Regional Seminar for Labour-Based Practitioners
In The Road Sector in Sub-Saharan Africa

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Labour-based Technology -
A Review of Current Practice

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Labour-based Contracting

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1 POLICY, RESEARCH AND DEVELOPMENT
1.1 A study of labour–based contracting commissioned by the ILO

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1.0 INTRODUCTION

Many African countries have a pre-independence experience of the use of labour–based methods especially for routine maintenance and minor rehabilitation works. The technical ministries/departments operated through direct labour (force account) systems. However, the immediate post-independence era, from 1960, introduced the use of heavy equipment for road maintenance works. Up to the early 1970's the heavy (imported) equipment produced satisfactory results, and the small networks of roads were well maintained.

However, the need to either upgrade or expand the existing road networks using (imported) heavy equipment against the backdrop of the oil glut of the mid 1970's created serious problems for the fragile economies of several countries on the African continent. Many African governments resorted to seeking donor-support to fund the increased volume of work on roads. Unfortunately, however, donors were more sympathetic to major reconstruction and rehabilitation works. The result was that even though more roads were added to the maintainable network, routine and recurrent maintenance were neglected.

An attempt to solve the routine maintenance problem was the initiation of the Kenya Rural Access Roads Programme in the mid 1970's. This involved the use of labour based methods by the Ministry of Public Works direct labour (force account) for rural roads maintenance.

In the past, the reconstruction, improvement and periodic maintenance of roads have been undertaken by equipment-based contractors; routine and recurrent maintenance, was however undertaken by Government departments through direct labour (force account) equipment-intensive operations. Most of the major road works have been undertaken by large international contractors with very little involvement of the local contractors.

Inadequate Government budgetary allocations for direct labour routine and recurrent maintenance works have also contributed significantly to the lack of maintenance of roads. It is evident that Governments are more willing to pay for contracts than direct labour works which, obviously, show a lot of wastage of resources. The World Bank, recognising the effectiveness of the labour–based approach to maintenance, especially by contract, included it in its Road Maintenance Initiative (RMI) in the Sub-Saharan Africa Transport

Programme (SSATP). Thereafter the Bank sponsored the labour-based contractor development programme as the feeder road component of the 4th Highway Project for Ghana.

The move towards the privatisation of road maintenance works is further strengthened by the various Structural Adjustment Programmes which require Governments to drastically reduce the number of civil servants (called re-employment in Ghana). The staff reduction/retrenchment/re-deployment has affected the technical departments as well; hence direct labour works have suffered.

It is, therefore, no wonder that after Ghana's experience, several other donor-supported labour-based contracting projects have sprung up in Africa. With the exception of South Africa, the projects have been on rural roads. In South Africa, in addition to roads (municipal and rural), labour-based contracting has been applied to buildings, water supply (reticulation) schemes and power supply.

Even though there are similarities in the application of labour-based contracting methods, it is evident that there are still many differences which could be resolved if there were good co-ordination of the various practices, possibly through the issue of a set of guidelines. The ILO has initiated action in this direction by:

- collecting data on country experiences, (April-May 1995)
- promoting a workshop to prepare an outline for a set of guidelines (Nov-Dec 1995), to be followed by,
- the production of a set of guidelines.

It is hoped that the outcome of this seminar will assist in improving the contents of the Guidelines.

2.0 COUNTRY EXPERIENCES

2.1 Introduction

Since the mid 1980's, the International Labour Organisation (ILO) has carried out country-specific projects to develop a private sector capacity for labour-based works. The experiences on the projects identified the following as some of the problems which impede the establishment of a viable and sustainable contracting system:

a) contractors' lack of financial management;

b) inadequate client systems to ensure transparent contract award, timely payment and adequate monitoring and control, and

c) procedural issues relating to:

   i. comprehensible project documentation;

   ii. contractors access to equipment and tools, and
the client’s capacity for the administration and supervision of contract.

The solution to the above problems lies in the availability of realistic guidelines for the planning and implementation of small-scale contractor systems. To achieve this, the ILO is sponsoring a three-phased study to collect and collate data from existing projects and produce Guidelines for project formulation and implementation. The first two phases of the study, i.e.

a) data collection and collation, and

b) workshop to draft an outline of the Guidelines

have been completed.

This paper reports on:

a) some of the observations made in Phase I of the study which covered projects in Ghana, Kenya, Uganda, Lesotho, South Africa and Tanzania, and

b) the outcome of the ILO-MART Workshop (phase II)

2.2 General observations

The following general observations were made during the study:

a) the environment for the application of labour-based technology varies from country to country. These differences must be appreciated and understood in project design and implementation. The wholesale replication of the experience of one country in another is therefore not recommended;

b) except in South Africa where the experience has been in urban infrastructure (roads, water and electricity) and buildings, the experience in all the other African countries has been on rural roadworks with governments as the employer. There are, however, some similarities in principle between the method applied in South Africa and that of the other countries, especially Ghana and

c) irrespective of their country, small scale contractors have very similar needs, expectations and potential to develop. Educational background does not make any difference: business acumen is the main requirement for success.

2.3 Ghana Labour-based Feeder Roads Programme

2.3.1 Background

The Ghana labour-based feeder roads programme was started in July 1986 as a component of the Fourth Highway Project under the sponsorship of the International Development Association (IDA). The following were the objectives of the programme:
a) to improve accessibility to rural areas through the large scale application of a cost-saving approach to feeder (rural) road construction, improvement and maintenance, using local resources;

b) to create a capacity within the Department of Feeder Roads (DFR) to manage labour-based contractors;

c) to create the capacity for private contracting firms to efficiently apply labour-based methods to road construction, improvement and maintenance, and

(a) to generate rural employment opportunities.

In order to achieve the above objectives:

a) DFR and contractors' supervisory staff were trained in the application of labour-based technology for the rehabilitation and regravelling of gravel-surfaced roads;

b) each contractor was provided with light equipment and assorted hand tools estimated at US $150,000;

c) each trained contractor was assured of contracts for the first 48 months after training, i.e. the equipment loan repayment period, and

d) in order to facilitate the design and supervision of works, DFR was provided with technical and logistic support.

2.3.2 Training

The following selection procedure is followed:

a) In the beginning (1987 and 1988), newspaper advertisements were put out for applicants. Thereafter, the practice was discontinued due to the large number of applications;

b) the applicant receives an application form and returns it after responding to the questionnaire.

c) the application is then evaluated against set criteria.

The labour-based training started in April 1987. A common training programme was run for the DFR and the contractors, each of whom sponsor four (4) supervisors. It lasted for about eighteen (18) weeks. The initial training covered the rehabilitation and regravelling of gravel surfaced rural roads. However, in 1993, a short, 3-week training programme, specifically designed for routine and recurrent road maintenance works, was introduced. The contractors who were trained earlier were invited to avail themselves of the opportunity for routine maintenance training. By February 1995, the programme had trained eighty one (81) contracting firms for roads rehabilitation and regravelling. Six (6) of the firms are owned and managed by women.
2.3.3 Contractor Profiles

The selected firms were generally small companies engaged in such businesses as trading, farming, the running of small restaurants, and small building and civil engineering contracting. Fifty-five percent (55%) of the Managing Directors have basic education, about ten percent (10%) each are civil engineers and other graduates, with the rest being technicians.

The selection of firms was based on a few years of demonstrated competence in some construction works and a registered office in the project area. After training, most contractors have performed very well, though a few have done badly. The payback rate for the loan has been slower than excepted, though repayment is in progress.

2.3.4 Arrangements For Contractor Support

Tools and equipment are advanced to each trained contractor as a loan which is administered by a Bank. The loan is repayable within forty eight (48) months.

Each trained and equipped contractor is awarded a contract of about US $240,000 each year, for the loan repayment period. The contract may be for either rehabilitation/regravelling or a combination of rehabilitation/regravelling and routine/recurrent maintenance works.

By March 1995, approximately 1300km of rural roads had been rehabilitated at an estimated cost of US $12,000 per kilometre. That created 3.5 million mandays of employment. About thirty percent (30%) of the labour force were women.

Funding for tools and equipment has been provided by the International Development Agency (IDA of the World Bank), Danish International Development Association (DANIDA), United States Agency for International Development (USAID) and the Government of Ghana (GOG). Technical assistance has been provided by the ILO with funding by the United Nations Development Programme (UNDP). The civil works contracts have been funded by DANIDA, USAID and GOG.

2.3.5 Contract Documentation and Administration

FIDIC conditions of contract (3rd Edition) with provision for formula (automatic) price adjustment and some adaptations for labour-based works are used.

As a policy, the DFR awards contract to each trained labour-based contractor until he fully repays the equipment loan. This policy, however, is in conflict with the principles of competitive tendering. Two (2) previous attempts to introduce competitive tendering failed due to the operation of cartels. The current system is that the DFR develops schedules of rates and negotiates them with the Labour-based Contractors Association. Serious consideration is however
being given to organising competitive tendering for those contractors who have fully repaid the equipment loan.

Contract documents are generally prepared in house by DFR staff, since there are few or no competent local consultants for the technology.

The Employer is the Ministry of Roads and Highways, the Engineer is the Director of Feeder Roads and the DFR Regional Engineer is the Engineer's Representative. Contracts are awarded by the Regional Tender Boards.

2.4 The Kenya Contractor Training Project

2.4.1 Background

The Minor Roads Programme (MRP) of the Ministry of Public Works and Housing of Kenya which was started in 1987 succeeded the Rural Access Roads Programme (RARP) of 1974. By 1995, both programmes had constructed/rehabilitated/maintained about 11,000km of roads by labour-based methods using force account (direct labour). Contractors were, however, engaged to haul gravel over long distances.

Drawing on the successful experience gained in the force account with (haulage) subcontract arrangement, the MRP decided to promote labour-based contracting with the following objectives:

(a) to generate more rural employment;
(b) to promote the growth of small scale local contractors who would compete for future contracts;
(c) to bring the skills and experience developed in labour-based techniques by the MRP into the private sector and
(d) to counteract the shortage of appropriately equipped contractors for road gravelling which had led to a lack of competition and high contract rates.

In 1991, the MRP received funding from the Swedish International Development Authority (SIDA) for the labour-based contracting project, with the following (narrow) objectives: "To establish guidelines for the selection, training and supervision of small, local contractors in labour-based gravelling operations".

Initially, the project was designed to regrave 96km of roads without any provision for training. This anomaly was later rectified.

The project did not provide any equipment for the contractors.

2.4.2 Training

A total of twenty four (24) contractors were expected to be trained in two (2) phases. Three (3) of the twelve (12) contractors selected for Phase I withdrew at various stages of the programme; of the nine (9)
contractors who successfully completed the training programme, only six (6) won contracts. Phase II of the project would involve the training of twelve (12) more contractors and staff of the Ministry of Public Works and Housing.

Invitations to participate in the labour-based contractor training programme were advertised in the local newspapers. Applicants were evaluated for:

a) qualifications of Managing Directors, preference being given to civil engineers;

b) background and experience of firms;

c) equipment holding (especially tippers and tractors).

Foremen were engaged separately by the project and trained, to be engaged later by the trained contractors.

The training programme lasts 15-21 months. Section I (theoretical) lasts 3 months, while Section II (practicals) lasts 12-18 months. Training Section II involves:

• on-the-job training (fixed rate contracts for all contractors), estimated at US $40,000.

• 1st trial contract (11 contractors tendered for 7 contracts), estimated at US $70,000 and

• 2nd trial contract (9 contractors tendered for 6 contracts), estimated at US $80,000.

As an improvement, in Phase II, each trainee foreman was attached to an experienced supervisor for a short period, prior to the formal training. Each trained contractor was also allowed to sponsor two (2) assistant foremen for training.

2.4.3 Contractor Profiles

Contractors were selected mainly for their educational qualifications (mostly engineers and technicians) and resources and experience as established contractors.

Even though the curricula vitae of the trained contractors have been boosted, there have been no substantial changes in the contractors’ profiles due to the lack of continuity of labour-based work.

2.4.4 Arrangements for Contractor Support

The future market has not been assessed; however, it was concluded from the Phase I training that labour-based contracting is viable in terms of value for money, available network offering potential candidate roads and large availability of labour in the project areas. However, there is no continuity for further contracts.
2.4.5 Contract Documentation and Administration

The contracts are based on FIDIC with additional special clauses. Standard tender and contract documents were developed during contractor training. The traditional method of fluctuation reimbursement (by receipts) is applied.

Contracts are awarded to tenderers who quote + 15% of the Engineer's estimate. In Phase I of the project, the staff of the Ministry of Public Works and Housing were not involved in the tendering and contracting processes. This arrangement created administrative problems. To solve the problem, District Engineers (DMIE) and their staff were later given formal hands-on training in tender documentation and evaluation and contract administration.

The Employer is the Government of Kenya, the Engineer is the Chief Engineer of MOPWH and the TA is the Engineer's Representative.

2.5 The Tanzania Labour-based Road Contractor Training Project

2.5.1 Background

The Labour-based Road Contractor Training Project, which is a part of the Integrated Road Project, is financed by the UNDP, IDA, USAID and the Government of Tanzania. The Government implementing agency is the National Construction Council (NCC), with TA provided by the ILO. The programme started in October, 1992.

The objectives of the project are to establish:

a) a labour-based contracting capacity in two (2) regions for the execution of road rehabilitation and maintenance works, and

b) the capacity, within the NCC, to continue with the training programme.

Initially, the project was planned for rural road maintenance. However, when it was discovered that most of the roads were not maintainable, the emphasis was changed to the rehabilitation of earth or gravel surfaced rural roads.

2.5.2 Training

Between January 1993 and June 1995, twelve (12) contractors were trained for each of the two (2) project regions: six (6) contractors are trained at a time.

The training programme has been divided into three (3) phases:

1. classroom training (6 weeks)
2. field training (14 weeks); and
3. trial contract (6 months).
Each contractor sponsors 3 (originally 5) supervisors. After the trial contracts, the successful contractors are registered as labour-based contractors. The field training is undertaken with hired equipment. The contractors also use hired equipment for their contracts.

2.5.3 Contractor Profiles

Each of the selected firms for the first batch was a registered building contractor with some construction equipment and landed property. After training, a typical contractor can turnover US $60,000 per annum, employing about 70 workers per day.

2.5.4 Arrangements for Contractor Support

Even though the future market has not been assessed, it is reassuring that the Government of Tanzania has a policy of privatisation with donor-support for labour-based road works.

2.5.5 Contract Documentation and Administration

FIDIC (3rd Edition) Conditions of Contract, with some adaptations for labour-based works, are used. A new (“user friendly”) document has been proposed for use. The new document is based on "The Administration of Labour-intensive Works Done by Contract" by Philippe Garnier and Marc Van Imschoot.

The traditional system (i.e. evidence of receipts) of fluctuation reimbursement is applied. Plant hire rates are included in the Basic Price List.

The Ministry of Works, Communications and Transport (MWCT) represents the Employer, with the Regional Engineer as the Engineer. During the trial contracts (training) stage, the NCC is the Managing Contractor who subcontracts the trial contracts to the trainee labour-based contractors.

However, the labour-based contractors are the Main Contractors on the standard contracts. During contract execution, the labour-based contractor is advanced 15% of the contract sum for mobilisation. Another 15% is advanced directly to equipment suppliers on behalf of the contractors.

2.6 The Uganda Labour-based Programme

2.6.1 Background

The Ministry of Works Transport and Communications (MOWTC) which is responsible for highways in Uganda introduced labour-based routine maintenance contracts in 1992, as part of the Interim Maintenance Project. Among the policy reforms of a powerful Inter-Ministerial Steering Committee was "As far as possible, to use small
labour-based contracts for routine maintenance operations; force account to be used only where labour-based contracts were not practicable.

The World Bank-supported Transport Rehabilitation Project (TRP: 1995-2000) which aims at achieving the following objectives, further reinforces the use of labour-based contracting:

a) to introduce labour-based methods of road maintenance and feeder roads rehabilitation wherever most cost-effective;

b) to improve MOLG's (Ministry of Local Government) and Local Authorities (Districts') capacity to plan, manage and monitor feeder roads rehabilitation and maintenance;

c) to improve feeder road network accessibility in 4 districts; and

d) to train, advise and employ domestic small- and medium-size contractors for feeder road works.

The following targets are to be achieved:

a) the rehabilitation of 680 km of feeder roads in 4 districts;

b) the introduction of a 4-year feeder roads maintenance programme;

c) the establishment, through training, of a feeder roads rehabilitation and maintenance capacity using labour-based contracting in 4 districts, and

d) strengthening the planning and monitoring capacity of MOLG.

The project will provide some light equipment, vehicles and tools to the contractors through either a leasing company or a bank. The MOLG will provide regular and continuous work to the contractors during the loan recovery period.

2.6.2 Training

The trainee contractors will be selected on the basis of qualifications of the Managing Directors, equipment holding and experience of the firms.

The contractor training will consist of a 2-week introduction on a demonstration site, to be followed by a 4-month detailed site training.

The successful trainees will be given their first contract.

The training of MOLG and District Administration staff will run in parallel with the contractor training. The full implementation of the project was about to start by May, 1995.
2.7 The Lesotho Labour-based Contractor Training Project

2.7.1 Background

Lesotho's experience of labour-based road works by force account dates back to 1977 when the Labour Construction Unit (LCU) was set up in the Ministry of Public Works.

In order to ensure sustainability, reduce government establishment, achieve greater efficiency, and generally to be more cost-effective, the Lesotho government decided that labour-based road works must be privatised.

As part of the Infrastructure Rehabilitation and Maintenance Project, the ILO was tasked to study the domestic contracting industry. The study resulted in a document titled: Entrepreneurship Development for Labour-based Road Maintenance. The ILO was again commissioned to produce training material, coordinate equipment procurement and train twelve (12) small scale contractors in labour-based road maintenance. The small scale contractor training programme started in April 1993.

The trained contractors were expected to arrange privately for their equipment and tools.

2.7.2 Training

Invitations to participate in the training programme are advertised by radio and newspapers. Trainees are then selected after a series of tests, interviews and verification of furnished information.

The training programme is made up of theoretical and field sessions, lasting about ten (10) months.

The Road Maintenance and Rehabilitation (ROMAR) and Improve Your Construction Business (IYCB) documents, sponsored by the ILO, were used for training; the former, for technical and the latter, for management training. Only the Managing Directors of the firms are trained.

Trial routine maintenance contracts are awarded to the trainees on fixed rates bill of quantities, after the field training in regravelling. The contractors ballot for the projects.

Trial regravelling contracts were awarded after the trainee contractors had tendered for them. The tender sums should fall within an acceptable envelope of ±5 percent of the Engineer's Estimate. Contractors whose tenders fall outside this envelope are awarded contracts at the Engineer's Estimate.

During the trial contracts:

a) LCU force account labourers are seconded to the trainee contractors;
b) contractors are paid labour advance plus 10 percent margin;
c) each contractor is given a set of tools to be repaid, from the contracts;
d) any additional equipment is rented by the contractor; and;
e) each contractor employs about 60 operatives for regravelling.

After the trial contracts, the successful contractors tender for regravelling contracts.

2.7.3 Contractor Profile
The backgrounds of the Batch No.1 trainees varied from primary education to engineering degree. The Batch No.2 trainees had better academic qualifications: in addition, each had a bank account, though not a healthy one.

It is a bit too early to assess the contractors’ standing at the bank. However, the acquired knowledge will enhance the chances of the contractors in securing contracts outside the project.

2.7.4 Arrangements for Contractor Support
All trained labour-based contractors are guaranteed routine maintenance contracts which are funded fully by the Government of Lesotho (GOL). Due to constraints in funding, fewer regravelling contracts can be awarded (with World Bank funding) than the number of trained contractors. This situation may worsen as the contribution of GOL to funding for regravelling increases.

The Lesotho Highlands Authority is a possible source of work for the trained contractors.

2.7.5 Contract Documentation and Administration
A simplified form of contract, for labour-based works, is in use. Some inconsistencies in the conditions of contract suggest that the document may not be thorough enough.

In view of the low rate of inflation in Lesotho there is no provision for fluctuations in the contracts.

The contract documents need further testing to facilitate fair comments.

The LCU is responsible for control and payment.

A contractor is entitled to a mobilisation advance payment against a Bank guarantee. When the Bank issues the guarantee, it opens 2 accounts for the contractor - an Advance Bank Guarantee Account into which the advance is paid, and an Operational Account from which overdrafts are given to the contractor. The advance money is not released to the contractor until he has completed the contract and
repaid the loan. The Bank uses the advance money as collateral for the overdrafts. All contract cheques are paid into the Operational Account.

2.8 The South Africa Contractor Development Programme

2.8.1 Background

In South Africa, the building and construction industries are dominated by enterprises which are mainly owned and directed by the white sector of the population, due to previous socio-political arrangements in the country. To address the imbalance, the construction process must be modified to facilitate the creation and development of small scale contractors within the disadvantaged communities.

‘Community-based construction’ may be defined as:

"The use of labour-based technologies and labour-intensive methods on projects in which the community is, in addition, involved in the commercial, managerial and administrative aspects so as to maximise the amount of funds retained within the community and to transfer skills and competencies to the community".

One of the several contractor development programmes is the Soweto Contractor Development Programme (CDP) which is founded on the above principle. The programme was started in mid-1988 by the Soweto Municipal Council. The Objectives of the Programme are to plan and execute local construction projects by applying labour-based technologies and labour-intensive methods such that:

a) employment and entrepreneurial opportunities are created for members of the community;

b) skills and competencies in technical, commercial, managerial and administrative areas are transferred to participants; and

c) the percentage of the construction cost retained by the community is maximised.

These objectives accord with the provisions in the Reconstruction and Development Programme (RDP) of the South African Government; hence the enabling environment has been established.

The following have been identified as barriers which prevent small entrepreneurs from engaging in civil engineering construction:

• tendering and contractual requirements e.g. tender rates, the provision of securities and penalty clauses;

• design based on plant-based construction practices;

• lack of financial resources to purchase materials, hire plant and tools and to pay wages;

• lack of commercial, managerial and administrative skills;
• discontinuity of work; and
• lack of technical competence.

The above barriers may be reduced by:
• employment of labour-based technologies;
• provision of access to resources;
• provision of developmental assistance; and
• structuring of contracts.

Therefore, in order for communities to participate in construction, there should be changes both in the construction method and process.

In an attempt to create jobs for local entrepreneurs, the following are some of the ineffective approaches which are followed:
• inviting open tenders from eligible contractors (there are no black registered contractors);
• insisting that local contractors be engaged as sub-contractors (no such sub-contractors are available); and
• including clauses in contracts which make it obligatory to use local materials or plant (does not necessarily involve communities in the management of construction). Local entrepreneurs from underdeveloped (black) communities cannot engage in construction without development support and the acquisition of external resources.

Three possible methods are applied in the Soweto CDP. These are:
a) The Development Team Approach
b) The Managing Contractor Approach
c) The Mentoring Approach

(a) Development Team Approach

In this method, experienced and suitably qualified people assist the contractors in the following areas:
• administration and management of the contract;
• offer of technical training; and
• engage of specialist contractors.

The local contractor enters into a contract with the Client while the Development Team is appointed on a fee basis, directly by the Client. The following constitute the Development Team:
• the Design Engineer
• the Engineer
• the Construction Manager, and  
• the Materials Manager  

The Design Engineer and Engineer are respectively responsible for the pre-tender design and supervision of the works.  

The Construction Manager:  
• advises and offers site assistance and training;  
• provides plant apart from small tools;  
• arranges for specialist works;  
• arranges the payment of fortnightly/monthly wages; and  
• transports materials to site (Level 1 contracts only).  

The Materials Manager,  
• provides all materials (Level 1); and  
• provides most materials (Level 2), and  
• makes materials available for purchase (Level 3).  

Materials are supplied to the client at cost i.e. net of discounts.  

Construction and Materials Managers may be either engineering contractors or project managers of consulting engineers.  

(b) Managing Contractor Approach  

In the Managing Contractor system, the Client enters into a contract with an experienced conventional contractor who administers, manages, finances, trains and supplies materials and equipment to a labour-based nominated sub-contractor.  

