FA3: Preserving Africa's Roads Assets

(STEMMING THE DEGRADATION)

BACK TO THE FUTURE?

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SYNOPSIS

This Focus Area firstly asks "*How can the seemingly inexorable degradation of a key infrastructure asset be stemmed to minimise agency and road user costs?"*

The availability of appropriate maintenance is implicit in the construction of any costly infrastructure asset. Too often the proponents of road construction ignore that fact. The economic analyses of planned road upgrading works invariably include a notional regime for Routine and Periodic maintenance interventions without considering whether such regimes are either practicable or affordable. The only concern is to justify the intended construction, and the specification of a 20-year Design Life lulls all concerned into believing that maintenance will be nice to have but not essential. In that they are seriously mistaken.

Having used mechanised methods to construct a road a road authority is conventionally committed to using mechanised methods for their maintenance. Such methods are expensive and of necessity require a significant minimum expenditure if the high cost of establishing heavy plant on site is to be adequately covered.

Plant yards at regional roads depots in Africa are invariably littered with defunct machinery that often appears to be easily repairable if the funds were available for spares and their fitment. Consequently, investing in in-house maintenance teams does not seem to provide a sustainable solution. Contracting out the necessary work offers a better solution and the OPRC form of contract has many advantages.

To address current problems therefore the OPRC methodology is suggested as offering the most viable option for 'stemming the degradation', for reasons that are explained in this paper.

1. INTRODUCTION

The availability of appropriate maintenance is implicit in the construction of any costly infrastructure asset. Too often the proponents of road construction ignore that fact. The economic analyses of planned road upgrading works invariably include a notional regime for Routine and Periodic maintenance interventions without considering whether such regimes are either practicable or affordable, or whether there is any likelihood of them being carried out. The only concern is to justify the intended construction, and the specification of a 20-year Design Life lulls all concerned into believing that maintenance will be nice to have but not essential. In that they are seriously mistaken.

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2. HISTORICAL PRECEDENT

The title of this paper – "Back To The Future?" - may seem cryptic, but it simply suggests that methods used in the past but now out of fashion may be part of the solution to maintaining Africa's road networks.

A large part of the Belgian Congo (now DR Congo) is covered by rain forests. Maintaining gravel roads in those wet conditions was problematic, but maintenance was essential if access to all parts of the colony was to be assured. Consequently, the Belgians adopted a system of piecemeal maintenance by local inhabitants. Each road was divided into short sections and a local resident was appointed to keep each section in a passable condition. The District Maintenance Engineer would then make a monthly inspection and if a road section met with the specified requirements the agreed fee for the work done was paid; if not, no pay.

This very simple approach to maintaining accessibility might therefore be considered the forerunner of today's Operation and Performance-based Roads Contract (OPRC). It also demonstrates that all types and classes of road can be maintained using variations in the scope, sophistication and standards of the OPRC contracts.

3. DISCUSSION OF THE OPRC OPTION

3.1 Objective of OPRC

The objective of **Output and Performance-based Road Contracts** is to increase the efficiency and effectiveness of road asset management and maintenance. It is aimed at ensuring that the physical condition of a road under contract is always adequate for the

needs and safety of road users over the entire period of the contract, which is normally several years. This type of contract significantly expands the role of the private sector from the simple execution of works to the management and conservation of road assets.

Minimum acceptable road conditions and Service Levels are defined through output and performance criteria, and these are used under the OPRC to define and measure the desired performance of the Contractor. In the OPRC, the defined performance measures are thus the accepted minimum thresholds for the quality levels of the road for which the Contractor is responsible. These thresholds ought to be the same as those that an 'in-house' maintenance division would be expected to achieve, the main difference being that the Employer is contractually committed to paying for the work to be done and cannot arbitrarily reduce payment, as is the case if the 'in-house' division's budget is cut.

3.2 Shortcomings of Traditional Contract Forms

In **Conventional Contracts** and in **Unit Rate/ Framework Contracts** for road maintenance, the Contractor is responsible for the execution of works that normally are defined by the Employer, and he is paid on the basis of unit prices for different work items, i.e. the contract is based on "inputs" to the works. The results of these traditional contracts are frequently less than optimal. The problem is that the Contractor has the wrong incentive, which is to carry out the maximum quantity of work to the lowest permissible standard and thereby maximise its turnover and profit.

