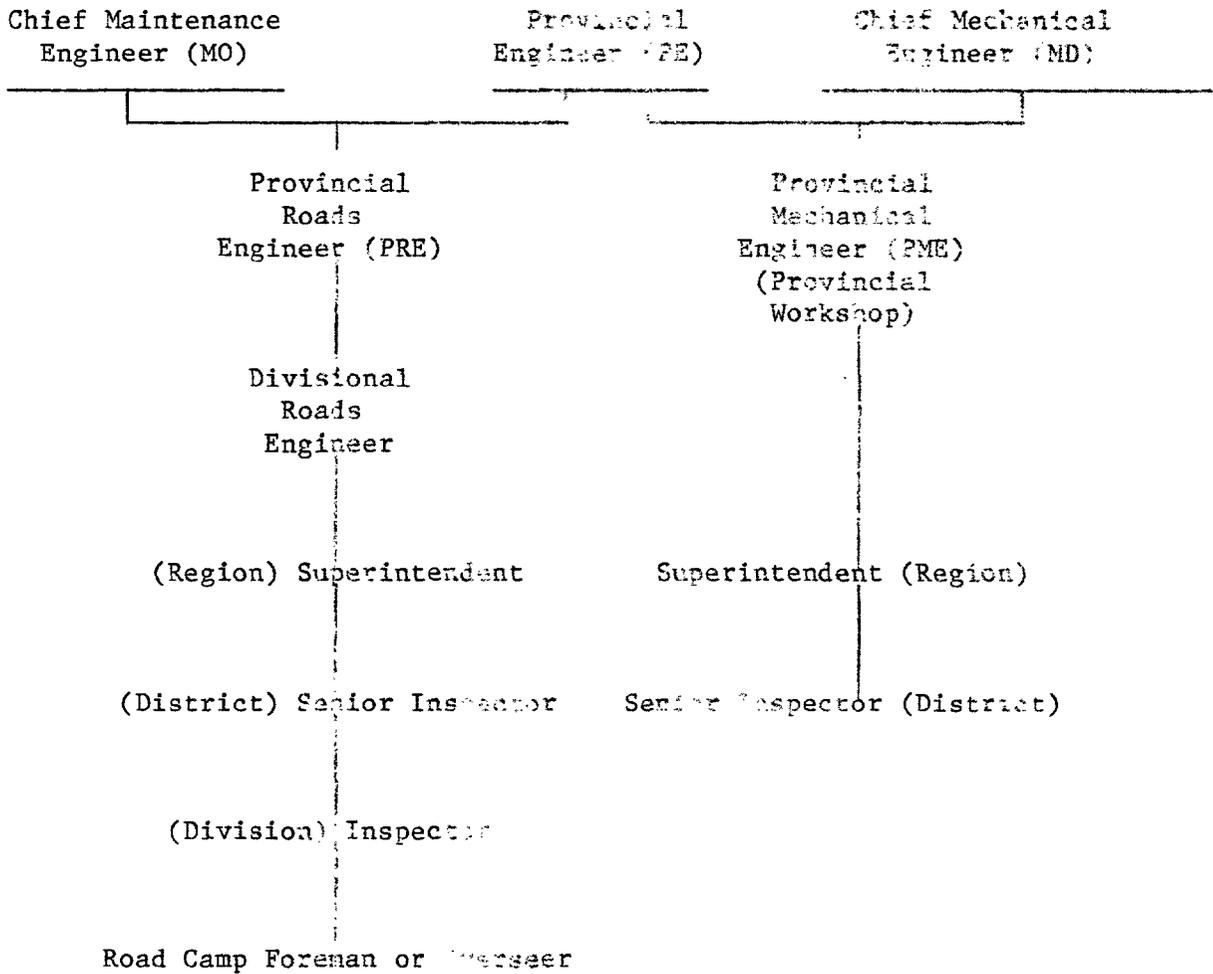


Chart 2: STRUCTURE OF THE MAINTENANCE AND MECHANICAL ORGANIZATIONS



ANALYTICAL FRAMEWORK FOR ORGANIZATION AND MANAGEMENT
OF DEVELOPMENT PROJECTS¹

1. Introduction

1.1 Design of development projects based on conventional organization theory results in organization structures and processes that often prove inadequate during the project implementation stage; and many of the difficulties currently labelled management problems, are in fact problems of organization design. A complementary/alternative conceptual orientation, which simultaneously addresses both internal and external organization and management issues, is needed. It is not enough to relate a project organization to its environment; instead, the organization must be capable to interactively (and adaptively) deal with other organizations and the environment itself. In development organizations, project success is determined not so much by the most logical or efficient arrangement of internal organization and resources, but by an appropriate co-alignment with external agencies (local, provincial and national government agencies; input suppliers; output users; and -- most of all -- project beneficiaries).

2. Understanding the project environment and organizing it to benefit the project.

2.1 Before designing the organization, it is necessary to identify and understand the environment in which the project will operate. The environment is not "everything out there"; there is a level between the organization and the "uncontrolled" environment which is external to the organization but can be influenced by the project's management. Therefore, project designers and managers should be concerned with three levels of environment: (a) internal or "controlled" environment enclosing the elements directly needed for productive activities, and defining the organization's boundaries; (b) transactional or "influenceable" environment consisting of external entities whose activities can influence organizational and management performance; and which in turn can, and should, be under the mutual influence of the focal project organization; and (c) the contextual or "appreciated" environment, comprised of institutions (social, economic, political, technological and cultural), that produce activities affecting organizational performance; and that can neither be controlled nor influenced by its management, but must be understood and valued instead.

1/ For details see World Bank Staff Working Paper No. 375, op. cit. This summary note was prepared at the request of F. Hotes, Irrigation Adviser, World Bank, by Pammi Sachdeva and William E. Smith, The Wharton School, University of Pennsylvania, Summer 1980.

2.2 It is never possible to completely specify the elements of the appreciated and influenceable environments in advance of project or organization design; the very act of design and implementation uncovers new sources of influence and adds to knowledge of these environments. Also, for any project, the relative importance of each environment differs. In single sector, physical-infrastructure projects (building a dam or a major highway), the relative importance of the controlled environment would be high; for projects with a broader orientation (managing large irrigation systems