(c) Mentorship Approach  

The Mentorship Approach is applied to Level 4 and 5 contracts. In this system, qualified people are employed as consultants on a fee basis, to help emerging contractors to:  
• acquire the necessary skills to win competitive tenders;  
• improve their management and business skills, and  
• acquire and develop improved competence in contract management.  

The development support to the community from each of the above methods is flexible and can be revised depending on the needs of the community.  

By the end of January, 1994, the following had been achieved in Soweto:  
• 215 km of secondary water mains had been laid;
19,500 housing plots had been re-plumbed; and
30,000m of roads had been upgraded, by community based contractors at approximately R44 million (US $12.25 million).

The Development Bank of Southern Africa (DBSA) assisted the Soweto Municipal Council with funds for the first phase of the CDP.

Levels of Contract

A Contractor Development Programme (CDP) is structured in levels of contract in order to afford small contractors with different capacities and sizes of business, the opportunity to enter and leave the programme at various stages. In addition, the levels of contract must be so structured that those contractors who leave at any level can perform without developmental support while the support will be reduced for those remaining in the programme at each successive level of contract but with increased responsibility and risk.

The following 5 levels of contract are proposed:

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Labour only</td>
</tr>
<tr>
<td>2</td>
<td>Labour plus transport of materials to site</td>
</tr>
<tr>
<td>3</td>
<td>Labour plus transport plus materials (assisted)</td>
</tr>
<tr>
<td>4</td>
<td>Labour plus transport plus materials (unassisted)</td>
</tr>
<tr>
<td>5</td>
<td>Labour plus transport plus materials plus full surety.</td>
</tr>
</tbody>
</table>

In order to encourage contractors to progress to higher levels, the following rules are applied:

a) Contractors within the programme can only tender for one level of contract above and one level below the highest level of contract at which they are currently operating, or where they have operated at in the past.

b) No contractor within the programme may tender for a Level 2 contract unless he has completed 2 Level 1 contracts.

c) No contractor can undertake more than 3 Level 1 contracts and a total of 5 Levels 1 and 2 contracts.

d) No contractor can undertake more than 3 Level 3 and 4 contracts and 2 Level 5 contracts.

e) Contractors who have worked outside the programme can enter the programme at any level provided that they have suitable contracting experience to operate at that level, whereupon they would be subjected to the above mentioned rules.

2.8.3 Contractor Profiles

The trainee contractors were either small building or civil engineering contractors, or former supervisory staff on labour-based projects or
contractors’ labourers. They had very little or no knowledge of business and were very weak financially.

From small, single-man firms or no firms at all, several of the contractors have become either small well organised contractors or subcontractors or pools of foremen for other contractors. A trained contractor may undertake contracts in roads, water, electricity or housing, depending on his level.

2.8.4 Arrangements for Contractor Support

So far there have not been enough jobs for the contractors. However, the situation is expected to improve in the near future.

2.8.5 Contract Documentation and Administration

The following forms of contract are used, as appropriate:

a) General Conditions of Contract for Works of Civil Engineering Construction, 6th Edition (1990), or


2.9 Peculiar Issues of Interest

2.9.1 The Ghana Programme

a) Light equipment and tools are provided for contractors through loans administered by banks at an average bank interest rate of 35% (1996);

b) Contractors are guaranteed contracts (no competitive tendering) to enable them repay the equipment loan; and

c) Funding for the programme is mainly donor-driven.

2.9.2 The Kenya Project

a) The labour-based technology for road works has been popularised in the country side through force account operations;

b) The roads are not compacted;

c) Funding for the training programme is donor-driven;

d) In the selection of trainees, emphasis is placed on the qualifications of the Managing Directors of the firms. Foremen are trained separately and transferred to the trained contractors;

e) Standard open tendering is applied - continuity of work is not assured; and

f) The annual rate of inflation is 26%
2.9.3 The Uganda Project

a) The MOWTC does not share its experiences on labour-based routine maintenance (petty) contracts with MOLG;

b) The trained contractors will be equipped by the project; and

c) The Technical Assistance (TA) team includes 3 local consulting engineers. This arrangement will promote technology transfer.

2.9.4 The Tanzania Project

a) The NCC staff on the project are given special remuneration as an incentive;

b) The contractors are expected to either own or rent light equipment for their work; and

c) Up to 30% of the contract sum is paid as mobilisation and plant advance.

2.9.5 The Lesotho Project

a) Only the Managing Directors of the contracting firms are trained.

b) Trained contractors are guaranteed routine maintenance contracts;

c) The selection criteria exclude big contractors;

d) No equipment provided for the contractors.

e) The annual rate of inflation is 7-10%, and

f) The technology is popular in the countryside due to the experience in force account of the LCU.

2.9.6 The South Africa Programme

a) Contractors are trained for several types of work;

b) Training includes management support;

c) The provision of training is project-related: therefore a contractor without a project may not have the opportunity of being trained;

d) For each construction contract, separate (about 3) contracts are signed with the consultants in the Development Team;

e) The administration of the Contractor Development Programme is almost entirely in the hands of a few external consultants;

f) Labour is very expensive in South Africa (about US $10.00 per day), so the alternative efficient use of equipment may pose a threat (financially) to the labour-based technology, especially for road works, and
g) The Development Team Approach (DTA) will be sustained so long as the big firms used as Construction Managers do not feel threatened by competition from the small labour-based contractors. As the big firms face competition from foreign firms for large contracts, they may turn to the otherwise less lucrative small labour-based contracts.

3.0 KEY ISSUES
In the course of the assignment of the 3-man ILO Mission, four key issues were identified as having a very significant impact on all labour-based projects. These are:

- Project Preparation;
- Training;
- Contract Documentation, and
- Detailed Implementation

3.1 Project Preparation
The following issues need careful consideration:

a) Whether the project is conceived as a result of government policy decision or as a condition of external financing, the appropriate enabling environment which will ensure continuity must be established;

b) The project objective needs clear definition and ideally should be linked to contracting industry development;

c) Project identification/appraisal needs to demonstrate early cooperation between governments and donors;

d) Preparation needs to be thorough in terms of both overall concepts and practical detail. Local knowledge and previous project experience are essential if all components of a project are to be adequately addressed;

e) There is no 'ideal' implementation formula and thus preparation needs to include the necessary flexibility for learning and adjusting to differing circumstances;

f) There are inherent dangers in suggesting a complete translation of a project from one country to another, and

g) Genuine, active government commitment is essential for anything sustainable to be achieved and this needs to be harnessed in the very early stages of preparation.

3.2 Training
The following are important:
• Training is often seen only in terms of the needs of the project and not in a broader, longer term context;

• The training approach may be limited to enabling contractors to enter the real competitive world in the shortest possible time or to continue structured support as they gain more experience;

• Careful thought should be given as to who needs the training, e.g. contractors; supervisors; clients’ staff; technical and/or administrative personnel. Needs should be assessed;

• Much training material exists which is widely relevant and which can be supplemented with locally specific additions;

• Training is a specialist activity; it should be given adequate status and carried out by appropriately trained trainers. Too often it has a fairly low priority in a project;

• To be sustainable, local training institutions (not necessarily technical) should be involved since they should have the professional expertise to ensure the appropriate level of training;

• Undergraduate/postgraduate courses need to include technology choice/appropriate technology for engineers to be introduced to these ideas at an early stage, and

• Feedback from trainees is an essential part of the development of good training programmes. Some of the training is seen as non-relevant while in other cases serious gaps are identified.

3.3 Contract Documentation

The main issues worth noting in Contract Documentation are:

• There is no consistency of approach to contract documentation within the projects studied;

• Many documents would have doubtful legal validity if challenged;

• There are no examples of labour-based contractors fully exercising their contractual rights (for fear of alienating their only Client);

• Either (inappropriate) FIDIC Conditions are used or locally written compilations which lack legal consistency;

• Uganda has the only example of good purpose written routing maintenance documents (but even these omit some fairly important clauses);

• No project uses 'minor works' conditions produced, for example, by the Institution of Civil Engineers (UK);

• Even simplified documents need to include clauses to cover basic contractual responsibilities;

• Ultimately it should be possible to design projects 'neutrally' to be equally suitable for a labour-based or equipment-based approach.
Engineers should be aware of steps that could be taken towards this objective;

- An (official looking) ILO document containing suggested contract conditions is being given more importance in this area than was probably intended, and

- The whole question of appropriate documentation for labour-based works needs a good deal of further work.

### 3.4 Detailed Implementation

- The Client management needs to be fully integrated into, and to take responsibility for the project implementation. There are a number of ways of ensuring this.

- The question of the choice and use of Technical Assistance needs serious review in the changing circumstances in Africa.

- The contractor's access to tools and equipment may be critical to the success of a project but there are key decisions to be taken regarding, for example, the financial liability against continuity of work.

- All projects are delayed to a greater or lesser extent by existing procurement procedures to the general frustration of all parties concerned.

- The identification and selection of contractors is important if the objective of 'contracting industry development' is to be fulfilled.

- Projects vary as to the amount of contractor support that is given during and after the project and this is an area of serious debate and differing views.

- The administration of contracts in terms of payment procedures; terms and conditions of employment; and negotiations over fixed rates, is an area requiring particular attention.

- The selection of roads and standards of construction need specific criteria which are agreed at an early stage since a purely economic assessment is rarely appropriate for the type of roads under consideration. Standards are also subject to political pressure.

- Public Relations exercises and the extensive use of the media are recommended to make the general public more aware of the importance of good road access and maintenance.

- Labour-based projects can be an excellent vehicle for the formal introduction of internationally recognised labour conventions.
4.0 THE ILO-MART WORKSHOP

4.1 Introduction

The ILO-Mart Workshop on Labour-based Small-Scale contracting for the Roads Sector held in Zimbabwe from 27 November to 1 December, 1995, represented Phase II of the ILO project referred to in 1.0 above.

The objectives of the Workshop were:

a) To discuss the key issues identified in the ILO Study Report (Phase I).

b) To produce detailed recommendations and an Action Plan for the content and production of the guidelines.

4.2 Outcome

The following were some of the key issues discussed:

a) The definition of the target audience for the guidelines and therefore the decision to have two parts (institutional and operational), or even two separate documents (for policy makers, and for programme designers and implementors).

b) The importance of the creation of an ‘enabling environment’ if small-scale contracting is to be sustainable; and an analysis of “the market”.

c) ‘Protection’ for small-scale contractors, its advantages and disadvantages, and the ultimate objective of releasing them into the free market, competitive environment;

d) The concentration on the roads sector as being the major potential market at present, but also the importance of enabling contractors to move freely into other appropriate fields to avoid a continuing ‘one Client’ situation;

e) The importance of the contractors having a ‘voice’ through well established Contractors Associations;

f) Many initiatives are only ‘project’ oriented and this is one reason for the failure of any significant expansion of “a contracting market” in labour-based construction works'

g) What is the justification (or otherwise) for ‘affirmative action’ (e.g. in South Africa) to promote labour-based contracting?

h) What is the role of Academic and Professional Institutions (Centres of Excellence) in achieving sustainability?

i) The critical importance of sustainable maintenance strategies.

j) The lack of any serious initiative to develop any local ‘consulting’ capacity in most countries; and

k) The lack of data from elsewhere to match the ‘African’ experience.
I) MART and ILO were assigned to write proposals for producing the Guidelines with a view to soliciting the additional resources needed. The preliminary indications were that the Guidelines might not be ready before the end of 1997.

5.0 CONCLUSION

The ILO's programme for labour-based contracting is well on course. The MART Workshop on tools and equipment held in the past few days is complementary to the ILO initiative. Everyone who sympathises with the system anxiously looks forward to seeing the Guidelines in print, hopefully by 1998. Meanwhile, some countries have either started, or are at the threshold of starting, projects which require the use of labour-based contracting:

What do they do?

I wish to suggest, in conclusion, that new entrants must:

a) Draw on the experiences of the 'older generation' of projects/programmes, visits are recommended;

b) Be guided by the 'Key Issues' listed in 3.0 above.

c) Pay particular attention to the following:

- Enabling environment: Governments and implementing Agencies must be fully and practically supportive of the system.
- The type of, and arrangements for securing, light equipment and tools;
- Types of contracts: conditions of contract must be less complicated to be understood by the small contractor. The caution must be given that in our attempt to 'simplify' the forms of contract, it must be realised that contracts are designed to avoid, and to be used in the determination of, disputes. Therefore, the 'simple' contract should follow this principle. It should not be assumed that we are dealing with a 'small' contractors: nothing prevents a small contractor from seeking expert legal advice when the situation so demands.
- Technical assistance should be fully competent for labour-based works. If ILO published a list of labour-based experts for use by prospective clients, it would be very helpful.
- The importance of local financial institutions in either managing equipment loans, or providing overdraft facilities or securities, must be recognised.
- Sustainability.
1.2 The Development of labour-based road contracting for road works

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INTRODUCTION

The implementation of public works through the private sector has become a heavily promoted strategy in recent years. The concept is being introduced both in countries which are transforming their former centrally led economies to market structures and in developing countries aiming to make their public sectors more efficient. The systems developed in the Western industrialised countries, where the private sector has played an important role in the provision and maintenance of public infrastructure for a long time, now serve as models to be replicated.

Contracting out public works and services has a long history in these countries. Early examples include the building of most of the railways, roads and airports by contract in North America as early as the 18th century. Not only did contractors implement the works but often the private sector also provided a significant part of the investment capital, for example for the railway system in the United States. In Europe, private entrepreneurs built infrastructure including roads, schools and houses for the owners of factories and agricultural companies from the 18th century onwards. During the first half of the 20th century, there continued to be a strong involvement of the private sector in the construction and provision of public utilities in Europe, Latin America and the United States.

Following the colonial period in developing countries, most governments aimed to industrialise rapidly and invested heavily in infrastructure. The private sector in most of these countries was predominantly foreign-owned or controlled and therefore viewed with suspicion. Public enterprises and Government organisations were created to build and maintain public works. However, since the late eighties these organisations and systems have come under heavy pressure to change. The combined effect of the debt crisis, the need to adjust economic policies and the inefficiency of the national Government ministries and public enterprises delivering products and services, led to a reconsideration of the private sector’s role in economic development. At the same time, the scarcity of foreign exchange and the need for the creation of productive employment opportunities pushed developing country governments into seriously considering construction and maintenance techniques which rely, to the maximum extent possible, on the utilisation of locally available resources.
DEVELOPMENT OF SMALL CONTRACTORS SPECIALISED IN LABOUR-BASED ROAD WORKS: THE ILO APPROACH

Through its employment-intensive infrastructure programmes in developing countries the ILO has promoted the use of local human and material resources since the early 1970's. Initially, most of the ILO's work in this field concerned the reorientation of technical ministries towards the efficient use of labour for road works. The emphasis of this work was on the establishment of systems and procedures and the training of staff to allow an efficient implementation of labour-based road works through force account/direct labour.

Since the mid-1980's the development of a local contracting industry able to mobilise and effectively utilise these local human and material resources was seen as an important means to promote employment and improve efficiency. It was also considered that the business sector could make important contributions to employment generation, skills development and economic growth, while at the same time progress could be made in the areas of worker protection, and safety and health conditions of work for casual workers.

Work carried out by the ILO has shown that the constraints on the use of labour-based techniques by the private sector have more to do with the general problems faced by small-scale contractors than with any basic difficulty with the techniques themselves. These contractors face a variety of problems related to obtaining credit, keeping an adequate cash flow, being paid on time and operating within very demanding contractual regulations; these problems remain the same whatever the technology. Any agency aiming to develop a small-scale contractor capacity will therefore have to help contractors overcome these problems.

The ILO's strategy aimed therefore to involve the business community and the Government Agency in the joint implementation of labour-based road works, while developing a supportive policy environment and introducing simple and effective administrative systems. Institution development, business management and technical training, demonstration and the introduction of transparent and streamlined procedures (e.g. for payment, certification and contract award) are the keystones of such a strategy.

If programmes of this nature are to be successful and sustainable, it is essential to establish a relevant training programme for both public and private sector trainees. Management and technical training for higher and medium level supervisory staff (or, in the case of small contractors, the contractor himself or his site agent) is absolutely indispensable. The programme will also need to train high level staff of the supervising agency to prepare for and manage the bidding process, review bids, negotiate contracts, and supervise work in progress. Furthermore, in the pilot stage the right types and qualities of tools and light equipment should be procured and mechanisms
established to make the required items available to the small contractors. Productivity and cost data need to be collected in order to set acceptable unit rates. Finally, steps should be taken to ensure adequate local and external funding for large-scale programme replication.

The programmes also serve to develop and introduce simple contract documentation with appropriate clauses regarding minimum age, minimum wage, non-discrimination and work insurance. The formation of employers’ and workers’ organisations is encouraged. ILO-supported contractor training programmes have resulted in the creation of labour-based contractor associations in Ghana and Lesotho.

Labour-based road rehabilitation and maintenance projects in dispersed rural areas can provide an excellent opportunity for local contractors to progress from small scale building works to road rehabilitation and maintenance. The initial capital investments required for labour-based work are significantly smaller than for equipment-based approaches. Being technically relatively simple, labour-based methods are particularly suitable for small local firms which have limited mobilisation costs, know the locally prevailing conditions and traditions, and are consequently well placed to effectively utilise the locally available human and material resources. Small firms are also more likely to generate local employment, make effective use of local materials and provide a continuing resource for building maintenance and gradual upgrading.

However, the complexity of projects carried out through the private sector in countries where no domestic capacity exists in this field, means that such projects should be allowed three to five years of development to a large scale programme. Another reason why a relatively long support period is needed relates to the financial exposure of the small contractors. When investing in light equipment to complement labour-based operations, small contractors are very vulnerable to abrupt fluctuations in workload. Contractor development projects must therefore incorporate certain safeguards to guarantee an essential minimum work load for a specified period to firms that are performing to expectations. Contractors should be encouraged to diversify their activities as much as possible. Building, small dam construction and the agricultural sector could offer a varied and flexible work load for efficient labour-based contractors.

**LABOUR OR EQUIPMENT-BASED METHODS?**

A number of factors influence the choice of technology for any given construction project: the design; the site conditions; the availability and motivation of the workers; the quality standards to be applied; the required speed of construction; and, finally, the costs of the different approaches. In the case of road works the decision in principle,
whether manual workers or heavy equipment will be the major means of production for excavation and shaping of the road formation, can be taken following a general analysis of these factors. This analysis should recognise, however, that labour-based works can achieve high quality and high productivity when the labour force is complemented with carefully selected light equipment for those operations which are difficult to execute by manual workers, i.e. rock excavation, compaction and hauling of materials over long and medium distances. For a relatively small increase in cost the technical scope of labour-based methods can be substantially increased by developing and introducing appropriate pieces of light equipment for a range of road construction and maintenance activities.

LABOUR-BASED CONTRACTING EXPERIENCE: AFRICA, ASIA AND LATIN AMERICA

Africa

Prior to starting its innovative pilot project entitled “Rehabilitation and maintenance of rural feeder roads by small-scale labour-based contractors”, Ghana already had a great deal of experience with contracting in the road sector. A considerable number of medium and larger-scale Ghanaian contractors were active in the road sector, primarily employed by the Ghana Highway Authority (GHA). GHA had a well established contracting division to administer and supervise the contracts.

The Departments of Feeder and Urban Roads were created in the mid-1980’s, becoming responsible for the rehabilitation and maintenance of feeder and urban roads respectively. With World Bank support and through the efforts of experienced core staff the Departments rapidly developed to their current position. In spite of the initial scepticism expressed by the established contracting community about the feasibility of introducing labour-based work methods in the country, the Department of Feeder Roads (DFR) enthusiastically supported the development phase of the labour-based contracting project along the lines recommended by the ILO. From 1987 to September 1995, 64 firms have been trained, some 1300 kms of feeder roads have been rehabilitated at a cost ranging from $12,000 to $16,000 per kilometre and 2,600,000 work days of employment have been created. These figures compare very favourably with the traditional approaches both in overall financial cost, foreign exchange use and social impact, while producing results of comparable quality in all respects.

The national capacity for feeder road improvement by labour-based contractors now amounts to some 1,000 kms per year, with a local employment creation potential of approximately 2 million work days per year. Relevant elements of the Ghana experience are being applied in different ILO-supported projects and programmes in Africa and Asia. The University of Science and Technology, Kumasi, currently
carries out design, cost and quality comparisons of feeder roads having been constructed by labour and equipment-based methods respectively. The DFR’s principal challenges now relate to the administration and supervision of the vastly increased number of labour-based contracts and the safeguarding of the quality of the training. The Ghana model offers many lessons in terms of the establishment of pilot projects of this nature, involvement of the local banking system, equipment procurement, training, the role of a Labour-based Contractors Association, administrative systems and procedures and, finally, the transition from a pilot to a large scale programme phase.

Currently labour-based road contractor development projects and programmes in various stages of development are being implemented in Guinea, Kenya, Lesotho, Madagascar, Nigeria, Sierra Leone, South Africa, Namibia, Tanzania, Uganda, Zambia, Zaire and Zimbabwe. The Lesotho and Uganda programmes particularly concern the development of a private sector capacity for routine maintenance with the specific training and systems and procedures development applicable to this type of work.

Through a World Bank-funded pilot project the ILO supported the Labour Construction Unit (LCU) in Lesotho in (i) training domestic small-scale contractors to efficiently undertake labour-based routine maintenance work and (ii) developing and introducing administrative and financial systems and procedures allowing the trained contractors to operate effectively. Special training manuals (Road Maintenance and Regravelling ROMAR, to be published in March 1996) were developed, comprising both business and technical training, and contract documentation was adapted to fit the special requirements of this type of work by this target group. Trained contractors received initial support for the purchase of materials and tools, wage payments and the hiring of transport vehicles.

Whereas the project has succeeded in excess of its targets in delivering capable and accredited contractors and in the delivery of suitable systems and procedures, much work remains to be done in reorienting the LCU to its future role of client and supervising/controlling agency. For various reasons, but mainly because of the lack of engineering manpower in the country, the Agency does not yet have the functioning ‘Contracts Section’ supposed to have been put in place during the project period.

Employment-intensive programmes of a more general nature, using the private sector mostly for carrying out labour-based urban infrastructure works, are being implemented principally in francophone Africa (Benin, Burkina Faso, The Gambia, Madagascar, Mali, Mauritania, Niger, Senegal, Chad and Togo). National contract executing agencies called ‘AGETIP’s’ (French equivalent of ‘executing agency of employment-intensive public
works') are organised in an international association entitled 'AFRICATIP'.

The AGETIPs are generally set up as private non-profit making Non Governmental Organisations and as such efficiently manage, with a minimum of bureaucratic red tape, large programmes of public works, which are to be executed labour-intensively. The success of this approach can largely be attributed to the use of simple systems and procedures, which allow the participation of small contractors and communities and ensure regular and timely payment. On the negative side, the AGETIPs are mainly dependant on external funding and operate outside of the restrictive Government environment, while replacing the Public Works Ministries as employers for public works. This raises important questions of sustainability and long term relations with the Government structure.

The ILO now closely collaborates with AFRICATIP in the establishment of a regional support programme of five years' duration, set up to (i) develop and support international and national training for different levels of staff from public and private sectors, (ii) generate and disseminate information on the cost effective use of labour-based techniques and local building materials, (iii) create awareness of the socio-economic and technical advantages of local resource use at political and decision making levels, (iv) establish policy units in planning ministries analysing and recommending the feasibility of increase local resource use for infrastructure development and maintenance at programme and project levels, and (v) provide technical advisory services in this field.

Asia

India has perhaps the longest standing tradition of working with contractors for the execution of road works. Most of these works are carried out by a main contractor relying for a number of activities on "labour-only" sub-contractors. Manual methods have also been extensively used by Government Agencies for major civil works such as canals. An interesting feature in India is the extensive use of animals in civil works, especially for earth works in canal and road construction and in quarries. Animals transport material in panniers and tow carts and simple compaction or scraping equipment. Specialised contractors own large handcarts for earth and gravel haulage from borrow pits along the roads. Other Asian nations which have traditionally used manual labour for all types of construction works include China, Indonesia, Pakistan and the Philippines.