Even if the work is carried out according to plan and specification the overall service quality for the road user depends on the quality of the design given to the Contractor, who is not accountable for it. In many cases the roads do not last as long as they should because of deficiencies in the original design or specifications, aggravated by inadequate construction and maintenance. In the UK, an asphalting contractor won an airport resurfacing contract in which the tolerance on the overlay was given as ±5mm. He laid the whole overlay to -5mm and made a big profit - his work complied with the specifications, so he had to be paid. The specification was at fault, not the contractor.

3.3 The OPRC Model

The OPRC as a model for road asset management is similar to the Design, Build, Maintain, Operate and Transfer (DBMOT) model of building contract, which addresses the issue of inadequate incentives. During the bidding process, contractors compete against each other by essentially proposing fixed lump sum prices for bringing the road up to a certain Service Level and then maintaining it at that level for a relatively long period. It is important to understand that the Contractor is not paid directly for "inputs" or physical works (which it will undoubtedly have to carry out), but for achieving specified "outputs" or Service Levels, i.e. the construction or rehabilitation of the road to pre-defined standards, followed by the maintenance of certain minimum Service Levels on the road throughout the currency of the contract, all defined by outcomes expressed in the Service Level criteria. The construction of specific improvements at certain times during the currency of the contract might also be included.

A fundamental feature of the OPRC is that the "Contractor" need not necessarily be a traditional works contractor, but can be any type of firm or business venture (a "Contracting Entity", rather) having the necessary technical, managerial and financial capacity to fulfil the contract. The definition of the exact nature of the works, their timing, their costing and their implementation is left to the judgment of the Contractor. This means that his capacity must

exceed the usual capacity of a traditional civil works contractor. In fact, an essential attribute is the ability to manage roads, whilst the actual physical execution of work may either be carried out by the Contractor himself or by different specialised firms taking part in a Joint Venture with the main contractor, or under sub-contracts. Joint Ventures might include consulting firms and small, medium or micro enterprises. This provides the opportunity for local enterprises to become involved, and contribute, *inter alia*, their appreciation and understanding of national, cultural, language and social implications to the project.

The use of specialised private firms under OPRC should realise significantly improved efficiency and stimulate innovation in comparison with traditional road management practices.

The OPRC form of contract transfers a significant burden of risk onto the Contractor. It is important that this burden is both equitable and within the capacity of the industry. The contract must define the risk profile carried by the Contractor arising from abnormal storm events, changes in legislation, changes in traffic volumes, regional development and the like.

In any case, the Contractor is responsible for designing and carrying out the works, services and actions he believes are necessary to achieve and maintain the Service Levels stated in the contract. The Service Levels are defined from a road user's perspective and from a pavement strength point of view. They will include such factors as average travel speeds, riding comfort, safety features and residual strength of the pavement. If the Service Level is not achieved in any given month the payment for that month may be reduced or even withheld.

Under the OPRC model, the Contractor has a strong financial incentive to be both efficient and effective whenever he undertakes work. To maximise his profit he must reduce his activities to the minimum possible number of well-designed interventions, which nevertheless ensure that the pre-defined indicators of Service Level are achieved and maintained over time. This type of contract makes it necessary for the Contractor to have a strong management capability. In this context, "management" means the capability to define, optimise and timeously carry out the physical interventions that are needed in the short, medium and long term, to guarantee that the condition of the road always remains above the specified Service Levels. In other words, within the contract limitations and those required to comply with local legislation, technical and performance specifications, the Contractor is entitled to independently define (within the limits indicated in the schedule of payment):

- what to do;
- where to do it;
- how to do it; and
- when to do it.

Under the terms of the contract, the Contractor will be responsible for the continuous monitoring and control of road conditions and Service Levels. This will not only be necessary to fulfil the contract requirements, but is an activity that will provide him with the information needed to be able to:

- know the degree of his compliance with Service Level requirements; and
- define and plan timely physical interventions needed to ensure that Service Level indicators never fall below the specified thresholds.

Under the OPRC model, the Contractor will not receive instructions from the Employer concerning the type and volume of works to be carried out. Instead, all initiative rests with the Contractor, who must do whatever is necessary to achieve the quality levels required.

The role of the Employer is to verify compliance with the agreed Service Levels and with all applicable legislation and regulations. In this it would normally be assisted by a Monitoring Consultant.