concerned with equitable distribution and productive use of water, maintaining a large network of feeder roads), the activities under control are relatively fewer. In addition, as a project evolves through design, construction and operational phases, it is achieving certain results. These very results obtained alter the pre-existing patterns of control, influence, and appreciation. Hence, there is a need for an organization design that is sufficiently flexible for adaptation to environments that are likely to change.

2.3 In sum, the first dimension of our conceptual framework is a more precise definition of the organization in relation to its environment. The key insight is the addition of the "influenceable environment". The implications for projects' management are profound. The management role can no longer be seen as primarily inward looking. The manager must focus not only on those internal elements subject to his control, but equally -- and often even more -- on those external elements of the environment that are subject to his influence and that he has to appreciate.

3. Building an organization based on participants' commitment towards its purposes.

3.1 The second link in our conceptual framework is based on the fact that this relationship between the organization and its environment has a purpose/political (or power) base. Organizations are instruments for bringing together people who see their involvement as a means of achieving their purpose. Participation is always partial (the organization satisfies only part of the individuals' total purpose), and conditional (on the organization being able to continue to supply the inducements necessary to the participants' continued contribution). Therefore, it is impossible to design a project unless we clearly map out its, and its potential members'/beneficiaries' purpose. The key steps in this essential political process of organizing are:

- (a) the establishment of a purpose, which gives direction for the exercise of power;
- (b) the development of an appreciation, i.e., an understanding and valuing, of the opportunities and risks in moving in the selected direction;

- (c) the development of a network of influence, i.e., joining with others whose own purposes suggest the possibility of mutual transactions that will aid in the achievement of the selected purpose; and
- (d) the choice of actions and resources that can be controlled to achieve the purpose.

3.2 Each of these steps represents an increase in the degree of power (from appreciation, to influence, to control). The art of designing development projects is that of devising a network of purpose and influence among organizations and individuals that will ultimately lead to a set of controlled activities producing the desired outputs. The power process is important at all levels -- national, provincial, organizational and individual; and must be recognized as such. Project designers should explicitly take into account the fact that the career-seeking motivation of bureaucrats' behaviour is designed to increase their own visibility rather than project performance. Similarly, political maneuverings are based on personal desires, motivations, and perceptions and should not be excluded from the formal design effort because they are somehow "irrational".