As in to Africa, Asia also counts a number of countries where, for various practical or ideological reasons, the private sector has not developed in the road sector. In such countries (e.g. Cambodia, Laos, Solomon Islands, Vanuatu) contractor training must necessarily be accompanied by the development of an enabling environment in which contractors are able to compete and survive. Other countries do have a
private sector, but with contractors either not being familiar with implementing labour-based methods or applying such methods inefficiently.

In Indonesia the ILO provided assistance through various projects, the first primarily concerned with contractor development and training, and the second with the introduction of modern management techniques for labour-based road works. During its final period the latter now also trains small scale contractors for routine maintenance. Proposals have been developed for an expanded labour-based programme with the Ministry of Works comprising, (i) the rehabilitation of 1,000 kms of district roads to gravel standard, (ii) the establishment of an effective routine maintenance system on these roads, using small contractors, community contracts or lengthmen in different conditions, (iii) developing the capacity of the District Road Agencies and local consultants to supervise and administer a programme of this nature, and (iv) further alternative low cost pavement testing and productivity assessments.

In the Philippines a number of studies and projects were undertaken from the mid-1970's to date. The technical and economic viability of labour-based road works in the conditions prevailing in the Philippines was well established by these initiatives. Private sector involvement was limited to 'labour-only' or 'pakyaw' contractors, who were subcontracted for activities such as site clearing, earth works and spreading. This type of subcontracting is common in the Philippines, being used for harvesting and building works. For road works pakyaw contracts are recommended to be limited to approximately 500 worker days for the above activities. It is considered, however, that this type of contract can also be used for more skilled interventions such as culvert manufacturing and installation, excavation and loading of aggregates and excavation for structures. This would imply that a certain amount of business management and technical training would be necessary for this target group.

In Thailand the ILO has supported the implementation of a 'pilot project on labour-based road construction' in 1984/85 followed by a 'Labour-based construction and rural self-employment' project between 1987 and 1992. The pilot project included the construction of a test road by labour-based methods supported by specially designed and locally manufactured light survey, compaction, hauling and grading equipment and a study and research component to develop, test and introduce this equipment. The follow-up project's main components comprised capacity building, technical and organisational efficiency improvements, and assessments and tests of the feasibility of applying labour-based methods in the rural water sector. Contractor development did not feature in this project, which was heavily oriented to working directly with local communities.
In Nepal the Swiss Development Cooperation (SDC) has cooperated with the Department of Roads (DoR) for almost 10 years in the construction and subsequent maintenance of a mountain road. During this period the use of labour-based methods and the involvement of local consultants and contractors were actively promoted. Its future support will be to assist DoR in developing its capacity for policy making, norm setting and strategic planning, while the implementation and supervision of the works will be gradually shifted towards the private sector. The latter will require an adjustment of procedures and capacity building of both local consultants and contractors. At the same time steps will be taken to create a stable national road rehabilitation and maintenance market for the private sector and to develop local professional organisations in this field.

Since 1980 the ILO has been involved also in supporting a gravity irrigation programme in Nepal. The interesting feature of this programme is the involvement as a legal entity of ‘User Associations’ in the rehabilitation and subsequent maintenance of irrigation schemes of between 10 and 250 ha. Contracts are signed between (i) the Department of Irrigation and the user association and (ii) the user association and small contractors and/or petty contractors, depending on the complexity of the task at hand. In some cases the works are also undertaken directly by the user association. Construction/rehabilitation costs are co-financed by the Association with contributions ranging from 7 to 25 per cent of the total cost depending on the degree of direct interest by the beneficiaries.

Central and Latin America

The ILO has assisted the Ministry of Public Works, Transport and Communications (MPTC) in Haiti in preparing a project component dealing with the routine maintenance of some 800 kms of unpaved secondary roads by village communities. The component includes the rehabilitation of severely deteriorated earth/gravel road sections using small scale contractors under simplified public works contracts. Standard community contracts for routine maintenance have been developed for use by the MPTC Departmental Authorities and the village communities. These contracts cover routine manual maintenance, cleaning of drainage structures and manual reshaping of the carriageway.

Feeder roads programmes in Colombia and Honduras and a major labour-based programme in Mexico entitled the ‘Roads and Labour Programme’ carried out in the 1970’s used a similar approach of directly involving the beneficiary communities. In Mexico, following a community request for the rehabilitation of a particular road, a Memorandum of Agreement was drawn up between an elected community committee and the Government Agency, spelling out the rights and obligations of each party. The committee acts as a subcontractor for the Government Agency, which provides payment at
the prevailing minimum rural wage rate, supervision, transport, construction materials, hand tools and light equipment. This programme built 64,000 kms of roads at an average cost of $5,750 per km. Work day inputs averaged 1,700 per km of gravelled road (formation width 4.6m, gravelled width 4m at 0.15m thickness).

CONCLUSIONS

The project experience presented above shows that the potential for labour-based road contracting is enormous, particularly for rehabilitation of rural roads and for all types of maintenance works in urban and rural environments. The changing socio-economic environment in many developing countries in the 1990's strongly reinforces the need to create productive employment and to give priority to programmes which utilise local resources for infrastructure construction and maintenance. Labour-based skills developed during construction/rehabilitation works can subsequently be used to establish decentralised maintenance approaches which rely to the maximum extent possible on local funding, local management and execution with locally available resources. For this purpose a decentralised organisational framework is necessary in order to ensure local participation (local communities/contractors/NGO's) in funding, planning and implementation of routine and periodic maintenance.

The world-wide experience also indicates that there is a growing need for institution and capacity building in this field. Both international and local consultants and contractors will need to know how to design and implement different technology options. Government Agencies need to be able to monitor and control different technological approaches. An analysis of the best practices and lessons to be learnt from the implementation of the different projects and programmes should allow the development of several models for labour-based road contractor establishment for countries in different stages of experience with private sector works.

The growing popularity of employment-intensive methods for infrastructure development and maintenance however also has its risks. First, a neglect of institution and capacity building work and of modifying the working environment to allow the effective use of these methods, will inevitably lead to inferior results and failure in the long term. The ILO will continue to provide policy advice on technology choice and on the creation of an enabling environment in which labour-based road contractors can effectively compete within an open market economy. Through its regional and support programme structure the ILO will also continue to develop country programmes and technical backstopping advisory services on the use of employment-intensive methods in the road sector. Initiatives will be taken to expand the knowledge of alternative technological
approaches through collaboration with Universities and learning institutions.

Second, the increasing involvement of the private sector in this work augments the risks of worker exploitation. In this context the gradual introduction of a number of ILO’s fundamental standards dealing for example with minimum age, minimum wage, work insurance, and equal treatment of female and male workers, into contract documentation will be of the highest priority. The ILO will also aim to improve the applicability of national labour laws to the type of employment provided in this field to large numbers of rural workers, many of whom have not been formally employed before. Awareness by both workers and employers of their rights and obligations under national labour laws will be created. In the long term this should contribute to an improved implementation and increased productivity of labour-based programmes through a better understanding and participation of the parties involved. Worker and employer associations and organisations will have an important role to play in order to make this a reality.

REFERENCES


1.3 Managing labour in labour-based activities: An approach for sustaining labour-based contracting


INTRODUCTION

Labour-based contracting is now in vogue as a strategy for employment creation in Africa.\(^1\) Promotion of the technology within an institutional framework of private large and small scale contractors takes off from a firm base of technical experience already established in force account implementation of labour-based activities. Indeed, it is in contrast to some of this experience that some of the potential benefits of a contractor approach are seen over force account implementation.

For labour the vogue presents opportunities, both for immediate employment creation and for longer term human resource development. These opportunities are linked to the dual imperatives of the new vogue: create jobs in a profit oriented private contractor sector. As an employment policy the two heads of this imperative are quite potent. As it links the success of the promoted enterprises to the use of a technology which creates jobs, the policy goes an important step beyond promoting the private sector as a primary object with hoped-for secondary results in employment generation. Complemented by a third (somewhat subordinated) imperative of promoting small scale contractors,\(^2\) the policy takes on important poverty alleviation aspects by reaching out to groups with links in, and bordering on, informal and rural sectors.

Looking at the labour input, however, there are tensions in the policy imperative which are not so well accounted for in the force account experience of labour-based activities. As one private contractor in Southern Africa recently put the nub of the dilemma:

"Why would I want to hire five hundred workers when I could hire one? Five hundred workers means five hundred problems."

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1  Promotional and operational activities are currently underway, at least, in Ghana, Guinea, Kenya, Lesotho, Madagascar, Mozambique, Namibia, South Africa, Tanzania, Uganda, Zambia and Zimbabwe.

2  Stock and de Veen, 1996:38. Comparing different models of labour-based contracting promotion, the conclusion reached was that "(I)n many ways, the small-scale contractor models provide the only long-term answer to efficiency."
How can a profit motivated entrepreneur be encouraged to productively employ large numbers of people without eventually falling into circumstances which either,

(a) undermine his capacity or incentive to do so, or

(b) undermine government’s motivation for maintaining a policy which promotes labour-based contracting?

These circumstances – which can occur at the level of the firm and aggregate at the sectoral level – include labour unrest based upon poor working conditions (with resultant delays in contract completion), poor product quality or cost affecting productivity losses resulting from poorly motivated workers, and exploitation of labour leading to political difficulties. In certain cases, difficulties can also be encountered from an organised labour movement not habituated to the use of labour-based technologies and working conditions as an employment strategy. Equally so, difficulties can arise from bad management.

This paper looks at this preliminary issue: What can be done – and what guiding principles established – at the early stages of contractor and policy development to promote sound management of labour? This paper provides some concrete examples of ‘best practice’, but focuses more on setting out clearly what would be the underlying objectives of such practices.

LABOUR MANAGEMENT UNDER PRIVATE CONTRACTS: ANY DIFFERENCE FROM FORCE ACCOUNT?

Sound overall management is important for the success of any private sector contractor. For contractors obliged to use labour-based techniques, sound management of labour is fundamental. Until recently, however, labour-based activities have been implemented largely by force account where, it can be argued, a premium was placed on convincing decision makers of the technical viability of labour-based technology by getting the job done and done well. Consolidating experience gained in labour management techniques was a subsidiary effect of figuring out the best ways to get the job done. At this stage, then, we should ask whether there are any fundamental differences between force account and contractor implementation of a labour-based policy which might impact on the

3 The term “sound labour management” is used several times in this paper. Sound labour management is the sort of management of the labour input which results in smooth and productive operations with a profit margin and confidence in the use of labour-based technology.

4 The operational differences between labour-based contracting in the construction and maintenance industry (usually roads and other civil engineering projects) and other, plant based contracting operations is implied throughout this discussion.
applicability of force account labour management experience to private sector contracting.

Clearly, the answer is ‘yes’. These differences and the influence they have on policy implementation are one of a group of reasons why the contractor approach is now being promoted.\(^5\) Aspects of force account implementation which have had an impact include:

- supervision being so well protected by civil service regulations that it becomes ineffective in the worst circumstance, and less than fully productive in the best;
- government bureaucracy being so burdensome as to make it difficult to administer a large work force;\(^6\)
- government being perceived as ‘beyond the law’ such that employment created under force account schemes sometimes perceived as not being governed by existing employment rules and regulations;
- government being in a position to ‘adjust’ existing rules and regulations to fit the labour-based activities.

Profit motivated private contractors would tend to view their labour force in a different, more ‘economic’ light. For example, depending on the arrangements established for letting of contracts and other details, contractors would more likely

- have an acute concern for the productivity of their work force such that training and retention of skills within the enterprise becomes more important;
- tend to view their workers more as employees covered by relevant laws and regulations; and
- be intent on minimising cash flow problems with its consequent wage payment delays leading to worker discontent and work stoppages, translating into delivery delays, client discontent and lost business.\(^7\)

\(^5\) See, for example, Osei-Bonsu, 1992:48. Speaking of the experience of contractor development pilot project in Ghana, “Before the advent of this pilot project, Department of Feeder Roads operated the direct labour system, i.e. workers were paid a fixed sum of money for 8 hours attendance with no account taken of output. Absenteeism was high, morale low, and supervision was almost absent and therefore output was low. It was the culmination of these factors which led to the adoption of contractors instead of using direct labour operations.” See also, Stock and de Veen, 1996.

\(^6\) Stock and de Veen, 1996: 38. “Also, force account operations place the administrative burden of having to pay hundreds of workers at remote sites on the road agency. In general, contracting reduces the administrative work of the government department and facilitates better control of the disbursement of public funds.”

\(^7\) Edmonds and de Veen, 1992: 104.
Low concern for productivity with minimal concern for labour discipline and labour standards

**Relief Work Mentality**

Typical Characteristics
- Force account: rural;
- attendance-based pay; barely monitored

A  Relevance of labour regulation, internal and external

B  Casualness of labour discipline

High Productivity Mentality

High concern for productivity with substantial concern for labour discipline and labour standards

Typical Characteristics
- Force account; less rural;
- task-based pay; closely monitored

A  Less

B  More

Figure 1: Tendencies in labour discipline in labour-based activities under “relief work” and “high productivity” mentalities.
The essence of the difference is that systems of enforcing labour discipline which are related to productivity and thus profits — would be more highly stressed under contractor schemes. This impacts on labour management. As depicted by the area within chevron A in Figure 1, management would in practice be relatively more concerned about the impact of internal (firm) and external (national) labour standards and how they would inhibit or support productivity. For example,

- do the standards allow the contractor to hire and fire at will (cutting down on unproductive labour costs and, arguably, increasing workers’ productivity by the fear of termination for reasons of low productivity);
- how extensive are the costs imposed on the contractor (payments for unproductive time, i.e. annual, sick leave); and
- how ‘far’ can a contractor go in setting up rules within his/her firm on matters such as acceptable absenteeism, levels of pay, the care and handling of equipment, etc., before the rules start impacting negatively on workers’ morale and productivity?

And overall there would be movement away from a casual employment relationship and toward a more formal one. This is reflected by the area in chevron B in Figure 1. For example,

- the contractor would tend to insist on more regular and predictable attendance in ways less frequently seen in the typical force account activity;
- task based remuneration might tend to be less prevalent because the contractor would want to impose more strict quitting times to

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8 Labour and government might express similar concerns depending on the local environment.

9 For a more detailed discussion of this effect on the labour standards issue, see Tajgman, 1995:3.

10 It has been suggested that labour-based activities are always for “casual” labourers, that is, those who, for example, have no expectation (on the workers’ or the employers’ side) of continuous work, and work only from day to day; for whom no attendance records are kept and for whom absence from a work site has no prejudicial consequences for future days of work; who are free to come to and leave the work site as they wish so long as they accomplish the task assigned for that day. In fact, evidence suggests that this high level of causality neither exists in practice nor is entirely desirable from the productivity standpoint. Regular attendance of workers is generally seen as a desirable thing and more so amongst private contractors who want to benefit from on-the-job training effects on productivity. Short term employment is, indeed, a theme for labour-based activities, but even this, depending upon the project, might be employment for several continuous months. Hence, it can be validly argued that the “casualness” of employment can vary, from more casual to more formal. The term “casual worker” used in the jargon is simply a shorthand term for a short term employment relationship with a certain degree of concern about the day to day work patterns of individual workers.
ensure the most productive use of plant, i.e., while it can most productively complement the presence of workers; or

• the contractor would be more timely and precise in the payment of wages, because otherwise, the likelihood of labour stoppage would threaten contractors’ productivity and profitability.

Returning to our basic question, and in light of the contractors’ orientation toward labour discipline, would contractors left on their own eventually fall into circumstances which undermine capacity or incentive to employ labour over machines? Or would they develop approaches to the management of labour which would sustain a practice of hiring people over machines? History suggests a tendency to eventually move toward machines, and to do so for reasons not wholly economic, i.e. it is difficult, emotionally and psychologically demanding, to manage hundreds of human beings. Even if this is not a real tendency, how long would it take for developing contractors to recognise the ‘right’ labour management choices? Put another way, can something be done in developing contractors’ skills which might prevent them—or their clients—from too rapidly coming to the conclusion that one machine is better than five hundred problems?

THE TESTS OF SUSTAINABILITY AND PRODUCTIVITY

As suggested above, the contractor must make many choices in managing labour in a labour-based project. Similarly for government in developing policies which promote labour-based contracting. What wage should be paid? Should food be given for work? What sort of payroll records should be kept? Should there be a written contract of employment? Should arrangements be made for workers’ compensation? Should sick leave or other leave benefits be given? If “fringe” benefits are given how should they be arranged? What size should contracts be let for (impacting on the size of the work force)? Should government intervene in labour market outcomes in the sector? At each turn, the wrong choice could push the contractor or the client incrementally closer to choosing plant over people.

What fundamental operational principles might underpin suggestions for the ‘right’ choice in each case? There seem to be two principles which are grounded in the objective of sound labour management and, therefore, have a certain universal applicability:

11 It is interesting to consider that at one time in history there was no such choice between labour and machines. Even today in labour abundant countries the option for plant is considered an inevitable one. But in a globalized economy, one could wonder whether the price of labour in labour abundant/capital scarce economies might not remain competitive with machinery for a very long time into the future. See generally, Stiedl and Lennartsson, 1995.
• choose the solution which tends to enhance the sustainability of the project or programme;\textsuperscript{12} and
• choose the solution which optimises productivity in the longer term.

Let’s apply these principles in a few concrete examples.

WAGES

Concerning wages, we might look first at what is legally required. If there is such a requirement and it is not met, sustainability is challenged, i.e. the contractor loses the contract because he/she does not pay according to the law. If the mandated wage is too high, here too sustainability is challenged, i.e. the financial advantage of labour over machines could be threatened.\textsuperscript{13} If the wage is too low, productivity is challenged. In both cases, a ‘re-negotiation’ of the mandated wage level might be suggested. As prices change over time, a wage level ‘re-negotiated’ on an ad hoc basis becomes a solution which challenges sustainability. Some sort of longer term solution becomes desirable, such as collective bargaining for the sector or, in the interim, an indexed statutory wage.

What if there is no statutory wage minimum? What solution is both sustainable and capable of maintaining productivity at appropriate levels? In a labour abundant country where labour-based contracting is likely to be promoted, a market clearing wage might be high enough to attract the required number of persons to work, but too low to attract high productivity workers. Overall costs might be adversely affected, threatening sustainability. To attract the cheapest and most productive labour force a contractor might switch from a task based remuneration system to a piece rate as a result.\textsuperscript{14} In certain environments, this might not be necessary as worker motivation is sufficiently high at low wage rates.\textsuperscript{15} In other environments this

\textsuperscript{12} See, for example, de Veen, 1987:13. “In applying any of the alternative options [direct labour, road section responsibilities, committee/government agreements, petty contracts, use of private sector] the key element to take into account is the motivation of the workers and their supervisors. Incentives at all levels must be incorporated as part of the system in order to make it sustainable in the long term....”

\textsuperscript{13} Recent research suggests, however, that the breaking point is actually quite high. See Stiedl and Lennartsson, 1995.

\textsuperscript{14} See, for example, Bentall, 1992, p. 57. Speaking of the contractor development programme in Ghana, “The payment of the casual labour is based on a task work system. Although task work may not be optimal in the long term for contracting (piece work is likely to be more appropriate), it greatly facilitates the planning and monitoring of the works for the contractors.”

\textsuperscript{15} For example, in environments where other subsistence or household activities demand workers’ time, they are motivated to successfully and quickly complete the task in order to be able to turn to their daily chores.
might be necessary and acceptable, resulting in sufficiently predictable productivity levels to permit management of the project and yet leave profit margins intact. And in still other environments, piece rate remuneration systems operating in practice to provide low average levels of daily income might not be acceptable. This has the potential for labour unrest challenging both productivity and sustainability. All these factors would be considered in the context of a particular firm’s project or national programme.

What if government’s labour-based programme is a short term solution to a politically intolerable unemployment problem, but existing systems for setting employment conditions are seen as highly desirable yet inconsistent with high levels of short term employment creation? What approach might be taken to wage levels? A negotiated fixed term settlement with established workers’ organisations might provide a sufficient solution. If a longer term settlement on the same basis is considered, sufficient assurances and programme elements might need to be exchanged, i.e. the limitation of labour-based (low wage) activities in the context of high community involvement in project initiation and implementation. Supplement this with workers’ education to inform and strengthen the workers’ hand in preventing sweating, and the solution becomes sufficiently sustainable for the circumstances.

RECRUITMENT AND WORK FORCE STABILITY

Turning to the related questions of recruitment, work force stability, and skill retention in the firm (with associated productivity benefits), we shall assume that contractors seek to maximise worker productivity and minimise production cost. In the context of a labour-based activity, achieving the first implies that maximum advantage be taken of training effects on productivity.16 To achieve the second, the contractor will want to minimise time on the site since overhead costs increase with time proportionately. Profits will be maximised on a fixed cost contract in these circumstances. In order to take advantage of the training effects, all other things being equal, the contractor must be able to move with his entire work force and the skills they have acquired.

In the ideal world, there are no barriers or costs involved in worker mobility and the contractor will be able to transport skilled supervisors and production workers. In the real world, there are barriers. Contracts which are let may be too large to permit mobility, distances too great, communication too slow or costly, and communities unwilling to forgo unskilled employment opportunities to compatriot “foreigners”. For a number of reasons related to labour

16 It is well known that the productivity of unskilled workers in labour-based activities improves with training and experience.
management, it is good if these barriers can be minimised and training-enhanced labour productivity thereby maximised. If institutional arrangements can be made with this effect in mind, contractors would be able to rely on training effects for minimising unit costs. Theoretically, the contractor will also be less able or likely to sweat labour because they are a familiar and stable workforce which he would be disinclined to alienate; doing so would ultimately threaten their productivity and the sustainability of his enterprise.

But one of the benefits of labour-based technology is that it is premised on the idea that unskilled labour is sufficient, typically abundant and able to recruit everywhere. The labour-based strategy was never meant to move complete (training beneficiated) workforces from one project to the next. Indeed this is so. But then again, it is only with the advent of contractor implementation that the profit-linked motivation for capturing skills within the firm has been increased. Nevertheless, unless barriers to the firm’s labour force mobility are minimised, the costs involved in workforce mobility on the scale suggested in the theory will prevent it occurring in practice.

Where barriers to the firm’s labour force mobility are not minimised, how will contractors react when it becomes less possible or feasible to maximise profits by training-based productivity? Luckily, training effects can be realised in the relatively short term of a project, i.e. two to four weeks, typically a short duration in the course of contract execution. After these gains are achieved, the contractor will theoretically seek unit cost improvement through other means. The next step would be to increase individual daily worker output, either by shifting to piece work remuneration or increasing the amount of output in a daily task while maintaining the pay level. Depending on the acceptance by workers of income levels, the tolerance of workers for the work load and, amongst other things, the duration of the project, this might not be an unsound labour management solution. However, the more the contracting environment moves towards this solution, the more likely it might threaten productivity and/or sustainability. The solution may also have hard to detect social influences. In the worst cases, the government and the entrepreneur will sooner prefer to employ one machine to accomplish the task than rely on 500 disgruntled citizens.

17 Such arrangements include limits to contract size, requirement of contracts being let to a project community member, etc.

18 It has always been accepted that a small number of skilled supervisory personnel would move with contractors. The economic benefits of such a practice are straightforward and well understood, notwithstanding costs involved. See, for example, Hernes, 1994, on supervision.
STATUTORY DETAILS

In 1983, the World Bank in an important work on the subject recognised the importance of statutory details in the planning and management of labour-based construction programmes. The experience accumulated up until then has been borne out in that accumulated since. Therefore, the few paragraphs warrant quotation here.

“Many countries have legislated measures regarding labour protection and wages. The implementation unit ought to provide site engineers with detailed instructions conforming to the prevailing laws and regulations. The instructions should cover the following: regulations on the method of recruitment and the use of recruiting agents, the provision of housing or transportation to the site, the duration of the hire period (in some countries, casual laborers become permanent employees of the hiring agency after a certain period of employment), and the differential wage levels for each type of labor (the fixed rates, the ranges of rates, and the percentage of wages paid in cash and in food), the hours of work (daily and weekly), the recognised public holidays (especially if a country has several religious groups), the social benefits (such as sick leave or the cost of medicines), the method of payment (daily paid, task work, piecework, other incentives), the pay period, and the mechanics of payment.....