3.4 Payments

The fixed lump sum monthly payment tendered by the Contractor covers all physical and non-physical services to be provided by the Contractor, except for unforeseen emergency works, which are paid for separately. To be entitled to those payments, the Contractor must ensure that the road under contract complies with the Service Levels that have been specified in the bidding documents. It is possible that in some months he will have to carry out significantly more (or less) work than in an average month to ensure that the Service Levels are met. However, his periodic payment for those months will remain the same (provided the Service Levels are met).

Together with each periodic payment claim, the Contractor is required to submit a Periodic Payment Report setting out his own evaluation of his compliance with the Service Levels. His evaluation will then be verified by the Employer (or his Monitoring Consultant) by inspections. If the Service Level is found not to have been met for any aspect the payment for that aspect is reduced according to a schedule given in the contract. Payments may even be withheld and/or the contract cancelled if the Contractor fails during an extended period to achieve certain minimum threshold values for Service Levels. The contract will define the formulae to be used to calculate payment reductions and the criteria applying to potential contract cancellation.

Under the OPRC model, the incidence of claims should be significantly reduced. For example, the Contractor cannot claim to have been delayed by the late issue of construction drawings since the design and preparation of drawings is his own responsibility. He cannot be delayed whilst awaiting the Employer's instructions because the Employer will not be required to take any decisions or issue any instructions. The onus is on the Contractor to identify and resolve problems as they arise. The Employer's only interest is in whether or not the solutions the Contractor chooses to adopt succeed in maintaining the specified Service Levels. Conversely, with no specific completion dates during the currency of the contract the Contractor cannot be penalised for late completion of interim interventions. He can only be penalised for failing to meet the required Service Levels.

3.5 Performance Criteria

Maintaining a road includes both routine and periodic tasks. Intelligent management, the timeliness of interventions and the adequacy of technical solutions are critical to the success of the maintenance activities.

Performance Criteria should ideally cover all aspects of the contract and take account of the fact that different sections of the overall contract area may require different Service Levels. Performance Criteria can be defined at three levels (although simpler contracts will not use all of the criteria identified below).

(a) Road User Service and Comfort Criteria can be expressed in terms of:

- Road Roughness;
- Road and lane widths;
- Rutting;
- Skid resistance;
- Vegetation control;
- Visibility and legibility of road signs and markings;
- Availability of each lane-kilometre for use by traffic;
- Response times to rectify defects that compromise the safety of road users;
- Attendance at road accidents;
- Drainage of the road surface, standing water being a hazard to road users.

(b) Road Durability Criteria can be expressed in terms of:

- Longitudinal profile;
- Pavement strength;
- The permissible extent of repairs before a periodic maintenance intervention is required;
- The degree of sedimentation in drainage structures; and
- Drainage of the road surface, standing water in this respect being a threat to the integrity of the road pavement.

(c) Management Performance Criteria that define the information the Employer requires both to govern the asset and to facilitate the next round of tenders should include:

- Delivery of regular activity and progress reports to the Employer;
- Inventory updates and other data sharing requirements; and
- Maintenance history and As Built records, for the benefit of future tenderers for the continuation of the work.

All performance measures must be clearly and unambiguously defined and objectively measurable. Together, the performance criteria define the minimum acceptable Service Level for each aspect of a particular road. In setting the measures, various criteria (both technical and practical) need to be carefully considered. These include:

- Traffic volumes and composition;
- Urban versus rural environments;
- Flat, rolling or mountainous terrain;
- Subgrade type and strength;
- Quality of available construction materials;
- Capacity of available contractors;
- Environmental constraints, such as protected areas, national parks, graves, cultural heritage sites and forest reserves.

However, probably the most important criterion is the question of what Service Level can be afforded and economically justified for the road in question.

3.6 Preparatory Work

Although the design of the works and services to be carried out is the responsibility of the Contractor, this type of procurement still requires good preparatory engineering work. Comprehensive information on the actual condition of the road must be provided to bidders. When rehabilitation works are required, the Employer should define the level of quality (or standard) to be achieved by the Contractor for delivery and completion during the contract.

If rehabilitation and/or improvement works are not specifically required by the bidding documents, it would often still be necessary for the Contractor to carry out some initial rehabilitation and improvement works of its own choosing, followed by routine maintenance and, later, periodic maintenance. The definition of the exact nature of the works, their timing, their costing and their implementation is left to the judgment of the Contractor. In the specification of the qualification requirements the Employer should consider whether the experience of specialist sub-contractors (such as an engineering consultant) should be added to those of the main applicant. The activities that may be delegated by the main contractor to sub-contractors that did not participate in a prequalification process should be listed in the Particular Conditions and bidders should be alerted to these requirements in the Bid Data Sheet.