3.3 The practical implication of this viewpoint is that purpose, power and politics are recognized as crucial design variables, rather than as "undue interference". The process of development, defined as "the beneficiary increasing his control and influence over, and his appreciation of, his environment", itself has a political dimension. The project designer and manager can succeed only if he is able to appreciate the "political" field as it relates to the project, and can actively harness it for the purposes of the project, its various stakeholder groups, and individual beneficiaries.

3.4 The problem of structural design, is therefore, one of linking the purposes of the power centers in a way that will ensure progress towards their consensus of objectives. Mechanisms have to be developed for controlling (where feasible) and coordinating both the internal and external component parts. Control can be generally exercised along the organization's vertical dimension, and here means that one level/agency can cause another to do what it wants. However, though there are degrees of control, some activities, especially those between agencies (along the lateral/horizontal dimension), cannot be controlled. These activities must then be influenced through various coordination mechanisms, ranging from ad hoc meetings (a weak mechanism), or committee membership (of moderate strength), to participating in matrix structures with dual reporting relationships (a strong mechanism).

3.5 While the mix of control and coordination mechanisms necessary and/or feasible varies from project to project, some general guidelines can tentatively, be formulated for development projects:

- (a) at least moderate power is required at all levels of the development organization;
- (b) relatively strong patterns of control and coordination are required at local level;
- (c) a balanced relationship is needed between the strength of coordination and control at the same level; and
- (d) the most promising area for organizational design improvements is the use of more and improved coordination mechanisms.

4. Designing appropriate learning mechanisms: time as a design dimension.

4.1 It should be noted, however, that the crucial organizational requirement is not just the "right" mix of mechanisms and processes, but the ability to modify its environment(s), and to adapt and change as necessary. The required learning-cum-evaluation system for self-diagnosis and correction depends on the flow of information between levels. This flow is governed by the design of the control and coordination system, which itself is conditioned by the distribution of power. Each level of a civil development system, for instance, or a highway organization has a distinct contribution to make in this process, and has a distinct criterion for its performance (national - legitimacy; intermediate - effectiveness; local - efficiency). Project evaluation, therefore, requires that the organization trace its decisions upwards through its levels of planning and structure to its purpose and its relationship to its environment. Anticipated consequences include problems of design or strategy and are due to variables in the "influenceable" or "unappreciated" environment.

4.2 This implies that organizational learning should be a continuous process. It depends on effective management of information flows within the organization and in exchange with its environment, and is thus, an integral part of the organization design. In such a learning system, no level exercises strict hierarchical control over any other -- each level is closer to influencing the other -- and the process is more one of coordination between semi-autonomous levels. It is a political process of confrontation, negotiation, and compromise; so that the organization can make constant small, adaptive changes rather than being forced to undertake massive disruptive ones.

4.3 This introduces our third major dimension to the analytical framework: Time. The dilemma for designers is the problem of balancing the long-term needs which tend to be heavily weighted toward social and organizational institution-building, with the short-term needs for launching a productive activity and building a physical infrastructure.

In addition, as we have seen above, a dynamic, adaptive approach to organization and management of project activities is needed. While there might be "appropriate" structures and processes for the project at different stages/phases of its development, this structure is continuously evolving out of the existing situation, so that the design of project organization is continuously linked to the ongoing flow of external events.

4.4 Consequently, while continuity of policies and procedures may be desirable from a project point of view, it is not realistic to assume that the environment will remain constant. In reality, the process of change and adjustment to change is likely to affect any project during its implementation. The emphasis on internal logic of design leads to a belief that events are subject to greater control than they really are. As a result, project organizations tend to be overdesigned or, more accurately, overspecified; errors of design tend to be diagnosed as problems of management or implementation; and learning takes place primarily between phases of the project rather than within the project itself. This cannot but lead to lack of success in meeting the major project objectives of achieving not only physical input and output, but also developmental effect and impact.