Laborers must be paid on time and in full -- the importance of this cannot be overemphasised. Unskilled workers on construction sites depend on their wages for subsistence and, if payment to them is delayed, they will fall victim to money lenders. Despite the administrative difficulties for the site staff, workers should be paid every two weeks. Under no circumstances should the payment period extend beyond one month.

Payment should be in cash. Payment by check is convenient for the technical ministry but terribly inconvenient for the workers. If payment must be made in food (either for the full value of the wage or as part payment), the implementation unit should keep in mind the logistical complications that are bound to arise. Massive food resources are available for payment in labor-based operations, and considerable volumes of physical work are carried out with food as the sole payment. The food itself usually comes from a donor agency,

19 The ILO and the WFP have a long standing agreement, based on international labour standards, concerning the use of food as remuneration. See, Stock and de Veen, 1996:Appendix 3 and Miller, 1992 with citations therein. To summarise the agreement, in labour-based activities where an employment relationship exists between the worker and the employer (i.e. not bona fide self-help activities where there is no employment relationship) a minimum of 50% of the wage prevailing in the locality for the kind of work to be done must be paid in cash with the balance in food costed at the prevailing market value rates.
and the implementation unit should agree with the donors on a distribution plan. Food items should be familiar and acceptable to the laborers. If only unfamiliar items can be provided by the donors, the implementation unit should take measures to explain, not to the laborers themselves but to the laborers’ wives, the benefits of the unfamiliar foods....”

There can be little doubt that the ideas of sustainability and productivity were in the minds of the authors of these paragraphs. But where does it leave us in promoting contractor implementation of a labour-based policy, particularly where statutory details seem to not be consistent with the prime directives of productivity and sustainability?

As a general proposition, any approach which does not conform with the established rules of the game – laws and regulations – threatens the sustainability of the entrepreneur as well as the programme. From this starting point, it can be validly suggested that there are rules which are so thoroughly inconsistent with labour-based activities that they themselves threaten sustainability as well as productivity. The most glaring example is a rule which completely prohibits payment on the basis of output, even in the form of task based remuneration. Such a rule would effectively mandate work time based payment and place the onus of production on the supervisor. This approach is ineffective in the employment of large numbers of unskilled workers. Maintenance of labour productivity through an output based remuneration system is required. If such a system cannot be used, necessary productivity levels are unlikely to be achieved and the labour-based technology will be challenged. Get rid of the people and bring in the machines!

The only way to deal with such a glaring example is to seek a change of the rules. This subject and the basis for such requests have been discussed elsewhere in detail. That discussion has also suggested that there are many rules which can be implemented with minor adaptation and that benefits can be derived from adherence to rules, even if it requires additional effort, training, or resources. These are ideas which are in line with the prime directives: manage labour in ways which will be both productive and sustainable. In sum, attempt

20 Coukis, 1983: 66-68.
to manage labour as closely to the rules as possible, but be willing to challenge them when absolutely necessary.\textsuperscript{22}

\textbf{THE CLIENT’S ROLE}

Once the decision is taken to adopt policies promoting labour-based contracting, the government is in a position both as the client and as the State to influence labour management in the ‘right’ direction. The first challenge, of course, is deciding the ‘right’ direction with respect to all – and more – of the questions alluded to above. The second is deciding which implementing mechanisms are most appropriate.

Meeting the first challenge is a detailed process looking not only to labour regulation, but also to contracting procedures which will influence contractor labour management behaviour. It is in this area that more precise guidelines for policy makers will soon be developed, making use of ‘best practices’ from a range of different experiences. Such guidelines must rely on the two fundamental operational principles, sustainability and productivity, balanced in the context of the country concerned and the details of the labour-based policy.

As to the second challenge, the implementing mechanisms are relatively straightforward. They are the policy design and implementation strategy itself, as suggested in the paragraph above; the rules and regulations relating to labour utilisation; the contract itself; and the development of contractors in which the state has, in many cases, had an important role. Once again, the strategies for using these mechanisms must differ from country to country. But once again, the choices to be made must rely on the ideas of sustaining the policy for its intended duration and permitting the technology to engage labour as productively as possible.

\textbf{THE CONTRACTORS’ ROLE AS EMPLOYERS}

In a free market environment which theoretically leaves the entrepreneur free to determine his own behaviour in managing, amongst other things, labour inputs to his activities, it would seem anomalous to suggest any role for the contractor to play besides abiding by its own self interest. Determining that interest theoretically brings the contractor to the ‘right’ labour management choices. To the extent contractor behaviour is influenced by the

\textsuperscript{22} Tajgman, 1995, suggests the following rule. “Modification of or exemption from existing standards has only been suggested in two circumstances: (a) Where the application of the specific norms to labour-based activities would have results inconsistent with the type of employment the strategy of labour-based activities sought to generate. (Example omitted here.) (b) Where the results of application of the law in practice would undermine the Rule of Law or the logical intent of the existing standards.”
State's mechanisms to move labour management decisions in the 'right' direction, there may be little more to say. Except for two points. First, there must be insistence on contractors respecting the rules set up by the State in the law and in the contract. Much is lost if this is not done. The same goes for relevant industry agreements with, for example, workers' organisations. Second, contractors must be susceptible to behavior altering knowledge provided either by experience or direct training. If this can be accomplished and the knowledge acquired is consistent with 'right' labour management choices, then there is some hope that contractors moving from people to plant can be forestalled long enough to achieve labour-based policy objectives.

THE WORKERS' ROLE

As with contractors in a free market environment, there may be little scope for suggesting what workers should do – beyond following well informed self interest – to avoid behaving in ways that will unnecessarily lead to their replacement by machines. The best suggestion is ensuring that workers are aware of their best self interest. Workers' and community organisations may be in the best position to make this happen. Experience suggests that workers' organisations habituated to the idea of labour saving devices might well question the interest of those they represent in setting back the technological clock, particularly when that might mean some adaptation of protections developed as a result of technological advancement. In this domain there is careful work to be done by providing reliable information on the way labour-based activities operate in general and in the particular programme envisaged, the way they are managed by contractors, and the way abuses leading to sweating can be protected against.

CONCLUSION

This paper has suggested a broad approach for constructively handling the management of labour in labour-based construction under contractor implementation. It has pointed out that labour management by profit motivated contractors may tend to differ from force account implementation in such a way as to threaten the viability of a labour-based policy. Relying on the idea of making labour management choices on the basis of sustaining the labour-based policy and contributing to long-term productivity of such activities, examples of resulting choices were provided. Finally, hints were made for the benefit of client/State, the contractor, and the worker about the most basic aspects of playing their role in the managing of labour in labour-based activities in a way which might be most supportive of entrepreneurial and employment policy success.
REFERENCES


1.4 The client/contractor relationship in labour-based construction and maintenance

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INTRODUCTION

It is a mistake to imagine that labour-based technologies are easy to introduce. Change always involves extra work as well as possible trouble, and the extra work (as well as the blame, if things go wrong) will usually devolve on the senior or middle ranking engineers in the Ministry of Works or highways agency. When the change also involves the use of contractors rather than direct labour (force account), they have to face the further dimension of change and disruption to their established work patterns and authority.

This helps to explain the caution and conservatism in experimenting with simpler and more appropriate forms of contract. Contractor-executed labour-based projects, like all projects, are vulnerable until the procedures are well understood, and the risk of failure is significantly increased when they are introduced without adequate preparation. There are two main reasons why failure can occur:

- planners tend to set over ambitious physical and employment creation targets, which disregard the fact that a certain amount of time is needed to build up local capacity and to develop a new technological approach; and

- labour-based work tends to be seen as simple and straightforward by people who are more used to dealing with large-scale, equipment-intensive operations, so it is entrusted to supervisory staff with no relevant knowledge or experience.1

If poor quality, slow work and high costs are the results, the reaction is ‘We tried it and it didn’t work’. To minimise the risk of failure, the relationship between contractor and client must be spelled out in clear and equitable contract documents. Equity is important, and one-sided documents are not really beneficial to the client in the long run because the reputable and competent contractor really has the choice—“To bid or not to bid.” Clients who alienate this group are doomed to rely upon contractors who are both incompetent and disreputable, and in performance terms they will get what they deserve!

THE CONTRACTUAL RELATIONSHIP

The relationship between the contractor and the client is governed by the contract itself, so it seems logical to start with the basic question, “What is a contract?”. A contract can be simply defined as an
agreement between two or more parties which is intended to be legally binding. It apportions responsibility and apportions risk between the parties. Standard contracts have obvious advantages, in that the clauses have been tried and tested over the years, so their interpretation becomes easier and there is less need to become involved in costly litigation.

The most common international standard contract is that issued by the Federation Internationale des Ingenieurs Conseil (FIDIC). The conditions do at least recognise that there are different circumstances in different areas of the world, and there is some scope for modification to meet these. The first part, the general conditions, are designed to be “general” and should not be modified. The second part, the conditions of particular application, are specifically written for each contract, and sample clauses are provided to guide the user in tailoring their use to each specific situation.

On large projects where the responsibilities are onerous and the risks are great, detailed FIDIC contracts are needed and well justified. On small jobs executed by labour-based contractors, it is open to question whether complex contracts are really needed to protect a relatively wealthy and powerful client from a relatively poor and weak small entrepreneur. Contracts do not have to be complex. The following box provides a fictional, but typical, account of how easy it can be (or used to be) to negotiate a simple labour-based road contract.

Although verbal contracts of this kind can valid in law, they are usually too elementary to provide any kind of protection to the parties if things go wrong. However, the example is worth including to show that there is a spectrum of contractual complexity that is appropriate in any given case. Indeed, for those who accept the logic of Fritz Schumacher’s argument that in development terms “small is beautiful”, there is no reason why the principle should not extended to designing small and simple (if not necessarily beautiful!) contract documents.

**Fixing a price for the road to the rice mill (Burma, 1974)**

Three men in longyis had appeared, and squatted down upon their haunches on the path in front of the steps..... A slow conversation developed, evidently punctuated with jokes and repartee. After ten minutes there was a final sally, and the three got up and went away.

Nevil Shute, The Chequer Board

This leads to the proposition that the ideal contract document in any given case would be the simplest formulation that will permit effective accountability. It is also worth noting that clients are able to safeguard themselves in a variety of non-contractual ways, such as pre-qualification of acceptable firms or individuals with good track record and a refusal to sanction payment for unsatisfactory work. The
likelihood of a small contractor attempting to obtain legal redress against a public sector client is remote, even where the contractor has a good case in law.

RISK TRANSFER

Inevitably, all contracts involve risk. Apart from mobilising the managerial and technical expertise – and the entrepreneurial drive – of the contractor, the main reason for a client employing a contractor is simply to pass on the risk to someone else. The reward for carrying the risk is the profit which the contractor will expect over and above the estimated costs plus a reasonable commercial return. The higher the risk, the higher will be the profit that will be needed and expected. If the ratio of the expected risk to possible reward is unacceptably high, the intelligent contractor will keep clear of the project altogether.

In our book Foundations for Change, Geoff Edmonds and I argued that, in developing countries anxious to encourage their fragile domestic industries, excessive risk transference is definitely counter-productive and noted that:

“the would-be developing country contractor remains at the mercy of a formidable array of endemic and imposed risks that he is frequently unable to understand, let alone evaluate. The client, meanwhile, continues to decide which bid is most favourable on price grounds alone, providing that he is satisfied that the bidder is financially solvent and offers to complete within the desired contract period. Accordingly it is only the financial area that any effective discretion is available to the contractor at the bidding stage. Even this discretion is effectively limited for neophyte bidders by the problems they experience in mastering the somewhat esoteric estimating techniques that are demanded by the traditional system incorporating a bill of quantities.”

Before deciding upon the optimum level of risk transference, it is helpful to define risk itself and to examine ways in which it can be analysed and assessed.

DEFINING RISK

It is important to remember that risk can rarely be eliminated from any aspect of human endeavour, since risk is inherent in any attempt to commit present resources to achieve some form of future benefit. So no contractual system, however complicated, can ensure a risk-free project. Risk can however be identified and analysed, and it seems sensible to base a study of client/contractor relationships on a realistic diagnosis of the worst sort of risks that are likely to arise on typical contracts for labour-based construction and maintenance. The process
of risk determination is commonly undertaken as a three-stage process:

- Risk identification - developing an understanding of the nature and impact of risk on the current and potential future activities of the organisation.
- Risk measurement - the assessment and classification of risky situations.
- Risk evaluation and re-evaluation - the judgement about actions to handle risk and the possible need to re-evaluate risk options.6

Table 1 sets out typical risks on a construction project as set out in a standard text on risk management in the construction industry7, together with the author’s assessment of the need for the client to expect the contractor to accept (and price for!) the risk in a typical labour-based construction project.

Most of the risks are not serious for the client, and they are risks that the client is better placed to bear than is the typical small domestic contractor. For the client they are what Tom Peters (quoting the late W. L. Grove) describes as ‘above the waterline risks’.8 The metaphor is that of modifications to a ship. If you drill holes above the waterline, there is little danger and the resulting problems can be corrected. If you drill below the waterline, you need to think long and carefully about what you are doing. Tom Peters’ message is “Experiment (and risk failure) as long as the issue is trivial.”

MINIMISING PROJECT RISK

If the minimisation of project risk is in the interest of both the contractor and the client, how is it to be achieved in practice? Having reviewed the ILO experience in supporting the introduction of labour-based road construction techniques, with a view to proposing the general lessons for engineers involved in international technology transfer, the author proposed the following list:9

- the need to take account of the local administrative, social, cultural and regulatory environment;
- the need for a sensitive assessment of the ‘software’ factors governing the host organisation (skills, knowledge, experience, together with suitable organisational and institutional arrangements);
- the need for an open-minded approach to the choice of technology, taking account of national priorities in employment creation and the use of local resources;
- the importance of the principle of sustainability;
Table 1: Risk acceptance on labour-based projects

<table>
<thead>
<tr>
<th>Typical Risk</th>
<th>Risk to Client</th>
<th>Implication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failure to complete within stipulated period</td>
<td>Limited</td>
<td>Contractor should normally bear risk, but cost of delayed completion is usually not great</td>
</tr>
<tr>
<td>Failure to obtain statutory approvals</td>
<td>Not usually relevant</td>
<td>Client could take responsibility</td>
</tr>
<tr>
<td>Unforeseen adverse ground conditions</td>
<td>Limited</td>
<td>Not likely to occur on simple projects. Relatively easy to calculate, providing client is willing to bear the risk</td>
</tr>
<tr>
<td>Delays due to exceptionally inclement weather</td>
<td>Limited</td>
<td>Contractor should normally bear risk</td>
</tr>
<tr>
<td>Strikes and labour force unrest</td>
<td>Depends on area</td>
<td>Risk must be transferred to contractor</td>
</tr>
<tr>
<td>Price escalation in labour and/or materials</td>
<td>Depends on local inflation rate &amp; contract duration</td>
<td>Relatively easy to calculate, providing client is willing to bear the risk</td>
</tr>
<tr>
<td>Failure to let to tenant on completion</td>
<td>Not relevant</td>
<td>Not relevant</td>
</tr>
<tr>
<td>Site accidents</td>
<td>Limited in most labour-based tasks</td>
<td>Risk must be transferred to contractor</td>
</tr>
<tr>
<td>Defects due to poor workmanship</td>
<td>Limited in most labour-based tasks</td>
<td>Poor workmanship can usually be detected during measurement inspections. Long term indemnity by contractor rarely needed</td>
</tr>
<tr>
<td>Force majeure (flood, earthquake, etc.)</td>
<td>Limited</td>
<td>Little benefit in transferring risk to contractor</td>
</tr>
<tr>
<td>Claim from contractor for loss and expense due to delayed delivery of designs</td>
<td>Not likely to occur on simple projects</td>
<td>Simple clause required</td>
</tr>
<tr>
<td>Failure to complete project within client's budget allowance</td>
<td>Limited</td>
<td>Scope of labour-based road projects can usually be reduced without significant cost implications</td>
</tr>
</tbody>
</table>
- the inseparability of technical and managerial innovation;
- the need to work with and through the local private sector, including initiatives to create a contractual and regulatory environment which favours the development of small enterprises; and
- the need to provide an appropriate mix of technical and managerial training to small enterprises, including cost accounting, estimating and bidding, and understanding contract documentation such as design specifications, drawings and payment procedures.

The essential message for the client is that the minimisation of project risk is a benefit for all concerned. Once this has been achieved, the next stage should be to decide how much of the residual risk is to be transferred to the contractor. Transferring risk always incurs a premium. In principle it is best to transfer the minimum realistic level of risk, but to ensure that the contractor is properly accountable for performance.

**ADVERSARIAL RELATIONSHIPS**

In the traditional British system the promoter of the project (or client) employs a consulting engineer and bears the overall design risk, except for those specific areas of risk which may result from negligence on the part of the consultant. At the operational stage, however, the contractor is expected to bear most of the construction risks, except those which may be taken by materials suppliers or subcontractors. The traditional system has the potential advantage for a client that the competition between would-be contractors should result in their offering the lowest prices in order to be chosen, and that the price tendered by the chosen contractor is all that the client will have to pay.  

Whether these advantages are gained in practice may depend upon a number of factors, the most important of which stem from the separation of responsibilities for design and for construction. The supposed advantages that stem from this rigid separation of roles is increasingly questioned, leading to experimentation with various types of teamwork or 'partnering' approaches in which the contractual relationship is deliberately structured to foster collaboration rather than competition.

**THE PRINCIPLE OF PARTNERING**

The idea of partnering starts with the proposition that the construction industry world-wide is frequently confrontational and
conflict prone, and has been generally slow to adopt the principles and practices of quality management. Conflict and confrontation are in fact built into standard contract procedures, and partnering has been defined as choosing to live by the spirit rather than the letter of the law...... It is going back to the way people used to do business when a person's word was their bond and people accepted responsibility. Partnering is not a contract, but a recognition that every contract includes an implied covenant of good faith\textsuperscript{11}

Reciprocity and Trust

Law, contract, and economic rationality provide a necessary but not sufficient basis for both the stability and prosperity of post industrial societies; they must as well be leavened with reciprocity, moral obligation, duty toward community, and trust, which are based in habit rather than rational calculation. The latter are not anachronisms in a modern society but rather the sine qua non of the latter's success.

Francis Fukuyama, Trust\textsuperscript{12}

In his book on project partnering, Ron Baden Hellard suggests that the parties should consider establishing a partnering charter, identifying mutual objectives for the various stakeholders. A set of typical partnering goals is set out in the following box.

Typical partnering goals

- achieving specific value engineering savings
- limiting cost growth
- limiting review periods for contract submittals
- early completion
- no lost time because of injuries
- minimising the generation of paperwork
- no litigation
- other goals specific to the nature of the project

SELF-ENFORCING AGREEMENTS

The attachment to detailed and formal contracts is to some extent a cultural phenomenon. Charles Handy described an early experience of negotiating an agency agreement with a Chinese dealer in South Malaysia. When, after the negotiation, he asked for signatures to a formal agreement, the reply was "In my culture, a good agreement is self-enforcing because both parties go away smiling and are happy to
see that each of us is smiling. If one smiles and the other scowls, the agreement will not stick, lawyers or no lawyers”.

He goes on to argue that what he describes as the Chinese contract embodies a principle which goes far beyond the making of lasting commercial deals.

It was about the importance of compromise as a prerequisite of progress. Both sides have to concede for both to win. It was about the need for trust and a belief in the future. Writ large, it was about sacrifice, the willingness to forgo some present good to ward off future evil, or, more positively, it was about investment—spending now in order to gain later.13

This paper has deliberately been limited to a discussion of broad principles. It has argued for an understanding of cross-cultural differences and an acceptance of the value of fostering trust through some form of partnering arrangement. There is now an urgent need to draw lessons from practical field trials of simple contracts based on these principles, in order to ensure that contractual relationships achieve an equable spread of risk and enable contractors to establish themselves as worthwhile and sustainable businesses.

REFERENCES
1.5 Force account or contractors? A comparison of Kenya and Ghana

Gary Taylor, Director of I.T. Transport Limited, UK

INTRODUCTION

The Minor Roads Programme in Kenya and the Labour-based Contractor Programme on Feeder Roads in Ghana are two of the best known labour-based road programmes in Africa. The obvious fundamental difference between the two programmes is that the one in Kenya is based on largely force-account operations and the one in Ghana on private contractors. This paper compares the two programmes with a view to providing advice for the design of future labour-based road projects.

BACKGROUND TO THE TWO PROGRAMMES

The **Kenya Minor Roads Programme** (MRP) commenced in the mid-1980’s as a follow on to the successful Rural Access Roads Programme. The latter had demonstrated the viability of labour-based methods under force-account operations for the construction of farm access roads. In the early 1980’s it became apparent that the rural access roads were often of a better standard than the classified roads to which they provided a connection. Moreover the policy of building new rural access roads whilst existing classified roads were falling into a state of disrepair through lack of resources was clearly illogical. Therefore the aims of the Minor Roads Programme were to transfer the use of labour-based methods to the improvement and maintenance of selected minor roads, as well as to continue to maintain the already-constructed rural access roads network.

By the early 1990’s a network of approximately 12,000 kilometres of roads (including 8,000 km of rural access roads) had been constructed or improved and was under maintenance using labour-based methods. The current plans are to extend labour-based maintenance on to most of the unpaved network of about 54,000 km. On roads where traffic levels are high, labour-based methods will be supplemented by the use of light equipment such as towed graders. In areas where labour is scarce, equipment-based methods alone will be used.

The **Ghana Department of Feeder Roads** (DFR) originated within the Ghana Highway Authority. It was established as a separate department in the Ministry of Roads and Highways in 1983. From the mid to late 1980’s feeder road rehabilitation accelerated with the commencement of several donor-assisted programmes. These included a pilot labour-based road rehabilitation programme using local contractors. These contractors were equipped and trained as part of the project.
The current National Feeder Roads Rehabilitation and Maintenance Project (NFRRMP) includes the continued development and use of labour-based contractors for a part of the planned road rehabilitation and maintenance work. The NFRRMP commenced in 1992 and is planned to be completed in two phases by 1999. The feeder road network is about 23,000 km in length. Of this approximately 4,000 km is currently in a maintainable state. Under the NFRRMP it is planned that about 12,000 km should be in a maintainable state by 1999. Currently there are within the project a total of 93 labour-based contractors. 54 of these contractors are trained and equipped and 39 are trained but not yet equipped.

COMPARISON OF THE TWO PROGRAMMES

Despite the different approaches of the Kenyan and Ghanaian programmes, there are a surprising number of similarities. Various aspects of the two programmes are compared below and, where possible, conclusions have been drawn:-

- Both the MRP and the DFR employ a similar overall number of permanent staff - around 1,000. Of these, in both programmes, about 40 are engineers and 300-400 are technical personnel; the rest are support staff such as administrative assistants and drivers. This is quite surprising as an organisation relying heavily on contractors might be expected to employ significantly less staff of its own. The conclusion is that, in practice, the use of contractors instead of force-account operatives does not necessarily lead to significantly lower staff numbers.

- Both the MRP and the DFR have approached road rehabilitation in an incremental way. That is, roads have been selected and improved on a road by road basis rather than by planning investment in the network as a whole. This approach has largely resulted from the involvement of donors who have required justification of investments based on a fairly narrow viewpoint. The result is that, in general, roads have either been fully rehabilitated or not rehabilitated at all. This is even though, with limited resources to invest, partial rehabilitation would often be the best option. MRP now has adopted a more pragmatic policy based on a network approach. DFR is also moving in the same direction. The conclusion is that donor programmes should avoid the trap of taking too narrow a viewpoint when designing similar programmes. Network-wide planning and a flexible approach to improvement works, including spot improvement, should be considered from the outset.