Emergency works, although impossible to quantify in advance should always be anticipated. They are needed to repair unexpected damage caused by extraordinary natural phenomena or operational damage, and which affect the safety and security of road users. To allow bidders to offer prices for Emergency Works, a unit price Bill of Quantities with indicative quantities should be prepared for bidders to price for bid evaluation purposes. When emergency works are needed these unit prices together with the actual quantities of work done will be used to calculate payments. The contract should limit the responsibility of the Contractor and establish that the Employer will approve the execution of services and additional remuneration based on specific amounts proposed by the Contractor in each case. A Provisional Sum is normally provided to cover the cost of emergency works.

3.7 Perceived Benefits

All participants in the OPRC concept will be beneficiaries - the Employer, the road users and the contractors and other private sector enterprises employed. The Employer will obtain better overall road conditions for the same level of expenditure. Road users will be able to know what Service Level they can expect in return for the direct or indirect payments they make for the use of the infrastructure. For contractors and other private sector enterprises, the OPRC type of contract opens up new business opportunities, in which longer contract periods provide a more stable business environment, through the establishment of true Public-Private partnership relationships.

However it will perhaps be future generations that will benefit most, since they will not have to pay for the reconstruction of roads destroyed in the event of a failure by today's politicians to provide adequately for the maintenance of the road network that is currently under construction.

4 RELEVANCE TO AFRICAN ROADS

Most African nations currently have under-developed road networks and inadequate institutional infrastructure to manage and maintain them. These are considered to be ideal conditions for the introduction of the OPRC model for design, construction and maintenance of the developing network.

On the design side, the standard of road design that passes as adequate throughout Africa, with the exception of southern Africa, is abysmally low, causing road construction and maintenance to be unnecessarily costly. Some roads authorities are beginning to realise that the low-cost design consultancies that Funding Agencies insist on are costing them dearly in increased construction and maintenance costs. That situation is preventable.

The adoption of the OPRC concept for design as well as for construction and maintenance would help to resolve the problem of poor design. Contractors will be keener to employ competent design engineers if they know that they will have to live with and maintain their products for 8 or 10 years.

There are other potential benefits. For example, under OPRC it would be possible to address the uncertainty that commonly exists in predicting the necessary strength of a road pavement over a 20-year design period by phasing the construction, with a light pavement being built initially and a strengthening overlay being added when it becomes justified by the actual traffic that materialises. That would undoubtedly provide a more economical solution and a better end result.

With currently limited institutional structures, nothing needs to be 'dismantled' to make way for maintenance by an OPRC contractor - there are no maintenance teams that would be left standing idle. The maintenance of new roads would be contracted at the same time as their design and construction, so the Service Level of the road would be assured for several years following its construction. In-house maintenance capabilities would not need to be established and personnel would not need to be recruited and trained to assume responsibility for each new road. Thus the current problem of the shortage of trained and experienced personnel would also be resolved. A Road Authority would need only limited Head Office and Regional capabilities to manage the whole process.

The adoption of OPRC would also allow flexibility in the funding of the road network development. During the initial development stage, international loans could be raised that would not only cover the design and construction but also the medium-term maintenance needs. As the network develops, contributions from increased traffic volumes to a dedicated Road Fund would increase, allowing the long-term maintenance to be funded internally.

Consequently, it is suggested that African road authorities should undertake in-depth evaluations of the practicalities of adopting the OPRC model as the basis for their maintenance strategy for bitumen surfaced roads.

Whichever maintenance options are selected, it is suggested that any road authority should obtain, maintain and keep calibrated the equipment that will be needed to assess road pavements, such as a Falling Weight Deflectometer and equipment for measuring IRI, surface profile and skid resistance. The cost of such equipment can be covered by renting it out to companies contracted to do road design and construction.

5. SUMMARY

From the above considerations it may be deduced that the OPRC type of contract can be tailored to meet specific needs, from the very simplest maintenance operations carried out by local individuals to the high-tech design, construction and maintenance of major road links. Consequently, if offers a very viable answer to the question "*How can the seemingly inexorable degradation of a key infrastructure asset be stemmed to minimise agency and road user costs?"*