- A feature of both programmes is the neglect, at least in the early years, of routine maintenance in favour of road improvement works. Partly this has been caused by the fact that donors have been reluctant to invest in maintenance work. Consequently DFR
and MRP have found it easier to carry out the more expensive, but
donor-supported, rehabilitation work rather than the cheaper, but
locally-funded, routine maintenance work. It is generally agreed
that routine maintenance is the most cost-effective investment
that can be made in a road network. Therefore the encouragement
of heavy investment in rehabilitation with an associated neglect of
routine maintenance is poor development. The MRP donors are
now moving to a position where their percentage contribution will
be at the same level for all activities including routine
maintenance. The onus will then be on the MRP staff to decide on
the optimum allocations to different activities. The conclusion to be
drawn is that donors should beware of providing different
levels of support to different activities (e.g. rehabilitation,
periodic maintenance, recurrent maintenance and routine
maintenance) as this can lead to a bias in investment
decisions away from priority routine maintenance work.

- Close site supervision has been found to be the most important
determinant of consistent and good quality work in both
programmes. It is worth noting that the level of DFR's own
supervision of contractor-executed work is little different from that
for the MRP force-account work. The conclusion is that close site
supervision by ministry personnel is the key to consistency
and good quality work whether force-account or
contractors are used for implementation.

- Both programmes, although labour-based, have significant fleets of
vehicles and equipment. It has been observed that these can take a
significant amount of time and effort to manage and maintain.
DFR appear to have made successful use of the private sector for
vehicle maintenance whereas MRP has generally relied on the
setting up of its own workshops. Also, the DFR fleet for the labour-
based works does not include construction equipment as this is
owned by the labour-based contractors. The DFR approach appears
more sustainable. The conclusion to be drawn is that the need to
manage and maintain equipment for labour-based
programmes is often underestimated. Measures such as
using the private sector for either vehicle maintenance or
ownership (through the use of contractors or through
hiring vehicles) probably offer the most sustainable
approach.

- Both programmes have purchased significant amounts of
equipment with donor support. This has usually been funded 100%
by the donor. The consequence has been that decisions on the
purchase of equipment by the recipients have been rather liberal
for both programmes. An additional problem is that the items
purchased will all come to the end of their useful lives at the same
time. With weak or non-existent equipment replacement
provisions, there appears little chance that these equipment fleets
The conclusion is that **conditions surrounding donor support of equipment purchase should be considered carefully. It is irrational that programmes promoting the greater use of local resources should, at the same time, lead to the liberal purchase of new equipment.**

- The institutional position of the two programmes has been quite different. The MRP grew gradually out of a ‘special project’ inside the Roads Department to a situation where it is only now, after nearly 20 years, becoming part of the mainstream strategy towards road maintenance in Kenya. The labour-based programme in Ghana, on the other hand, has been established from the outset as a key part of the DFR’s strategy towards the improvement and maintenance of feeder roads. The existence of an independent department responsible for feeder roads in Ghana appears to have been helpful for the institutional development of the labour-based programme. The conclusion is that **it is preferable that a labour-based programme is established from the outset as part of mainstream policy. Moreover, this will probably be easier in a department which has a prime responsibility for the low-trafficked road network.**

- Routine maintenance under the MRP has generally been carried out by individual lengthmen, each responsible for a clearly defined road section. The DFR uses road maintenance contracts to carry out the same activities on a complete road or a number of roads in an area. The lengthman system has several weaknesses. The key one concerns the level of supervision required to achieve good output and the costs involved with this. In reality in this becomes a trade-off between the costs of extra supervision and the benefits gained from increased, or more effective, output. However, the main strengths of the lengthman system are that it is simple to initiate and, once in place, it ensures that each section of road receives attention at all times. (This is much more important on gravel and earth roads than on paved roads.) The routine maintenance contracts, on the other hand, appear more discretionary and are apt to be postponed or forgotten. At least this is the observation in Ghana. The conclusion is that **a system of routine maintenance should be adopted which ensures that all parts of the road network receive attention at all times and, moreover, that this reliably commences as soon as improvement works have been completed. Currently, a well-organised lengthman system appears the best option. (However, this does not preclude the possibility that equally effective labour-based contractor systems could be developed.)**

- The annual work planning methods adopted by MRP and DFR are significantly different. The MRP system is based on the district
engineers, who will be responsible for implementing the plan, taking responsibility for producing the plan and setting the targets. MRP workplans are produced in a standard format and the district engineers are directed by the MRP Planning Section on the key parameters to use. The DFR is developing a Maintenance Performance Budgeting System (MPBS) to produce annual plans for each Region. This is produced centrally using a series of averages for work inputs to the roads in the network. The involvement of the Regional Engineers is limited to providing feedback on outputs at the end of the year which are then used to adjust the averages used for succeeding years. The MRP system has been in use since 1989 and works reasonably well. DFR's MPBS is still under development. Conclusions cannot yet be drawn on the relative success in practice of the two systems. However, it was the experience of the MRP that District Engineers only began to take careful notice of plans and targets when they had prepared them themselves.

- Both DFR and MRP have used computerised systems. These have tended to be overly complex for the needs of the projects. The most successful and well-used computer programs appear to be those which are small, flexible and transparent. Most other computer programs have quickly fallen into disuse.

FORCE ACCOUNT VERSUS CONTRACTORS FOR LABOUR-BASED WORKS

- The MRP has experimented in a small way with the use of labour-based contractors. However this has not, so far, been as successful as in Ghana. One of the main reasons for this appears to be that in Ghana a more wholehearted effort was made to introduce labour-based contractors. This included full-scale training programmes and assistance with the procurement of the necessary items of light equipment. However it should be noted that, even after eight years, the labour-based contractors in Ghana are still not yet considered ready for full open competition with equipment-based contractors. The conclusion drawn is that the initial introduction of labour-based contractors requires a significant and carefully-planned programme of assistance which should be sustained over a period of several years.

- The use of contractors instead of force account appears potentially more sustainable. However, there are a number of risks. The key ones appear to be that:

  i. the contractors may go out of business due to lack of continuity of work; late payment causing cash flow problems; or weak business management;

  ii. the contractors may dispense with labour-based methods and move to more conventional equipment-based methods
for a number of reasons including increased prestige in owning equipment; desire to compete for bigger contracts; desire to diversify into other areas of work; or the desire to reduce the management workload involved in dealing with a large labour force.

In Ghana, these risks have not so far been confronted. This is because the contractors remain tied by the conditions of their as yet largely unpaid equipment loans and are sheltered by the project in terms of a guaranteed workload and negotiated payment rates. The next phase of development in Ghana, when many contractors begin to complete their loan repayments and are gradually introduced to more open competition, will be the first real test of the sustainability of the labour-based contractor system.

RECOMMENDATIONS

The above comparison of the MRP in Kenya and the DFR labour-based programme in Ghana and the conclusions made have been drawn together below into a number of recommendations for future labour-based road programmes:

1. Donor contributions should be set at the same levels (i.e. at the same percentage) across all activities required for the project. This eliminates the risk of bias towards activities which attract higher donor support. The same comment applies to support for the procurement of equipment.

2. Priority should be given to the establishment of a comprehensive and reliable system of routine road maintenance. This should be a precondition to any investment in road improvement works. This is best effected by including some donor support to routine maintenance in the programme. This could be on a decreasing scale through the life of the project.

3. Selection of roads for improvement should be carried out based on a consideration of the overall network under the responsibility of the partner organisation, not on individual road links.

4. The options of spot improvement and partial rehabilitation should be considered as well as full rehabilitation of roads. Such limited investments will often prove more cost-effective than full rehabilitation on roads carrying low traffic.

5. The strategy towards providing the equipment required for the project should be carefully considered. The experience is that government-owned equipment is difficult to maintain and difficult to replace. The options to consider are:
   - hiring from the private sector;
   - selling the equipment to contractors e.g. via loan schemes;
• government-owned equipment but maintained by the private sector.

6. Labour-based programmes require a clear and unambiguous institutional setting if they are to eventually expand and become sustainable. This is best provided by a department which has the full responsibility for the roads where labour-based methods will principally be used. This will often be a Feeder Road or Local Government Engineering Department.

7. Developing labour-based contractors in a country where these do not already exist can offer a potentially sustainable means of introducing labour-based methods for roadworks. However this requires a comprehensive set of measures, including training programmes, which need to be sustained over a period of several years. It also requires an institutional framework which permits fair, open tendering for relatively small contractors and the prompt payment of their bills.

8. Planning systems should be developed which are, above all, sustainable. These systems should encourage ‘ownership’ of the plans by those responsible for their implementation. This will usually require the implementors to play a significant part in producing the plans.

9. Computerisation for planning, budgeting and monitoring should be approached cautiously. Small, simple and transparent systems tend to be the most successful. If larger systems are necessary, these should be broken down into modules which should be developed one by one and each thoroughly tested before moving on to the next module.
1.6 Research in labour-intensive construction and related development issues at the University of the Witwatersrand, Johannesburg

Prof. Robert T. McCutcheon, Head, Research Centre for Employment Creation and Related Development Issues, Department of Civil and Environmental Engineering, University of the Witwatersrand, Johannesburg, South Africa.

INTRODUCTION

Since 1987, education and research in Development Engineering has been carried out in the Department of Civil Engineering at the University of the Witwatersrand. In 1991, an introductory survey was published entitled: 'Socio-political Dimensions in Civil Engineering Education at the University of the Witwatersrand'. This article will provide an updated summary of the research. The research is contributing to the resolution of various national problems through the application of First World engineering skills in such a way as to take account of the Third World context within which they are required.

The programme involves original research into problems that require urgent resolution, particularly the provision of the urban infrastructure for developing communities and the provision of the major infrastructure required to underpin economic development in both urban and rural areas.

The objectives of the research programme in development engineering are:

i. a contribution to the resolution of the technical problems;

ii. the production of a body of knowledge and human resources required for future small and large-scale developments;

iii. the provision of guidelines as to how communities, engineers and the public sector should interact during project definition and implementation.

Particular progress has been made in relation to a subset of Development Engineering, namely, Employment Creation in Construction (construction and maintenance of infrastructure using labour-intensive methods).

The objectives of this subset are:

a) the production of the necessary knowledge to enable a significant increase in the proportion of skilled and unskilled labour in the construction of civil works projects: this increase will be achieved economically and will be to specification, i.e. it will result in as high a quality of product as allowed by the funding available;
b) the production of skilled human resources capable of understanding, directing and controlling the technologies and processes required to optimise the use of labour-intensive methods of construction and maintenance and thus the achievement of productive employment creation in civil construction;

c) the production of the necessary information base for the institutional, organisational and administrative aspects of a national employment creation programme for the provision of public infrastructure.

The research that has been carried out in relation to employment creation in construction and related development issues is summarised below under three broad headings:

i. policy aspects of employment creation in construction;

ii. technical and organisational aspects of employment creation in construction;

iii. development engineering.

1. POLICY ASPECTS OF EMPLOYMENT CREATION IN CONSTRUCTION

Two national programmes of productive employment creation in road construction and maintenance have been described and analysed: the Kenyan Rural Access Roads Programme and the Botswana District Council Roads Improvement and Maintenance Programme.\(^1\text{-}^7\) Analysis was both internal and comparative: the programmes were analysed in terms of their own objectives and by comparison with each other and international material (in particular the World Bank's Study of Labor and Capital Substitution in Construction). The research led to various conclusions as to the reasons for the success of these programmes.

Drawing upon experience and analysis of the programmes in Kenya and Botswana in particular, it is considered that the following are the main reasons for success:

i. Programmes were long-term and national.

ii. There was a sound intellectual assessment of the technical feasibility and economic efficiency of using labour-intensive methods: cognisance was taken of technological and institutional capacities.

iii. Technical, institutional, organisational and socio-economic aspects received concentrated attention during preliminary work, continued through pilot projects, embryonic training programmes, and subsequent national programmes. Technical matters included design, standards of construction, specifications, tools and equipment, and methods of construction. Institutional matters included the decentralisation necessary for grassroots success and
the centralisation necessary to plan and co-ordinate a large
 programme. Organisational aspects included management
 structures and systems (recording, reporting, controlling,
 monitoring and evaluation) and training. Socio-economic aspects
 included wage rates, conditions of employment, labour supply, role
 of women and social impact studies. Prior agreement was reached
 between the different parties with regard to wage rates, conditions
 of employment and the role and responsibilities of the community.

iv. Strong organisations were established with good management
 systems; a balance was achieved between decentralisation and
 centralisation.

v. Training was extensive and good at what is set out to do.

vi. There was long-term political support.

vii. There was long-term financial commitment.

viii. On balance, there was good co-ordination between the
 government, government departments, those administering the
 programme, local authorities, those providing technical assistance
 and donors. This was facilitated by objective external advice by
 the ILO.

And the corollary: they were not short-term emergency relief
 projects.8-12

The last point cannot be over stressed. The large national
 programmes were not conceived, designed or implemented as
 emergency or relief programmes. To the contrary, while social
 objectives were important (employment creation, skills development,
 local and national institution building, rural development), the
 engineering and management aspects were treated very seriously.
 The research led to the formulation of practical guidelines for rural
 road programmes in South Africa.13-14 It also provided a series of
 benchmarks against which to compare South African employment
 creation programmes.

A general survey of such endeavours15 has been complemented by
detailed research into particular programmes (Greyling, Pitso,
 Mthombeni in Table 1). In general, these studies have concluded that
 the local endeavours have failed to achieve their stated objectives. In
 particular in relation to the road component of the Strategic Oil Fund
 the following was found from a detailed examination of what actually
 happened to the expenditure: 54% conventional; 7% labour-intensive;
 39% labour extensive (i.e. little or no good quality product obtained by
 very unproductive methods of using labour). The studies also
 concluded that the local endeavours have failed because they have
 ignored the criteria for success identified above.

The research into the national programmes also led to the formulation
 of a strategy for increasing employment creation per unit of
expenditure in the construction industry. This strategy has been progressively refined. The necessity for the adoption of a long-term ‘programme’ (as opposed to ‘project’) approach to employment creation in construction has been substantiated by the conclusions from the failure to date of most South African endeavours.

At the same time, we have collaborated with industry and organised labour in developing a Framework Agreement. Industry agreed to maximise the use of labour-intensive methods of construction in the provision of public works with due regard to economics while in turn COSATU agreed to the linking of payment to production under certain circumstances. The Agreement functioned formally for one year and informally for another. It is in the process of being re-negotiated and appears poised to fail in two crucial respects: payment is being uncoupled from production and casual employment rapidly becomes permanent.

The strategy for increasing employment creation per unit of expenditure was developed further through a widely participatory study under the auspices of the National Economic Forum. The necessity for the adoption of a long-term ‘programme’ (as opposed to ‘project’) approach to the issue has been substantiated by the conclusions as to the reasons for the failure of most South African endeavours. Research has also led to some interim conclusions as to what may be achieved under what conditions with short term programmes. Some of the strategy has been incorporated into the National Public Works Programme (NPWP) (initiated by the Government of National Unity in August 1994, responsibility for which is located in the Department of Public Works). In essence, the NPWP has two strands: (i) the restructuring of public expenditure on infrastructure and (ii) a community based public works programme (CBPWP). The restructuring of public expenditure would include (i) changing the tender regulations in such a way as to encourage labour-intensive methods and small contractor development and (ii) incorporation of the Framework Agreement into the formal process (according to the original intention of linking payment to production). If these objectives are achieved it could have a positive impact on employment creation. By contrast, the CBPWP is noticeable for its transgression of most of the factors identified as reasons for success above.

Research has also been carried out by Phillips, Pintusewitz and McCutcheon into a Choice of Technique Analysis (subsequently re-named Cost of Technique Analysis (COTA)). Conventional civil construction is highly mechanised. Without sacrificing quality, employment may be created through the substitution of labour for equipment in most road construction activities. However, there may or may not be a premium to be paid depending upon the particular type of work, the specification, the wage-rate and the conditions of employment. Depending upon the assumptions, in his PhD thesis
Phillips found that employment could be increased by a factor of 40 (4,000 per cent increase). This COTA may be used by decision makers and practitioners in the field of employment-intensive construction to find the best mix of labour and equipment on any particular project, or to establish policy guidelines on the amount of labour best suited for a programme of construction. COTA provides a methodology whereby for any wage rate and any mix of labour and equipment, the cost of employment may be estimated. Further research has led to estimates of the amount of employment that can be created within the five-year time scale of a NPWP.21

2. TECHNICAL AND ORGANISATIONAL ASPECTS OF EMPLOYMENT CREATION IN CONSTRUCTION

Technical and organisational aspects have received and are receiving attention from Gertzen, Grobler, King, Kwesiga, Mayne, Miyanadeniya, Mkhize, Pama, Phillips, Rankine, Sakulski, Semenya, van Steenderen and Wienmann (Table 1). In 1991 Phillips investigated the viability of reintroducing water bound macadam (WBM) as a base course material for high standard road construction.25-29 He found that there was the possibility for a ten-fold increase in the proportion of labour devoted to the construction of the base-course. Depending upon the assumptions made, there was a financial premium of 10 to 70 per cent. As part of his doctorate he carried out more detailed research into technical matters (and into the financial trade-offs between cost and employment COTA).

The potential to make greater use of labour-intensive methods for higher standard rural and urban roads has begun to be explored by van Steenderen in his examination of ionic chemical stabilisers.30 The use of labour-intensive methods for low-volume, low-cost roads is no longer problematic (the establishment of programmes is a different matter). If methods could be developed to ensure that ionic chemical stabilisers are used sensibly it would lead to the possibility of much greater use of labour in the construction of higher standard rural and urban roads.

Guidelines for appropriate contract procedures and documentation for labour-intensive construction have been prepared for the Development Bank of Southern Africa.31 The technical and organisational methods developed during the Botswana District Council Roads Improvement and Maintenance Programme have also been distilled and brought to a wider audience: Guidelines for the Training of Road Builders.32

Collaborative research initiated by the South African Bitumen and Tar Association (SABITA) resulted in the publication of SABITA’s Manuals 11 and 12 on labour-enhanced construction of bituminous surfacings.33,34
3. **DEVELOPMENT ENGINEERING**

In the broad field of Development Engineering several pieces of research have been carried out (Abbott, Abrams, Gericke, Kanetsi, Oliviera, Thom and van Ryneveld) and research is currently being pursued (Hazelton, Ive, Makhetha, Molepo, Rust and Tainton) (Table 1). Most of this research has been carried out by students who have only been able to register part-time. They have been encouraged to focus upon topics related to their daily employment.

John Abbott (‘The theory and practice of community participation in the provision of urban infrastructure’) has since become Professor of Civil Engineering (Urban Engineering) at the University of Cape Town). Len Abrams (‘Family scale rural water treatment’) set up and ran the Rural Advice Centre (now defunct) before becoming an adviser to the Minister of Water Affairs.

McCutcheon is a co-founder and co-editor of a journal ‘Urban Forum’ which is into its seventh year and publishes academic articles on the issues confronting South Africa in relation to development, planning and physical infrastructure. The journal was accredited by the Department of Education in 1993.

**CONCLUSIONS**

**Assessment of Impact to Date**

The programme has made significant contributions in the following endeavours which are important for development in South Africa:

1. Innovative research which has indicated that employment-intensive methods of construction and maintenance may be used for high volume, high standard urban and rural roads not just low volume, low standard rural roads.

2. Research related to a greater understanding of the spectrum of matters which require attention for the successful implementation of employment-intensive employment creation programmes.

3. Broadening of civil engineering education to include an understanding of the importance of socio-political factors while making sure that the engineering is technically and economically sound.

4. Production of competent human resources across the rainbow to contribute to the resolution of the socio-technical problems confronting this country.

5. Transfer of the technical research findings into practical field engineering projects.

6. Incorporation of the policy research findings into the policies and strategies of the nation.
We consider that our work is extremely pertinent to the needs of South Africa. We have made good progress in relation to research, education, graduates, field work, policy and institutional development. Our work has been recognised locally and internationally.

**Expected Medium Term Impact**

To date, the research has concentrated upon policy and technical aspects of employment creation in construction with particular reference to road construction and maintenance. The strategy for the future is as follows:

In relation to technical aspects, the research group will focus upon:

i. technical problems related to use of labour-intensive methods for high standard rural roads and urban bus routes;

ii. the use of chemical stabilisers for both high volume and low volume roads;

iii. maintenance.

In relation to institutional, organisational and managerial aspects, the research group will focus upon:

i. the role of the public sector in the planning, financing, training and execution of road construction projects;

ii. the role of small contractors in the provision of infrastructure.

This work will be carried out through the funding provided by the Department of Transport.

There is great scope for the creation of employment in road construction. The intellectual underpinnings are sound. However, it has to be admitted that the existing civil engineering industry is structured in such a way (machine based) that employment-intensive construction is counter intuitive for an individual company or public agency. Industry can only change if the rules are changed. Until this happens, labour-intensive methods will not be used on a large scale. In the meantime, we must continue with research into policy and into the more technical and organisational issues which will be faced by the public sector and industry during the implementation of such projects and programmes as are initiated.

By contrast, the building industry is already labour-intensive. At the same time there is a huge need for housing. The provision of low-income accommodation could provide an opportunity to also create employment and skills. Experience during the past few years should have indicated that a significant increase in the production of housing is difficult to achieve quickly. The scale and scope of various delivery systems needs to be investigated thoroughly in order to provide the basis for the preparation of realistic programmes. Post World War II experience in Europe suggests that we should be wary of capital-
intensive solutions (less employment, less skills development).\textsuperscript{35,36} Previous research also indicated that the role of artisan skills required particular attention. The research will initially be funded by the FRD and will focus upon the relationship between housing (scale, scope, type, technology), employment creation (amount, skills) and delivery (management, organisation, institution).

As in the past, part-time students will continue to be encouraged to focus their research upon problems with which they are or have been confronted in their daily work. In this way we will gain further insight into broader aspects of Development Engineering.

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1.7 Contract documentation for labour-based road construction

B. K. Yanney, Lecturer, Department of Civil Engineering, University of Zimbabwe, Harare, Zimbabwe

1. INTRODUCTION

When building engineering projects, two methods of construction are possible, viz., using technology dominated by mechanical equipment or that dominated by mechanical labour. The items of plant now available to the construction industry are very intensive. Construction equipment now ranges from simple hand tools to very expensive and sophisticated equipment capable of executing tasks beyond the capabilities of manual labour.

Many construction industries normally opt for plant-intensive methods of construction. The main reasons given for selecting this method of construction are that:-

- Plant-intensive methods of construction tend to increase the rate of output so that project construction duration can be considerably reduced.
- The use of construction equipment can help maintain high quality standards required by present-day designs and specifications.
- It is difficult to control workers. Only experienced supervisors can induce workers to produce acceptable labour outputs. The rated output of basic construction equipment can be obtained from the plant manufacturers. In the case of labour-intensive activities the expected outputs are normally negotiated with the help of gang leaders before the actual implementation, which may still require very tactful handling.

Although the use of plant-intensive methods for the construction of rural roads can be very effective, the procedures usually have two major drawbacks for developing countries. Firstly, the construction equipment (including spare parts and, in some cases, the personnel to operate and maintain the equipment) are paid for in foreign exchange. Secondly, equipment-based methods of construction offer very few employment opportunities for the rural people. Over 75% of the total population in a typical developing country lives in the rural areas where employment generation is always needed.

Most developing countries face severe shortages of foreign exchange which is needed for the importation of construction equipment. In addition, the economic structural adjustment programmes (ESAP's) being pursued by most of these developing countries have resulted in market reforms leading to keen competition in the industrial sector. A number of industries in the informal sector which have not survived
this competition have been forced to wind up thereby increasing the level of unemployment which has already witnessed steady increase and undergone a steady increase resulting from the trimming down of the size of the formal sector.

Part of the solution to the current unemployment crisis facing most developing countries would be to embark on a serious employment creation programme for the rural areas. A programme of rural road construction and maintenance using labour-based methods can serve the dual purpose of creating employment opportunities for rural people while at the same time conserving the scarce foreign exchange needed for importing the construction equipment.

### 1.2 Conditions which favour labour-based methods

Before a final decision is taken to implement labour-based methods, the following important factors must be considered.

**1.2.1 Minimum wage of available unskilled labour**

Labour-based methods of construction have been found to be competitive with plant-intensive methods when the average unskilled wage rate is equivalent to about US $4.00 per day (1995) or less. This 'break-even rate' or the wage beyond which workers cease to be economic compared to machines has been found to vary from one project to the other. It also depends very much upon the employment climate in the country. The break-even wage has been found to be only US $3.00 in Zimbabwe; it is as high as US $10.00 in Lesotho, probably because workers in Lesotho have access to employment opportunities in rich South African mines.

**1.2.2 Availability of labour**

The project manager must determine in advance how many workers will be needed and for how long. A detailed programme of work must be drawn up. Copies of the programme of work must be distributed to sub-contractors, suppliers etc.

Rural roads (e.g. feeder roads) generally link villages (and other major agricultural centres) to cities and towns. Local chiefs have been found to be very helpful in arranging casual labour at short notice. It is always advisable to take into consideration planting and harvesting seasons which are always devoted to serious work on farms.

**1.2.3 Experience with labour-based methods will ensure good results**

Experience with labour-based methods of construction will ensure good results. Correct management techniques must be enforced so that large numbers of people may be effectively employed. The supervisory staff must be conversant with the basic techniques of task setting. These consist essentially in establishing gangs for the project in hand and defining the pre-measured activities to be performed by
each gang in a measured time interval. The allocation of resource for example, manpower to a construction activity on a daily basis so that each worker in the gang would have contributed his daily output, is the most important aspect of labour management control.

1.2.4 Designs must be ‘neutralised’

Designs must be modified to suit labour-based methods. In the industrialised countries, the use of advanced technology, availability of capital and high cost of labour have led to designs, specifications, conditions of contract and other methods of construction which favour equipment-based method of construction. Engineering and other training institutions in the industrialised countries expose students from developing countries exclusively to equipment-based construction concepts. When projects are being formulated, those aspects of design, specification and contractual procedures must be defined in such a way that any bias is removed and alternative methods can be considered on a comparative basis. This process is known as ‘neutralisation’.

Under normal circumstances field engineers seldom participate in decision making. Therefore they cannot influence any decision taken at the project implementation stage when the design may influence one specified basic method of construction. Opportunity must therefore be given to field engineers to participate in the ‘neutralisation’ process.

1.2.5 Nutrition and health of workers

The nutrition and health of the workers on the project must be given serious consideration. Experience has shown that the following measures will help improve productivity on the site.

1.2.5.1 Subsidised meals

Subsidised meals for the workers may mean extra expenditure for the employer, yet in the end, workers may return from break on time. Some employers supply meals to the workers on credit, payable at the end of the month. This ensures that workers are well fed during the critical days of the month when most workers do not have money to buy food. If meals are not to be subsidised then the alternative is to provide canteen facilities for workers to buy their food at break times.

1.2.5.2 Transportation facilities

Lateness and absenteeism can be substantially reduced by providing transport for workers to and from the site. The collection points and times when each group of workers are to be picked up should be communicated to the workers or their gang leaders.
1.2.5.3 First-aid kit on site
First-aid kit on site may save very serious situations. Such facilities which tend to improve the welfare of workers help to improve productivity.

2. DIRECT LABOUR OR CONTRACT?
The current economic structural adjustment programme has intensified the call for the reduction of the formal sector. Hitherto the size of each ministry has been allowed to grow large enough to allow the ministry to execute projects by 'direct labour'. In using this strategy the ministry can execute projects using its own group of professional and technical staff, and other gangs of skilled and unskilled workers. The major advantage of this approach is that the ministry will retain a group of workers who may have gained several years of construction experience. The problem of having to look for casual workers on monthly or daily basis does not arise and therefore the expected output which has been developed over the years can be sustained.

2.1 Labour-based contracting
A typical labour-based construction may consist of about 600 casual labourers excluding senior site supervisors, site supervisors, field assistants etc. Assuming that during the final phase of the programme, four units are to be established in each of the eight provinces, then about 20,000 casual workers will be employed. The ministry will need a substantial financial injection in order to establish site offices in addition to the staff needed to supervise such a large labour force.

If construction and maintenance works are given out on contract to local contractors who have experience in labour-based methods, then the ministry can afford to reduce staff and retain a few of the highly experienced supervisors who will then check and approve items of work being executed by contractors. Most of the labour-based roadworks are still being executed by direct labour in Zimbabwe. The next phase (which will follow soon) will be to involve some local contractors.

2.2 Some possible advantages of contracting
If workers are adequately and promptly motivated, productivity can be considerably increased. The bureaucratic system in the Civil Service does not give room to field supervisory staff to use their initiative to explore ways of motivating workers to offer increased outputs. Contractors normally have smaller outfits (and hence overhead costs are much smaller). If intensive training programmes are started now then there will be a great future for labour-based contract works.
3. DEVELOPING DOMESTIC CONTRACTORS

Background

In the past two decades, domestic contractors in Ethiopia, Ghana and Kenya have been gradually developed. Domestic contractors in these countries were selected, provided with works and site management assistance, and finally licensed as road contractors. A reasonable measure of success was attained, but, in Ghana, a third of the contractors previously trained have been put out of business as a result of long delayed payments, and also by the massive devaluation of the cede.

Domestic contractors have a competitive advantage over large international firms especially in the case of rural road construction and maintenance. Rural road networks are small and scattered. Besides, a large percentage of the rural road construction and maintenance may be carried out using labour-based techniques which again tend to favour small domestic contractors. Therefore if rural road construction and maintenance programmes are planned on a regular basis, there will be a steady demand to sustain domestic contractors.

Small and medium-sized contractors may be suitably prepared for rural roadworks such as labour-based road construction, regrading and regravelling, through seminars, training, technical manuals and specially prepared contract formats.

4. TRAINING OF DOMESTIC CONTRACTORS

Opportunities are provided for various categories of the contractors' staff (viz managers, administrative managers and staff, project managers, engineers and technicians) to attend seminars on site management techniques, and labour-based road construction/maintenance methods. Sample works are organised with and are carried out by selected contractors while other contractors in the area are invited to visit and watch demonstrations.

Technical assistance to contractors should focus on works preparation, programming, allocation of resources, site management, cost and quality controls. Promoting labour-based methods of road construction/maintenance is another way to develop small contractors. Labour-based methods require low capital investment; however, good organisation and site management are the recognised keys to successful project implementation - these techniques must be taught to contractors.

If the role of domestic contractors should continue to be dynamic, the need for reforms in the following areas will be required:
• Payment procedures for public contracts must be overhauled so that contractors are paid promptly for work executed.
• Conditions of contract including escalation formulas based on reliable statistics, contract administration procedures etc. must be constantly reviewed.
• Employment regulations, restrictions on hiring and firing of labour, minimum wages, contractors’ access to foreign currency etc.

5. CONTRACTS FOR ROAD CONSTRUCTION

Modes of measurement for payments

The three modes of measurement for payments are associated with three options for setting up contractors for works as follows:

a) Cost-plus-fee type of contract

This appears to be the weakest with regard to cost efficiency. However, in very specific and emergency cases a cost-plus-fee contract may be used because it gives the site manager wider flexibility to address needs. To prevent possible abuse, it may be desirable to include a small cost-plus-fee component in a unit-price contract in order to give some flexibility. Also a ceiling amount on the cost-plus-fee component will limit the risk of abuse.

b) Paying for actual works under a unit-price contract

The contract consists of unit prices for the itemised kinds of works and bill of quantities (BOQ). Payments are made in accordance with actual works executed. Labour-based routine road maintenance, drainage maintenance and repairs, regrading and regravelling works may be given out on such contracts.

c) Paying for services under lump-sum contract

Under this contract scheme, the road standards to be reached are specified: contractors are free to select and carry out appropriate works to meet these standards. Contractors may be paid for road maintenance work on lump-sum basis per year.

d) Quality specification

A simple, realistic and verifiable target should be set. Tough technical specifications that contractors cannot meet and that supervisors do not enforce demoralise both parties and lead to abuse.

e) Working conditions

Adverse climatic conditions create an important risk, especially on earth and gravel roads. A storm can seriously damage the road just
after the contractor has completed the section but before the supervisor's visit. A heavy truck can destroy several kilometres of earth roads. Who pays for this damage? Contract documents must give a clear definition of the risk to be borne by the contractor.

f) Contract award

Procedures for contract awards should be streamlined and timed so as to enable contractors to take advantage of the dry season.

6. CONCLUSION

Contract documentation for labour-based road projects must be simplified since most contractors may not understand voluminous contract documents.

Some simple schedule of rates contracts may be quite ideal for labour-based road construction and maintenance.

ACKNOWLEDGEMENTS

The paper is presented as a contribution from the Civil Engineering Department, University of Zimbabwe with Prof. L.D. Vassileva as the Chairperson.

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E.N.K. Ashong, National Co-ordinator, Department of Feeder Roads, Accra, Ghana

1.0 INTRODUCTION

The economy of many developing countries is on the decline. Attempts to reverse this trend have led to the institution of economic recovery programmes with their attendant austerity measures. The socio-economic effects of economic recovery programmes need to be cushioned to avoid short term economic hardships and long-term social upheavals. Most developing countries have identified the ineffectiveness of the Civil Service due to lack of adequate logistic support as one of the core causes of the problem and have started shedding part of the government direct labour load to the private sector. This re-deployment exercise cannot be effective without vibrant private sector programmes to give adequate absorption of the hitherto redundant government labour force in order to cushion the obvious effect of this exercise. One such private sector programme which has a potential of high labour absorption is the labour-based road programme.

Ghana embarked on an economic recovery programme in 1993. Some state owned enterprises (SOE) were privatised to absorb the government shed load due to a re-deployment exercise. By 1984, the condition mix of the road network was 15% good and the rest were divided between fair and poor; the acquisition and running costs of capital equipment were prohibitive and there was quite a stock of idle rural forces. These conditions were opportune for the introduction of the novel labour-based road rehabilitation and maintenance programme with private sector participation. This project can be said to have absorbed quite a substantial part of the hitherto idle labour force in both the government sector and the rural areas. For the private sector to perform such a role there needs to be a planned systematic training and capacity development with a view to enhancing and tapping the latent business acumen of this sector.

The failure of many labour-based road programmes has been attributed mainly to non-acceptance and on the part of most technocrats. Scepticism by technocrats can easily be overcome by physical output. The real cause of failure or limited success can be attributed to the way the programme is developed. In most cases the target group is alienated or just utilised instead of being made participant at each stage of the development. This paper looks at how the Ghana programme was developed including classroom training, pilot, demonstration and replication stages.
2.0 BACKGROUND

2.1 Status of the Ghana Programme

The labour-based road programme in Ghana using small-scale contractors started in 1986. Currently ninety-three (93) contractors have been trained and fifty-four (54) have been equipped with the appropriate set of light duty equipment at an average cost of US $150,000 per contractor. About 1,400km of roads had been rehabilitated by the end of 1995 at a total cost of US $14 million. With an average of 2,500 man-days per km and a minimum wage-rate of about US $1.0 about US $3.5m (about 25% of the total cost) has been injected directly into the rural economy so far. The trickle down effect of this injection in terms of the uplifting of the social status of the rural folk cannot be overemphasised.

3.0 SMALL-SCALE CONTRACTOR DEVELOPMENT

Small-scale contractor development should be planned to fit into the overall programme development. This is necessary to ensure that the private sector efficiently performs its supporting role at every milestone of the programme development. The use of the private sector in labour-based works imposes an extra technical supervisory role and vigilance on the government supervising agency and there should always be adequate internal capacity to perform this function.

3.1 Programme Objectives

The development and application of labour-based technology for road rehabilitation and maintenance in Ghana started in 1986 as the Department of Feeder Roads (DFR) component of the World Bank funded Fourth Highway Project. UNDP provided funds for the necessary technical support by the ILO. The programme has the following objectives:

• Improvement of access to rural areas through the large scale application of cost-saving approach to feeder road construction, improvement and maintenance utilising local resources.

• Creation of a capacity within the Department of Feeder Roads and a number of private contracting firms to efficiently apply cost-saving methodologies to road improvement and maintenance.

• Creation of additional employment opportunities by the introduction of cost-effective labour-based approaches for feeder road construction improvement and maintenance.

From the above programme objectives a systematic and planned programme with private sector involvement is inevitable.

The project objectives were achieved in three phases:

I. Training of individual supervisors from small-scale contracting firms and foremen and engineers from DFR.
II. Developing company capabilities of contractors by giving them 5km each of real life trial sites to run on their own under DFR supervision.

III. Company development through on site training by giving each qualified contractor from the second stage 20km of road to rehabilitate per annum.

The Ghanaian road construction industry, before the introduction of labour-based technology, was characterised by the conventional capital-intensive methods. Thus like the introduction of any new product into a monopolised market, this new technology met a hostile environment. To break this barrier and penetrate the market there was a need to advertise hard. This advertisement was done by initially holding meetings with various interest groups.

The target group, politicians, community leaders, chiefs and other opinion leaders participated in these project seminars. These meetings and project seminars created a forum for initial marketing of the programme. Other issues discussed at these meetings related to the roles to be played by all involved, the assistance needed from and benefits to the target group. These meetings were followed by a careful field introduction of the project.

A three stage process must be adopted in the introduction of this technology. The programme must be considered as a policy experiment and therefore an effective feedback mechanism must be created in order to alert the executing agency in time to respond and adapt to changes at any stage of the project. The three stages can be classified under Pilot, Demonstration and Replication.

3.2 Pilot Stage

This phase is used to test the feasibility and acceptability of the innovations upon imported norms from programmes in other countries. New organisational arrangements and management procedures are tested.

Prior to the Ghana programme, there had been a large scale programme in Kenya (RARP) using force account and with the full involvement of the ILO. The Ghana model was unique in the sense that it was the first programme to use small-scale contractors. Thus although the efficacy of the technology could not be doubted, the same could not be said about using the private sector. The Pilot Project was started in Sefwi-Wiawso in the Western region of Ghana in 1987 and was managed by a team headed by a Project Engineer and an ILO Technical Advisor which operated from a Project Office in Sefwi-Wiawso and reported directly to the Director of DFR. By setting up a separate project office the level of supervision and interaction and feed-back is high than through the normal Departmental set-up.
During this stage, seven contractors were trained, equipped and taken through the three carefully planned training phases. The following must be addressed during this stage:

1. Security in terms of finance

2. Time for establishment, diffusion of information and acceptance by participants.

3. An understanding and respect for diversity of cultural values and the norms found within communities, their amenability to change and degree of control that local people have over the factors that create, maintain, and alter those values.

4. Formal and informal authority relationships within communities taking part in the programme.

Project planning during this phase is flexible and responsive. Careful attention is paid to site selection, labour recruitment and avoidance of conflict with local officials, political leaders and vested interest groups.

3.3 Demonstration

The demonstration stage of the labour-based programme was started in 1990 by expansion into two more regions namely Ashanti and Brong-Ahafo.

The purpose of a demonstration stage is to test how the organisational structures developed during the pilot phase will fare in different environments and away from the strict monitoring of the project team.

Six contractors were trained and equipped for each of the two regions. During this stage some of the advantages and autonomy of the pilot phase were withdrawn. This was so as to determine how the project would fare under the stringent civil service rules. This phase is therefore necessary to build administrative capacity in small incremental, rather than large scale and complex activities which have a higher probability of failing. This phase helps to determine the additional resources and manpower needed for full-scale expansion of the programme. The transfer of expertise from experts to local counterparts must be evident at this stage.

3.4 Replication and Dissemination Stage

This phase is the nation-wide expansion of the tested methods and techniques. The major aim of this phase is to expand administrative and productive capacity and sustainability. Local counterpart staff should be adequately trained and equipped to run the projects. The sustainability of the programme should not be hinged on artificial structures and privileges which cannot be maintained. These structures, which are necessary during the pilot stage, should have been removed by now.
At this stage, the administration of the project was transferred to the normal DFR regional set-up. Each region had a Project Engineer for labour-based projects. In determining the rate of replication, the following factors are considered:

- Degree of Executing Agency participation
- Quality of project staff
- Degree of financial support
- Strength of leadership and human resources within the Executing Agency

The project is managed at Head Office level by a National Co-ordinator under the Deputy Director (Development). The most important phases are the initial and trial contract period of training. Actual knowledge and skills of labour-based technology are imparted at the initial stage. This is then put on trial where areas of insufficiency in knowledge and skills are corrected. Our main focus has been on the initial training phase. This phase has been quite dynamic. It has gone through various forms, each time improving on a previous form.

4.0 MANAGEMENT OF A FULL SCALE PROGRAMME

Experts in modern marketing will confirm that every new product introduced into a competitive market has a life cycle made up of four distinct periods namely introduction, growth, maturity and decline. The period of decline is very difficult to manage. Two of the main contributory factors to a sharp decline are excessive competition and uncontrollable decline in product quality. The same marketing principle can be applied to development of a labour-based programme. The Ghana programme is in the maturity period and needs to be cautiously and judiciously guarded to avoid early entrance into the decline period. Appendices (1) and (2) set out causes of decline and suggest measures needed to avoid the transition into the decline period.

Experience gained over the years has shown that there are some pitfalls which need to be addressed or avoided in any labour-based programme involving the private sector. The most important of these are:

**Politically Propelled Over Expansion:** This becomes inevitable when the programme has been accepted as a panacea for the solution of labour problems in the country. Care and diligence should however be exercised not to sacrifice quality by considering the programme as just an employment generation exercise.

**Enough Supervisory Capacity of the Executing Agency:** As the number of contractors trained increases a corresponding number of
supervisory staff of the executing agency should be trained. In the worst case there should be one supervisor to two (2) contractors.

Private consultants should be trained to help in the design and supervision of projects where in-house capacity is found to be inadequate.

**Follow-up Training:** Enough and prompt feedback mechanisms should be put in place to enable the training division to respond to the needs of already trained foremen and supervisors. This will lead to the institution of corrective measures at the very early stages.

**Geographical Expansion:** This should be gradual and should be matched with the available manpower and logistical support.

The labour-based programme in Ghana has been in existence for about eight years. The number of contractors trained have increased from seven (7) to ninety-three (93) over this period.

**5.0 CONCLUSION**

The novel labour-based programme in Ghana like a good new product has been able to penetrate the Ghanaian construction industry. Having made its mark, the programme has won the support of all especially the Government because it is in line with its privatisation programme and has the added benefits of rural employment generation leading to a reversal of rural-urban migration. For cost-effective and sustainable private sector development and utilisation in labour-based road programmes, a high premium needs to be placed on training and supervision. When the in-house capacity for supervision is out-run as a result of a fast expansion employment of the services of private consultants should be employed.
Objective analysis tree

IMMEDIATE OBJECTIVE

Increase in quality and output

Increased DFR supervision and monitoring

Increased DFR site visits

Increased DFR engineers and foremen's commitment

Reduction in number of trained contractors

Narrow geographical spread of contractors

Increase in DFR engineers and formen's commitment

Ability of contractors to pay promptly

Reduced cash-flow problems by contractors

Acquisition of financial management exp. by contractors

Increased performance of contractors' equipment

Non-frequent break down of equipment

Trained contractors mechanics and operators

Prompt payment by DFR

Provision of incentives and high motivation
Problem analysis tree

STARTER PROBLEM

Reduction in DFR supervision and monitoring

Reduction in DFR site visits

Increased number of trained contractors

Wide geographical spread of contractors

Reduction in DFR engineers and formen's commitment

Lack of incentives and low motivation

Reduction in quality and output

Resignation of contractors foremen

Inability of contractors to pay promptly

Increased cash-flow problems by contractors

Lack of financial management exp. by contractors

Reduction in performance of contractors' equipment

Frequent break down of equipment

Lack of trained contractors mechanics and operators

Delayed payment by DFR
2.2 The Labour-based programme in Ghana: Facts and figures as at December, 1995.

E. N. K. Ashong, National Co-ordinator, Department of Feeder Roads, Accra, Ghana

PROJECT OBJECTIVES

a) Improvement in accessibility to rural areas through the large scale application of cost-saving approach to feeder road construction, improvement and maintenance utilising local resources.

b) Creation of a capacity within the Department of Feeder Roads and a number of private contracting firms to efficiently apply cost-saving methodologies of road improvement and maintenance;

c) Creation of additional employment opportunities by introducing cost effective labour-based approaches for feeder road construction, improvement and maintenance.

The project objectives are to be achieved in three phases:

1. Training of individual supervisors from small-scale contracting firms and foremen from DFR. These people are given 20 weeks training comprising 6 week classroom and 14 weeks model site training. This training is run by DFR engineers and other professionals. Managing Directors of firms are encouraged to participate in the programme. A week's management training is run for the top personnel of the firms by external resource personnel mainly from the banks.

2. Developing company capabilities of contractors by giving them 5km each of real life trial sites to run on their own under DFR Supervision. Duration of this phase is four (4) months. The contractor's performance at this stage shall be the main criterion for selecting the firm for the next phase of Standard Contracts.

3. Company development through on the site training by giving each qualified contractor, 20km per annum of road to rehabilitate.

2. EXECUTIVE SUMMARY

a) Training

Since the inception of the Project in November 1986, 522 Management and Supervisory staff from 93 contracting firms and DFR have been trained in the application of labour-based technology. An indicator of the effectiveness of the training course and the project as a whole is the continued interest expressed by new and even large contracting
firms to be trained in the technology. The breakdown of this figure is as follows:

No. of Contractor’s Personnel 380
No. of DFR Foremen 78
No. of DFR Engineers 64

Twenty newly recruited foremen are currently under training and will complete in February. Table (1) gives details of the Training Schedules and the number of contractors trained from each region whilst Table (2) shows the number of contractor’s personnel and DFR foremen trained. The labour-based programme is now nation-wide with contractors operating in all the ten (10) regions.

b) Procurement of Equipment for Trained Contractors

Out of the 93 contractors trained to date, 54 have been equipped. The appropriate light equipment supplied comprises:

3 tractors heads
6 trailers
2 pedestrian vibratory rollers
1 towed water bowser
1 water pump
1 pick-up
1 tipper truck

A set of handtools
The cost of a set of equipment is about US$ 150,000. Equipment supply to trained contractors on loan has not matched the rate of training of contractors. The schedule of supply of equipment to contractors involved is given in Table 3. The time lag between contractor training and equipment provision to trained contractors is evident when Tables (1) and (3) are compared.
Table 1: Training schedule and regional distribution of trained contractors

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Table 2: First three (3) training sections were held in Sefwi Wiawso (Western Region) and the rest in Koforidua

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There are currently thirty-nine (39) contractors to be equipped.

**c) Accomplishment**

As at end of 1995, 1,395km of feeder roads have been rehabilitated to year round accessibility standards and some 3,711 box culverts of project standard design type (1m span) have been constructed.

The ninety-three (93) trained contractors are at different levels with respect to equipment status and training phase. In 1991, the first nineteen (19) contracting firms went through all the three phases of the project training and undertook Standard Contracts through the normal DFR Competitive Bidding Procedures. Because of the commitment of DFR to give these contractors work till they had fully paid for the equipment loan, this bidding procedure was found inappropriate at this time. DFR has therefore decided that all awards to labour-based contractors will be based on a negotiated price until the contractors involved have finished paying for their equipment and therefore all current contracts being handled by this group were awarded on this basis.

The remaining thirty-nine (39) non-equipped contractors have been engaged on culvert works while DFR explores possible sources of equipment funding. Thus the total number of equipped and non-equipped contractors are 54 and 39 respectively.

**a) Average production achieved on the Standard Contracts has dropped to about 1.50km/month per contractor instead of the Project Target of 2km/month per contractor although a few have hit a record target of 2.30km/month. This can partly be attributed to irregular payment of contractors. There has been an improvement in the payment situation since DANIDA and USAID**
started paying for labour-based works. The effect of this regular payment by DANIDA and USAID has not been translated into higher productivity yet because of initial problems with some of the pieces of equipment supplied under the USAID component. Steps have been taken to solve these problems.

b) The average cost per kilometre of the improved roads including culvert works is ₦15 million (about US$10,000).

c) To date, some 4.4 million mandays of employment have been created made up of 3.5m for the rehabilitation of 1,400km (including culverts) and 0.9m for culverts-only contracts executed by non-equipped contractors. The average daily wage continues to be approximately US$1.0.

d) With the success of the programme, it has been integrated into the DFR Regional Structure in all the ten regions.

3. Constraints

i. Excessive downtime in the performance of the pedestrian vibrating rollers accounts for the major shortfalls in production on both Standard and Trial Contracts. This has been due to excessive usage because of the number of passes needed to achieve the required level of compaction. This problem has been addressed by the introduction of one heavier pedestrian roller (1.3 tons) in the equipment recently procured by USAID and DANIDA.

ii. Seasonal variations in labour supply and competition with other employers for labour available within an area reduced production rates.

iii. Some of the roads tackled were complete developments of timber tracks through hilly terrain which involved extensive earthworks thus slowing down progress of works.

DFR level of supervision has been reduced by the training of more contractors. DFR has recruited twenty (20) new foremen for training as a first step to improve the situation. DFR intends training some personnel from private consultants to help improve the situation.
Table 4: Regional Distribution of Equipped and Non-equipped Contractors

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<thead>
<tr>
<th>SN</th>
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<th>Non Equipped</th>
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<td>USAID</td>
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4. **Lessons learnt**

i. The minimum level of education of participants in the training course should be GCE Ordinary level or its equivalent. This has been taken care of during the last training.

ii. Construction sites should be spaced apart to avoid competition in recruiting labour.

iii. Roads selected must not involve extensive earthworks.

iv. To alleviate the maintenance burden on contractors, the 20km Standard Contracts should be phased into 2 sections with a stipulated completion period for each phase to ensure sectional handing over of roads.

**Appendix A**

**Employment creation as at the end of 1995**

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### Summary of Achievements: Labour-based Programme

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The table above summarizes the achievements of the Labour-based Programme across different regions of Ghana for the period January-December 1995. The data includes the total distance in kilometers (Km), the number of people involved (No), and the cost in cedis (¢’M). The regions are categorized into Greater Accra, Volta, Eastern, Central, Western, and Eastern (Afram Plains), Ashanti, Brong Ahafo, Northern, Upper East, and Upper West. The total achievements across all regions are also provided.
## APPENDIX C
### Summary of operation

<table>
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<tr>
<th>Region</th>
<th>Length Of Road Completed (Km)</th>
<th>No. Of Culverts Constructed</th>
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NE Not Equipped
2.3 The Maintenance Performance Budgeting System (MPBS) of the Department of Feeder Roads in Ghana.

Nils Bakke, Road Maintenance Engineer and Tonny Baek, Project Manager, COWI AS, Accra, Ghana

SUMMARY

The MPBS is at root a performance budgeting system which can be used to develop annual maintenance budgets and provide an operational system for planning and implementing maintenance. Implementation entails the application of both labour- and equipment- based methods implemented by contractors. Successful pilot implementation has proven field operations to be practical, cost effective and sustainable.

INTRODUCTION

Performance budgeting is a concept which is based on development of standards of performance for allocating resources and scheduling activities. It is especially suitable for the programming of routine, repetitive and measurable activities. The main advantage of the method is to concentrate attention on the work that needs to be done rather than on the things that need to be acquired, such as materials and equipment. Priorities can be placed on the work to be accomplished and on the quantity standards to be applied to operations, thus permitting the development of flexible maintenance programmes depending on the criteria and standards selected. Performance budgeting was first applied to road maintenance some 20 years ago, and has since been shown in many countries throughout the world to be the most effective for managing maintenance work programmes.

A maintenance performance budgeting system should meet the following requirements:

- establishment of maintenance levels;
- definition of work load;
- determination of resource requirements,
- establishment of procedures for planning, implementation, control, management and evaluation;
- being simple and economical to install and operate.

Within this framework there are numerous options as to the establishment of standards and various alternative techniques and procedures that can be applied. When designing a Maintenance
Performance Budgeting System there is a wide scope for adapting to local conditions and procedures, which often proves essential for the success of a System.

**SYSTEM DEVELOPMENT**

The development of MPBS in the Department of Feeder Roads started in 1993, when COWI was assigned to the job under the Danida component of the National Feeder Roads Rehabilitation and Maintenance Project. Initially 3,500 km of feeder roads in ‘maintainable’ condition were surveyed in order to establish reliable data for development of the various standards. Simultaneously, existing procedures and regulations were analysed, and the System was designed in close co-operation with DFR. The development took about 6 months and resulted in the following main parts:

- Road inventories, traffic counts and condition survey for about 3,500 km of road and establishment of road database;
- A planning system and 5-year maintenance programme, including budgets;
- An operation system and maintenance management manual;
- Maintenance cost structure

The MPBS in DFR consist of 2 distinctive parts:

**Part 1** is an annual maintenance budgeting system, which is based on average quantity standards for a number of specific maintenance operations on the network. The quantity standards vary for the individual roads according to climatic zone and traffic density.

Apart from adding new roads as and when they are brought to a maintainable condition and improvement works on existing roads, the only data required to maintain the system are updated traffic figures. The traffic figures govern the intensity of operations on the individual roads, so that the maintenance funds can be canalised to where the largest benefits are achieved.

The annual budgeting system can be operated manually, or it can run on a PC, using a simple spreadsheet programme. It results in an annual maintenance work programme and budget for the maintainable network in each of Ghana’s 10 regions, and a summary covering the whole country. The programme provides sufficient documentation for the annual maintenance budget application to Parliament.

In addition the system contains a unique feature, which can assist in adjusting the work programme, whenever less than the required budget is allocated. In such a case, it is important to concentrate on the activities which preserve the invested capital on as large a part of
the network as possible, and sacrifice the less important activities. The feature starts with reducing the level of comfort by cutting the surface maintenance. The various activities are reduced by different proportions depending on importance, until a minimum level has been reached, where virtually only basic survival maintenance is carried out. Further cuts from this point will result in roads being abandoned entirely to preserve the rest. The strength of the feature is that DFR is able to document the effect of various levels of budget cuts, and thereby are in a better position to argue their case.

**Part 2** consist of an operational system for implementing maintenance work on the feeder road network. The system operates entirely on the regional level, and although it will be possible to run force account operations, its main emphasis is on maintenance by contract.

The regional budgets made under Part 1 above can serve as a guide for the regions in preparing Bills of Quantities for groups of roads. In order to be directly condition responsive, however, the region must inspect the roads and take into account the particular maintenance needs of the individual roads.

A Standard Contract Document including General Specifications and Activity Specifications, together with Bills of Quantities form the basis of the contract. The Activity Specifications define the individual standard maintenance activities, and highlight the factors that are essential for obtaining an acceptable quality of work.

The actual works to be carried out will be specified by the Regional Maintenance Engineer on a monthly basis using a Site Instruction/Measurement Report and a Road Maintenance Line Diagram, according to the specific maintenance needs of the road. The works will be inspected and approved the following month, wherefore payment will be certified.

At the end of each year or maintenance cycle, each region will have to issue a regional Quantity Standard Report, to feed back actual field data into the annual budgeting system under Part 1.

The activities of the MPBS are illustrated in the enclosed MPBS Flow Chart.

**The Pilot Phase**

The MPBS has been implemented as a Pilot Project since mid 1994 in Eastern Region and from mid 1995 also in Western Region. Currently about 1,000 km of roads are under MPBS maintenance contracts. In July 1995, after a year of Pilot operation, an Implementation Report was issued, in order to harvest the experience gained during the first year of operation, to revise the MPBS where necessary, to make
recommendations for a nation-wide implementation strategy and to revise the 5-year maintenance programme.

During the Pilot phase, the MPBS proved a very flexible system, able to deal with routine operations and 'backlog' maintenance as well as actual rehabilitation works, in a cost effective manner. The roads have been kept in a regular good condition throughout the period, due to the timely intervention built into the System.

An important observation made in the Implementation Report is that both funds for routine maintenance and the availability of trained manpower in DFR are putting limitations on the nation-wide rate of expansion of the System. It has therefore been agreed to embark on a gradual expansion which can match the expected increase in budgets, as well as the recruitment and training of supervision staff.

COUNTRY WIDE IMPLEMENTATION

Funds allocated to routine maintenance of feeder roads have grown significantly during recent years, as shown below:

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<tr>
<td>1996</td>
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Even though the increase in funding is significant, it is recognised that the funds are not sufficient, neither to counter the considerable maintenance backlog which has built up over the recent years, nor to keep pace with the speed with which the donor financed rehabilitation projects are completed and handed over to routine maintenance. The System will be expanded to Ashanti and Brong Ahafo Regions and Dunkwa Road Area in Central Region in 1996, increasing the length of roads MPBS maintenance from 1,000km to 2,400km. The length of maintainable roads is expected to have risen to 6,900km by the end of 1996 and 12,000km by the end of 1998, so there is an obvious scope for expanding the MPBS. The roads that are brought to a maintainable level are however newly rehabilitated, so the challenge will be to keep the backlog maintenance from accumulating on the network. A full nation-wide expansion of the MPBS is not envisaged to be accomplished until the end of 1999. In the meantime the rehabilitated roads in the regions without full MPBS will have to be given special attention.
FINDINGS AND CONCLUSIONS

Among the lessons learned during the process are:

- Whenever donors embark on major road rehabilitation projects, they have to be more pro-active in the establishment of maintenance systems. It is be considered advisable to provide initial funding for the actual maintenance operations, perhaps on a declining scale over some years, in order to have the maintenance systems up and running when the rehabilitated roads start feeding into the network.

- The cost per kilometre of the maintenance work carried out has been between US$900 and US$3,400. In Eastern region the average costs per kilometre have fallen from the first to the second year. This is due to a gradual catching up with the maintenance backlog on the roads in the Region.

- Recruitment and training supervision staff is a key constraint on the expansion of the Maintenance Performance Budgeting System;

- Training of contractors and supervisors is likewise important to ensure understanding of the MPBS concept, and thereby the required standard of workmanship.

- The MPBS in its current form is very flexible, and can equally well handle labour-based and equipment-based road maintenance.

- The system can be effectively used for routine maintenance, as well as backlog maintenance and outright rehabilitation.

- Roughness measurements have shown that the roads are kept in a regular good condition by the MPBS.

Should further information be required, please contact any of the addresses below:

The Director
Department of Feeder Roads
PMB Ministries Post Office
Accra, Ghana
Tel: +233 21 668314

COWI AS
15 Paralelvej
DK 2800 Lyngby
Denmark
Tel: +45 45972211; Fax: +45 45972212
Attn.: Tonny Baek
1.1 Carry out traffic counts
1.2 Update road inventory
1.3 Analysis of previous years quantity analysis

2.1 Compile MPBS road list
2.2 Update unit costs
2.3 Revise annual frequency standards
2.4 Revise basic quantity standards
3.1 Ideal annual quantity standards
3.2 Annual work programme and budget
3.3 Reduced annual quantity standards

4.1 Is cost within budget?

5.1 Standard contract and specification
5.2 B.O.Q.
5.3 Road location plans 1:50000
5.4 Line diagrams with strip maps

6.1 Site instruction/measurement report
6.2 Monthly payment certificate
7.1 Annual regional quantity standard report

Figure 3.2 Simplified MPBS Flow Chart
## MPBS Contract Package for Eastern Region

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<td>Road Code</td>
<td>Road Name</td>
<td>Length</td>
<td>Old Quantity Standard, New Unit Rate</td>
<td>Cost Of Extra Gravel</td>
<td>Cost Of Extra Culvert</td>
<td>Contract Amount</td>
</tr>
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<td>Cost Of Extra Culvert</td>
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2.4 A study of the field performance of selected labour-based contractors in Ghana

Samuel Kofi Ampadu, Lecturer; Yaw A. Tuffour, Lecturer, Civil Engineering Department, University of Science and Technology, Kumasi, Ghana

1. INTRODUCTION

Labour-based technology is currently being applied in the road sector in several countries in Africa. However, the particular way in which the technology is applied appears to differ from country to country. For example, whereas in almost all other countries in Africa, the technology is applied for rural road infrastructure development and maintenance, in the Republic of South Africa the technology is applied in the urban setting mainly for the development of roads and water distribution systems for the townships. Again, whereas in Kenya, for example, the technology has been executed with force account systems, in Ghana contracting has been the hallmark of the technology since its inception about a decade ago. In fact, in Ghana, the private sector small-scale labour-based contractors have become synonymous with labour-based technology in the country.

Despite these differences in the mode of application of the technology, the underlying use of casual labour as the predominant unit of production remains the same. Therefore, the proper planning - cost estimation and resource scheduling, as well as the general management of labour-based projects require among other things, up-to-date information on the availability as well as productivity of labour. Productivity rates are known to increase, within certain bounds, as a country gains experience in the use of the technology, (Coukis 1983), but the productivity rates being used in Ghana today appear to have been generated during the pilot study phase of the introduction of the technology in the country, about a decade ago. Thus, there was the need for a feedback from the field to determine whether or not the productivity rates being used in the country for planning labour-based projects reflected the actual productivities on contractor sites.

In Ghana, the development as well as the management of labour-based technology is the responsibility of the Department of Feeder Roads (DFR). This agency which is one of three line agencies under the Ministry of Roads and Highways (MRH), is responsible for the planning, design, construction, maintenance and operation of the approximately 21,300 km of feeder road network in the country. To ensure that roads constructed by labour-based contractors meet the required technical quality specifications, DFR attaches its own foremen to labour-based construction sites. However, over the years,
whereas the number of small-scale labour-based contractors has increased tremendously, the growth in the number of DFR foremen available has been almost stagnant. In the face of such dwindling field supervision resources there has been an understandable concern for the technical quality of the output of these small-scale labour-based contractors. There was therefore the need for a technical quality study to serve as a barometer of how well these small-scale labour-based contractors were meeting the technical specifications. Furthermore, such feedback data would be required for updating the content of the contractor and supervisor training programme.

As in many other countries, labour-based technology does not have a high appeal to the technical leadership of Ghana. Since the involvement of the University of Science and Technology (UST) to support the long-term sustainability of the technology in the country, however, there has been the desire to raise the level of labour-based road technology to conventional highway engineering level. Under the resulting cooperation between DFR and UST with support from the ILO, a number of studies aimed partly at addressing the productivity and technical quality issues raised above were conducted. This paper reports on two of these studies. The first study, conducted in two phases, was aimed at determining the prevailing labour productivity rates and the effect of site organisation through the collection and analysis of the relevant field data. The second study, a technical quality study, collected the relevant field data to evaluate the extent to which roads being built by these contractors satisfied the DFR technical specifications. This paper provides only a summary of the results of these studies but the details are available in the respective project reports (Civil Engineering Dept. UST., 1995a,b,c).

2. **Experimental Design**

2.1 **Field Organisation and Productivity Studies**

The study to collect data on the field organisation as well as on the productivity of contractors on site covered a total of eleven contractor sites in two phases. The first phase involving seven contractors spread over three administrative regions in the country covered a nominal period of 3 months from November 1992 to February 1993. The second phase of the study was conducted from May to August 1994 and it involved four contractors in four regions. In both phases, a young civil engineer was attached to each contractor for effective periods varying between 3 and 11 weeks. The engineer lived in the contractor's camp, went to the construction front daily with the contractor's staff, observed, measured, interviewed and recorded data relating to the different categories of workers on site distinguishing between migrant and local labour, male and female workers as well as permanent and casual labour. The methods of task allocation were also observed and recorded as well as the tasks accomplished at the end of each day.
together with the average number of hours spent on the task. The field data was then analysed with respect to the field organisation of these contractors, the composition of the workforce, their productivity rates at the activity level as well as worker time input on site.

2.2 Technical Quality Studies

For the second study, which was on the technical quality of the output of labour-based contractors, a total of eight (8) roads, two in each of four administrative regions, were selected for study. These roads were either newly constructed or were under construction at the time of study. This ensured the availability of newly gravelled sections for the study. For each study road, up to three different sections, each 80m long, were selected. The technical quality was evaluated in terms of the quality of gravel material used for the construction, the thickness of the gravel layer, the level of compaction achieved on the finished gravel layer as well as the camber and dimensions of the side drains.

2.2.1 Evaluation of quality of gravel material

On each study road, bulk samples of gravel material were taken from all the gravel pits being operated at the time and sent to the laboratory for testing in order to evaluate the quality of gravel material used. In the laboratory, the samples were subjected to the standard soil identification and classification tests consisting of tests for the determination of the Liquid Limit, LL, and Plastic Limit, PL, as well as the particle size distribution. In addition to these identification tests, laboratory compaction tests were performed on samples of these gravel material using the Modified AASHTO specification.

2.2.2 Field measurement of quality of gravel layer

For the measurement of the level of compaction achieved on site, in-situ density tests by the sand replacement method were performed at selected points on the finished gravel layer at a sampling frequency of 4 per each of 3 study sections per study road as shown in Table 1. In the testing procedure, first a hole, terminating at the bottom of the gravel layer, was made. Except for a few cases, the bottom of the gravel layer could be easily identified from the change in the colour and texture of the waste material recovered from the hole. The recovered waste material was collected for laboratory determination of water content. The thickness of the gravel layer was then measured as the depth of the hole with a measuring rule. After the measurement, the sand replacement test was continued using the standard procedure (BS1377: part 9, 1990). From the results of the bulk densities obtained from the field and the water content determined in the laboratory, the dry densities of the in-situ material were evaluated.
2.2.3 Measurement of quality of gravel layer drainage

The camber of the finished gravel pavement and the side drain depth, width and foreslope were used as parameters for the technical quality of the drainage of the gravel layer. The quality of concrete for cross-drainage structures was also evaluated but not reported in this paper. For the measurement of these parameters a grid of 0.5 m longitudinal sections and 10 m lateral sections was established on the study section and the grid-points were levelled using a levelling instrument. The linear distances were measured by means of a tape measure. The edges and bottom of the side drains were also measured and levelled. From the differences in spot levels and the linear distances measured from the centreline the camber at each cross-section was evaluated. Also based on the linear distances and the spot levels at the edges of the side drain, the depth of the drain, the width and the foreslope were evaluated.

The frequency at which the various technical quality parameters were sampled in the field are shown in Table 1.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>No. of trials per study section</th>
<th>No. of Trials per study road</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-situ Density</td>
<td>Mg/m³</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Thickness of gravel layer</td>
<td>mm</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Camber measurements</td>
<td>(%)</td>
<td>35</td>
<td>105</td>
</tr>
<tr>
<td>Drain dimensions</td>
<td>(cm)</td>
<td>10</td>
<td>30</td>
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</tbody>
</table>

3. DISCUSSION OF RESULTS OF STUDY

3.1 Field Organisation of Contractors

The background data available on some of the contractors covered in these studies showed that the contractors were rather well-educated and well-trained. A good proportion of them came from either construction or business background, and had at least five years’ experience in labour-based construction.

3.1.1 Site Organisational Structure

The typical field organisation of a labour-based contractor is shown in Fig.1 while the composition of the average daily workforce on the site is shown in Table 2. The maximum, minimum as well as the average...
values of the number of workers in each level in the hierarchy in Table 2 are also indicated on Fig. 1. There are basically four levels of command. At the top of the hierarchy is the Managing Director (i.e. the Contractor). Below the Contractor at the second level are the supervisors who constitute the technical staff of the company. It is this level of staff who possess the necessary technical and site managerial knowledge required to build the road and manage the relatively large number of people involved in labour-based works. The staff at this level are trained in labour-based road construction technology by DFR. The study showed that there was an average of 3 supervisors on each site. At the third level are the operators of trucks, tractors, vibratory rollers as well as artisans such as carpenters, steel benders and masons together with the storekeeper and the contractor's foremen. On some sites, Level 3 also include a group of junior supervisors trained by the supervisors from Level 2. On the average there were 8 workers in Level 3. At the bottom of the hierarchy, at Level 4, are the casual workers usually organised in gangs under headmen along activity lines.

3.1.2 Casual Labour

In this study, workers in Level 4 were categorised as local or migrant and male or female. Workers were categorised as migrant if they required motorised transport to commute between the camp or their collection point and the site. Within the migrant category was another group consisting of itinerant workers who generally followed the contractor from one project to another. One feature of this category, in addition to the transportation requirements, is that they also required accommodation which the contractors assisted with to various degrees.

The mean daily distribution of the various categories of labour force are shown in Table 2. The composition of the labour force in terms of migrant and local labour on the various sites are shown in Fig.2. The minimum daily casual labour force of 29 recorded on AL3-J FW was actually an end-of-contract condition. On the sites studied, the results show a daily maximum of 94, with an average of 63 casual workers. The figure also shows a variable local labour participation across sites from no local labour on AL3-FM to all local labour on BL1-TT, BL2-NN, EL2-AA or AL2-ST. The zero local-labour participation on AL3-FM may be due mainly to the presence in the area of a gold mining industry which paid higher returns than the labour-based construction project. Similarly, the relatively low, 20%, level of local labour participation on EL3-ON was due to the presence in the area of a large commercial pineapple plantation which competed for casual labour and paid higher wages than the labour-based road construction project. These confirm the general observation elsewhere that the
availability of labour for labour-based works depends on the presence or otherwise of a competing industry in the locality.

On the time-variation of the availability of casual labour, it may be noted that AL3-FM and AL3-JFW referred to the same contractor working in the same general community during the second and first phases respectively. The fact that there was a 55% local labour participation during Phase 1 (Nov. 1992- Feb. 1993) but none during Phase 2 (June-Aug. 1994) suggests that even for the same area labour availability could vary with time. This implies that in order that the results of any labour availability surveys be meaningful even in the same general area, they need to be updated regularly.

The study also shows that female participation rates varied from a low 5% to a high 46%. Certain activities such as grubbing and camber formation were the preserve of female workers. With the exception of one site, females were not involved in gravel excavation, ditching and sloping and bushclearing.

3.1.3 Level of Supervision

The number of casual workers per trained supervisor, $S_1$, was taken as a measure of the level of supervision available on site. With reference to the different categories of workers shown in Table 2, the $S_1$ values were obtained as the ratio of the values in Level 4 to the corresponding values in Level 2. This value will obviously depend on the construction stage since the casual labour demand varies throughout the construction process. For example the low value of 7 obtained for AL3-JFW was an end of contract value and therefore not a true mean value. The possible effects of the level of supervision on the quality of output are discussed later in section 3.4

3.2 Productivity Data

In general, the productivity rates of labour may be obtained either by feedback of output data from previous construction works or by work measurements (i.e., work study). In this study the productivity rates were generated using the feedback approach which is merely a historical record from the site of the quantity of output per unit time. It should also be pointed out that, in these studies, the results measured from the various sites were constrained by the task rates in operation on the particular site.

3.2.1 Productivity Rates

On all sites, the employment contract system in operation was the task work system in which payment of an agreed sum (wage rate) was made for the completion of a fixed quantity of output (task rate). The daily tasks were allocated to individuals or gangs depending on the activity. For preparatory activities and earthworks, individuals were assigned tasks that allowed them to accomplish the day's task at their
own pace. Activities such as destumping, gravel loading, hauling and offloading (LHO) that required individuals working together were assigned to gangs. On completion of a given task, the supervisor in charge of the particular operation measured the quantity of output. In the case of gravel excavation and stockpiling, the quantity of gravel excavated was estimated using very simple geometric relationships involving the height and base dimensions of the conical gravel heap. For other activities such as grubbing and bushclearing in addition to the quantity of output, the supervisors had to be satisfied with the quality of work accomplished before a worker’s task was certified as completed.

For labour, productivity is defined as output per full work day consisting of 8 hours and is expressed as output per manday. Based on data from the field the productivity rates were computed for the various activities on all study sites. The minimum and maximum values together with the mean values of the productivity rates for the various activities are summarised in Table 3. The results show large variations in the outputs from one contractor site to another especially for bushclearing, grubbing, and camber formation as evidenced by the relatively large values for the coefficient of correlation (CV). This is illustrated with bushclearing, ditching-and-sloping and gravel spreading in Fig. 3 where the minimum and mean values are expressed as percentages of the maximum values. The large variation in productivity from one contractor site to another suggests that different contractor sites were using different task rates. The effect of various factors on these task rates are examined below.

Effect of Input Time

It was observed that on different contractor sites and for different activities, workers spent varying amounts of time on their tasks. A quantity/input time ratio, T, defined as the ratio between the length of time that workers actually spent on their task (including time taken to stretch etc.) and the time available in a manday i.e., 8 hours, was used to quantify worker time input. The T values for the different activities on the different sites are summarised in Table 3 in terms of the maximum, minimum and mean values for the particular activity, together with the CV values. The results show quite a variation in the values of T with a minimum of 0.31 and a maximum value of 1.02 obtained on the same site for compaction and for L-H-O of gravel respectively. The variation of T at the activity level is illustrated with bushclearing, ditching-and-sloping and gravel spreading in Fig. 4(a) while the mean T values across study sites are illustrated in Fig 4(b). The figure shows different mean T values for different contractor sites, with generally higher values for Phase 1 than for Phase 2. The fact that the T values for the same contractor, AL3, on different sites in different phases of the study AL3-J FW in Phase 1 and AL3-FM in
Phase 2 were similar suggests that the T values may depend more on site organisation and less on site condition. The data showed a positive correlation between productivity rate and input time ratio for certain activities such as bushclearing and ditching-and-sloping. This suggests that in general for contractors with higher productivities per manday, the workers tended to spend more time on site.

Hourly Productivity Rates
For a given task rate the value of T is a direct measure of the worker motivation to finish work early. However, since both the productivity per manday and the T values were different for different activities and on different contractor sites, the hourly productivity rate was considered a better measure of worker motivation to finish work early. This is computed from the measured productivity rate and the T value as shown below:

\[
\text{Hourly productivity Rate} = \frac{\text{Productivity Rate per manday}}{T \times 8\text{hrs}}
\]

The maximum, minimum and the mean values of the hourly productivity rates for the different activities are also summarised in Table 3. Again large variations were observed across activities and across study sites. It was observed that on the site of the contractor who had the highest or one of the highest hourly productivity rates at the activity level, the only tractor-trailer transport left the camp at a given time each day. Even though this contractor site also had a high itinerant worker proportion, and therefore on the average a highly experienced workforce, the transportation arrangement is considered to be the singular most important motivation to finish work early. Thus it appears that the T values depend heavily on site organisation. The possible implications of these high hourly productivity rates for the quality of output are examined later.

Effect of Site Condition
An attempt was made in the studies to evaluate the effect of site condition on the productivity rates and input times. It was observed that the minimum values of 95m²/manday and 45m²/manday recorded for bushclearing and grubbing respectively, were obtained on sites where the vegetation consisted of rather dense shrubs. Apart from these sites, the effect of vegetation type was not clear especially since the vegetation was similar on most sites.

For ditching-and-sloping, the field records showed that the material varied from firm to stiff clay and compact gravel while the gravel pit condition could be described as dense gravelly material. No significant differences in mean productivity rates per manday were observed between the first and second phases representing the dry and wet
seasons respectively even for activities such as ditching-and-sloping which involved excavation. Even though the $T$ values for Phase 1 were higher than the corresponding values for Phase 2 for all excavation activities, because this was also true even for activities such as bushclearing and gravel spreading which did not involve excavation, it was not possible to ascribe the increased $T$ to hardening of formation during dry season. Consequently the lower hourly rates during Phase 1 could also not be attributed to the hardness of the formation. Thus in these studies, the effect of hardening of formation on productivity rates could not be evaluated even though the results from one site, AL3-FM (based on a comparison of the rates during the rains in early July and after the rains in late August) appears to suggest insignificant effect of hardening from compact to dense gravel.

**Effect of Experience of Labour Force**

Table 4 shows the productivity rates per manday, $O$, the input time ratios, $T$, as well as the resulting hourly productivity rates for ditching and sloping on one contractor site (AL3-FM) over a period of 6 weeks. On this site most of the workers assigned to this activity were itinerant workers who had worked with the contractor for about 3 years. From the fourth week, however, new workers were recruited.

| Week | T(1) | O(2) | TOTOTOTO |
|------|------|------|..........|
| 1    | 0.70 | 5.8  | 0.54 5.0 | 0.66 4.9 | 0.91 4.9 | 0.86 5.2 | 0.89 5.4 |
| 2    | 1.04m³/hr | 1.16m³/hr | 0.93m³/hr | 0.67m³/hr | 0.76m³/hr | 0.76m³/hr |

(1) $T$ is the input time ratio, defined as ratio of the actual number of hours spent on the task to the number of hours available in a manday, i.e., 8 hours. (2) Output in m³.

The effect of the inexperience of the new workers is evidenced by the relatively large $T$ values for similar outputs. The equivalent hourly productivity rates are plotted against progress of work in Fig. 5. It can be seen that whereas on the average experienced hands achieved 1.04m³/hr inexperienced workers achieved only 0.73m³/hr. The hourly productivity of experienced hands was, therefore, 1.4 times that of inexperienced hands. Due to the relatively large float of time available in an 8-hour work day, such differences do not necessarily manifest themselves in the productivity rates per manday.

As expected in task work contracts, no correlation was observed between the level of supervision and the productivity rate per manday.
The average productivity rates measured on the various contractor sites are compared with some DFR suggested rates in Table 5. No attempt is made in these tables to separate the effects of the various factors on the average productivity rates since the individual effects could not be conclusively evaluated in these studies. However, for camber formation and gravel spreading, the quoted values of 50m²/manday were derived from technical quality considerations. It may be noted that these values are lower than the actual average values of 90m²/manday and 86m²/manday measured for camber formation and gravel spreading respectively. The results suggest that the DFR rates for bushclearing are rather ambitious but that the average DFR suggested rates for excavation are lower than the mean output in the field. The results suggest that for several activities, the productivity rates for planning labour-based projects may be different from those achieved on site.

Table 5. Comparison between DFR suggested and average measured productivity rates

<table>
<thead>
<tr>
<th>Activity</th>
<th>DFR suggested rates (per m²)</th>
<th>Average measured rates (per m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bush Clearing</td>
<td>350 m² - 400 m²</td>
<td>260 m²</td>
</tr>
<tr>
<td>Grubbing</td>
<td>150 m²</td>
<td></td>
</tr>
<tr>
<td>Ditching-and-sloping</td>
<td>3.0 m³ - 4.5 m³</td>
<td>4.1 m³</td>
</tr>
<tr>
<td>Camber formation</td>
<td>50 m²</td>
<td>50 m²*</td>
</tr>
<tr>
<td>Gravel spreading</td>
<td>75 m²</td>
<td>50 m²*</td>
</tr>
<tr>
<td>Excavation of gravel</td>
<td>3.0 m³ - 4.5 m³</td>
<td>4.2 m³</td>
</tr>
</tbody>
</table>

(1) Source: DFR Fieldbook for Road Supervisors, 1991
(2) Averages of productivity rates from eleven contractor sites in the forest regions of Ghana.
* Based on the optimum rate of 10m²/hr required to achieve 100mm gravel thickness x 5 hours /manday

3.3 Technical Quality of Output of Contractors

3.3.1 Technical Specifications

The different MRH technical specifications for gravel material for a basecourse and for a wearing surface course are shown in Table 6 reflecting the different functional requirements for both layers. For an unsurfaced gravel road such as labour-based roads in Ghana, however, the same gravel layer serves both as a basecourse and a surface wearing course. The appropriate specification for a gravel road, therefore, should be a specification that satisfies both requirements. However, such a specification would be too restrictive.
for a geologic material. Therefore, for the purposes of this study a more liberal material specification based on either a surface wearing course or a base course was adopted as shown in the last column.

**Table 6  Technical specifications used for gravel material**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Gravel Base Course</th>
<th>Gravel Surface Course</th>
<th>Either Base or Surface Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid limit</td>
<td>Less than 25</td>
<td>22-35</td>
<td>Less than 35</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>Less than 10</td>
<td>8-14</td>
<td>Less than 14</td>
</tr>
<tr>
<td>% Passing 0.075 mm</td>
<td>5-15(25)(^{(1)})</td>
<td>15-25</td>
<td>5-25</td>
</tr>
<tr>
<td>CBR(^{(2)})</td>
<td>80%</td>
<td>NA</td>
<td>80%</td>
</tr>
<tr>
<td>Level of Compaction(^{(3)})</td>
<td>98%</td>
<td>98%</td>
<td>98%</td>
</tr>
</tbody>
</table>

(1) Up to 25% fines content may be accepted depending on engineers judgement.
(2) CBR at 98% MDD of Modified AASHTO after 4 days of soaking.
(3) According to Modified AASHTO level of compaction.

For an unsurfaced road, one of the major agents of deterioration is improperly managed surface water. The proper design of such roads therefore seeks to ensure the efficient collection and disposal of surface water from the road. The camber and the side drain dimensions were therefore used as the relevant parameters for evaluating the technical quality of the drainage of the gravel layer. The specifications for the gravel layer and its drainage are shown in Table 7 below.

**Table 7  Specifications for gravel layer and side drains**

<table>
<thead>
<tr>
<th>Width of labour-based road</th>
<th>6m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness of finished gravel layer</td>
<td>100 mm ±10 mm</td>
</tr>
<tr>
<td>Width of side drain</td>
<td>40 cm</td>
</tr>
<tr>
<td>Depth of side drain</td>
<td>40 cm</td>
</tr>
<tr>
<td>Foreslope of side drain</td>
<td>40%</td>
</tr>
<tr>
<td>Minimum camber</td>
<td>5%</td>
</tr>
</tbody>
</table>

The results of measurement of the quality of gravel layer and the gravel material are summarised in Table 8 for all the study roads,
while the results for the camber and the longitudinal side drain characteristics are summarised in Table 9.

3.3.2 Quality of gravel material

The index property values for the gravel material are tabulated in Table 8. The values show that even using the lower limits of the ranges obtained in the laboratory, only material from two roads satisfied the maximum 35% limit specified for LL and 14% specified for the PI. Similarly, the results of the grading showed that less than 50% of the material satisfied the specifications. These results illustrate the general difficulty of obtaining gravel material that satisfies all the requirements of the specification.

3.3.3 Quality of Gravel Layer

The maximum dry densities (MDD) obtained from the laboratory compaction tests using the Modified AASHTO specification on the different gravel material are shown in Table 8. The values quoted are the mean values for the gravel pits along the road. The in-situ dry densities are also tabulated. It was observed that the lowest values of in-situ density were measured near the ‘shoulder’ of the gravel layer. It is well known that areas near the edges of gravel layers are difficult to compact. The values of the relative compaction (RC) with respect to the Modified AASHTO specification which is the ratio of in-situ dry density (DD) and the laboratory MDD are also tabulated. It may be observed that the values range from 72% to 85%. The individual values relative to the specified minimum of 98% Modified AASHTO compaction standard are illustrated in Fig. 6.

The magnitudes of the values relative to the specification clearly shows that without exception the level of compaction achieved in the field is rather low. Such low levels of compaction in general could be attributed to several factors including compaction procedure and compaction plant. In this study, the contractors used a standard compaction plant, the Bomag BW 65S with a 600 kg operating weight. The fact that the results from eight different contractors reflecting eight different field organisations varied within a narrow band of 72%-85% appears to suggest that the low level of compaction is due principally to inappropriate compaction plant. The results suggest that the question of compaction of labour-based roads requires further study.

The results of the gravel layer thickness measurements for the study roads are also shown in Table 8. It can be seen that for a 10 mm tolerance, 4 out of the 8 roads studied had gravel thicknesses within the specification. Two roads, however, had relatively low gravel layer thicknesses of below 60 mm. Fig. 7 illustrates these results relative to the technical specifications.
### Table 8: Results of measurements of material properties and pavement quality characteristics

<table>
<thead>
<tr>
<th>Study road</th>
<th>LL (%)</th>
<th>PI (%)</th>
<th>&lt;75µm (%)</th>
<th>MDD (Mg/m³)</th>
<th>DD (Mg/m³)</th>
<th>RC (%)</th>
<th>Thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WL1-DL</td>
<td>39-45</td>
<td>19-22</td>
<td>23-33</td>
<td>2.230</td>
<td>1.739</td>
<td>78</td>
<td>102</td>
</tr>
<tr>
<td>WL2-AP</td>
<td>29-39</td>
<td>11-18</td>
<td>15-22</td>
<td>2.400</td>
<td>2.014</td>
<td>84</td>
<td>100</td>
</tr>
<tr>
<td>BL1-TT</td>
<td>38-59</td>
<td>17-30</td>
<td>34-37</td>
<td>2.209</td>
<td>1.867</td>
<td>85</td>
<td>52</td>
</tr>
<tr>
<td>BL2-OA</td>
<td>65-78</td>
<td>31-39</td>
<td>17-23</td>
<td>2.367</td>
<td>1.701</td>
<td>72</td>
<td>74</td>
</tr>
<tr>
<td>AL4-FA</td>
<td>44-51</td>
<td>18-30</td>
<td>23-41</td>
<td>2.177</td>
<td>1.756</td>
<td>81</td>
<td>58</td>
</tr>
<tr>
<td>AL3-FM</td>
<td>36-62</td>
<td>14-32</td>
<td>24-53</td>
<td>2.115</td>
<td>1.769</td>
<td>84</td>
<td>99</td>
</tr>
<tr>
<td>EL4-AO</td>
<td>34</td>
<td>17</td>
<td>18-21</td>
<td>2.177</td>
<td>1.777</td>
<td>82</td>
<td>85</td>
</tr>
<tr>
<td>EL3-TA</td>
<td>49</td>
<td>28</td>
<td>20</td>
<td>2.348</td>
<td>1.782</td>
<td>76</td>
<td>94</td>
</tr>
</tbody>
</table>

(1) Average MDD values for all gravel pits on given study road
(2) Average of 12 dry density (DD) determinations for each road

3.3.4 Quality of gravel layer drainage

The results of the camber and the drain characteristics measurements are given in Table 9. Each tabulated value is actually the mean from the average of three sections on each study road. The mean camber for the study roads ranged between 3.14% and 6.19%. Relative to the minimum specified camber of 5%, the results show that 50% of the roads easily satisfied the camber requirement.

Six out of the eight roads (i.e. 75% of study roads) satisfied the requirements for the drain width and depth while 63% satisfied the required foreslope inclination. The high compliance rate of specification for the drains suggests that the drain template was being used effectively.
Table 9  Side drain characteristics and camber of study roads

<table>
<thead>
<tr>
<th>Study road</th>
<th>Width (cm)</th>
<th>Depth (cm)</th>
<th>Foreslope %</th>
<th>Camber %</th>
<th>CV(1) %</th>
</tr>
</thead>
<tbody>
<tr>
<td>WL1-DL</td>
<td>51</td>
<td>43</td>
<td>41</td>
<td>5.41</td>
<td>17.4</td>
</tr>
<tr>
<td>WL2-AP</td>
<td>43</td>
<td>36</td>
<td>42</td>
<td>6.17</td>
<td>19.0</td>
</tr>
<tr>
<td>BL1-TT</td>
<td>39</td>
<td>40</td>
<td>42</td>
<td>3.44</td>
<td>45.9</td>
</tr>
<tr>
<td>BL2-OA</td>
<td>41</td>
<td>44</td>
<td>37</td>
<td>3.20</td>
<td>58.1</td>
</tr>
<tr>
<td>AL4-FA</td>
<td>33</td>
<td>38</td>
<td>36</td>
<td>6.19</td>
<td>25.7</td>
</tr>
<tr>
<td>AL3-FM</td>
<td>44</td>
<td>40</td>
<td>42</td>
<td>4.85</td>
<td>30.7</td>
</tr>
<tr>
<td>EL4-AO</td>
<td>40</td>
<td>47</td>
<td>37</td>
<td>5.34</td>
<td>37.4</td>
</tr>
<tr>
<td>EL3-TA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>3.14</td>
<td>34.4</td>
</tr>
</tbody>
</table>

(1) Coefficient of Variation CV = Standard Deviation / Mean x 100

3.4  Interrelationship among site organisation, productivity and quality of output.

Fig. 9 plots the mean input time ratio for each study road against the percentage of local casual labour. The negative correlation obtained confirms the observation that local labour tended to spend less time on site than their migrant counterparts. This may be due to the fact that being local the workers probably had other activities to return to and the prospects of returning to these activities were enough motivation to finish work early. This observation combined with the general observation that productivity appears higher on sites with larger T values suggest that migrant workers may be more productive than local.

Some relevant results from the four study sites which were common to both studies are summarised in Table 10 below in an attempt to discuss the interrelationship among the productivity rate, the level of supervision (field organisation) and technical quality. The thickness of the measured gravel layer was plotted against the level of supervision defined in terms of the number of casual labourers per trained supervisor in Fig. 10. The results clearly show that as the number of casual labourers per trained supervisor increased, workers tended to put insufficient amounts of gravel material for compaction. The figure also suggests 19 casual workers per supervisor as the optimum number for achieving the required gravel thickness of 100 mm.
Table 10: Productivity, technical quality and supervision data for some study roads

<table>
<thead>
<tr>
<th>Study Road</th>
<th>Rate of Gravel Spreading (m²/hr)</th>
<th>Rate of Compaction (m²/hr)</th>
<th>Level of Compaction (%)</th>
<th>Thickness of Gravel layer (mm)</th>
<th>Camber (%)</th>
<th>No. of casual labourers per supervisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL3-FM</td>
<td>10</td>
<td>84</td>
<td>84</td>
<td>99</td>
<td>4.85</td>
<td>19</td>
</tr>
<tr>
<td>AL4-FA</td>
<td>18</td>
<td>43</td>
<td>81</td>
<td>58</td>
<td>6.19</td>
<td>24</td>
</tr>
<tr>
<td>BL2-NN</td>
<td>16</td>
<td>132</td>
<td>72</td>
<td>74</td>
<td>3.20</td>
<td>21</td>
</tr>
<tr>
<td>BL1-TT</td>
<td>27</td>
<td>108</td>
<td>85</td>
<td>52</td>
<td>3.44</td>
<td>30</td>
</tr>
</tbody>
</table>

The hourly rate of gravel spreading was also plotted against the thickness of gravel layer in Fig.11. The results indicate that at high hourly rates, smaller gravel layer thicknesses are achieved and suggests 10m²/hr as an optimum rate for achieving the required thickness. This rate of gravel spreading per hour translates to a productivity of 50m²/manday based on a 5 hour input/manday, i.e. a T value of 0.625. This productivity per manday is considered the recommended productivity rate if it is assumed that workers put insufficient material because they are in a hurry to complete their assignment. Since the output of the standard pedestrian roller far exceeds the demand, the level of compaction achieved was found to be insensitive to the rate of compaction.

4. CONCLUSION

The following conclusions could be drawn from the foregoing discussion:

1. On the average there were 63 casual workers on each labour-based contractor site. Labour availability for labour-based works varied greatly from one district to another, and also with time within the same district and appear to depend on the presence or otherwise of other commercial activities in the locality with better returns than labour-based construction.

2. In general, different contractor sites used different task rates and so achieved different productivity rates per manday. For several activities, these productivity rates from the site differed from the DFR base rates used for the planning of labour-based projects.

3. The levels of compaction achieved on labour-based roads were below the minimum specified levels and most of the gravel material did not meet the technical specifications. These suggest the need for further studies on compaction of labour-based roads.
and a possible review of the technical specifications for gravel material for labour-based roads.

4. Only about 50% of labour-based roads had the required minimum gravel thickness of 100mm. An optimum number of 19 casual workers per trained supervisor together with rates of gravel spreading not exceeding 10m²/hr were observed to be the site organisation parameters required to achieve the minimum specified gravel thickness. The quantity of output was found to be insensitive to the level of supervision.

5. At least 50% of the study roads satisfied the minimum 5% camber on labour-based roads and more than 75% of the roads satisfied the required drain dimensions implying a relatively high quality of drainage of gravel layer and effective use of drain template during construction.

ACKNOWLEDGEMENT

The authors are greatly indebted to members of the 1992 and 1993 graduating class in the Civil Engineering Department who executed the fieldwork especially Mr. Paapa Essel-Mensah, currently pursuing a Master’s programme in the Department. Also the assistance of the various DFR Regional Engineers in facilitating the fieldwork is greatly appreciated together with the various contractors who allowed us access to their unfinished project sites.

REFERENCES


Figure 1: Typical field organization of a labour-based operation
Table 2: Composition of average daily labour force
<table>
<thead>
<tr>
<th>Activity</th>
<th>Units</th>
<th>Min.</th>
<th>Max.</th>
<th>Mean</th>
<th>CV(1) (%)</th>
<th>Hourly Rate (per hour)</th>
<th>Units</th>
<th>Min.</th>
<th>Max.</th>
<th>Mean</th>
<th>CV (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bushclearing</td>
<td>m²</td>
<td>95</td>
<td>487</td>
<td>258</td>
<td>51</td>
<td>0.35 0.94 0.59 35</td>
<td>m²/hr</td>
<td>20.1</td>
<td>93.9</td>
<td>58.8</td>
<td>46</td>
</tr>
<tr>
<td>Grubbing</td>
<td>m²</td>
<td>45</td>
<td>246</td>
<td>151</td>
<td>42</td>
<td>0.36 0.95 0.69 29</td>
<td>m²/hr</td>
<td>7.0</td>
<td>45.9</td>
<td>28.9</td>
<td>41</td>
</tr>
<tr>
<td>Cut widening</td>
<td>m³</td>
<td>2.50</td>
<td>4.00</td>
<td>3.60</td>
<td>17</td>
<td>0.36 0.93 0.62 30</td>
<td>m³/hr</td>
<td>0.49</td>
<td>1.40</td>
<td>0.81</td>
<td>41</td>
</tr>
<tr>
<td>Ditching &amp; sloping</td>
<td>m³</td>
<td>3.40</td>
<td>5.10</td>
<td>4.10</td>
<td>16</td>
<td>0.40 0.92 0.63 29</td>
<td>m³/hr</td>
<td>0.61</td>
<td>1.26</td>
<td>0.89</td>
<td>26</td>
</tr>
<tr>
<td>Camber formation</td>
<td>m²</td>
<td>54</td>
<td>119</td>
<td>91</td>
<td>29</td>
<td>0.33 0.95 0.68 28</td>
<td>m²/hr</td>
<td>7.1</td>
<td>28.7</td>
<td>17.7</td>
<td>33</td>
</tr>
<tr>
<td>Gravel excavation</td>
<td>m³</td>
<td>2.90</td>
<td>5.30</td>
<td>4.20</td>
<td>16</td>
<td>0.35 0.93 0.64 33</td>
<td>m³/hr</td>
<td>0.45</td>
<td>1.50</td>
<td>0.92</td>
<td>37</td>
</tr>
<tr>
<td>L-H-O gravel (3)</td>
<td>m³</td>
<td>2.50</td>
<td>6.00</td>
<td>4.60</td>
<td>22</td>
<td>0.41 1.02 0.74 23</td>
<td>m³/hr</td>
<td>0.44</td>
<td>1.68</td>
<td>0.84</td>
<td>43</td>
</tr>
<tr>
<td>Gravel spreading</td>
<td>m²</td>
<td>55</td>
<td>118</td>
<td>86</td>
<td>26</td>
<td>0.40 0.96 0.72 25</td>
<td>m²/hr</td>
<td>7.5</td>
<td>26.5</td>
<td>16.0</td>
<td>36</td>
</tr>
<tr>
<td>Compaction (roller)</td>
<td>m²</td>
<td>225</td>
<td>560</td>
<td>389</td>
<td>34</td>
<td>0.31 0.88 0.60 37</td>
<td>m²/hr</td>
<td>32.0</td>
<td>132.4</td>
<td>82.5</td>
<td>38</td>
</tr>
</tbody>
</table>
Figure 2: Composition of average daily casual labour force on study sites
Figure 3: Productivity rates observed on site for selected activities
Figure 4 (a): Mean input time values for selected activities
Figure 4 (b): Variation of mean input time across contractor sites
Figure 5: Time variation of hourly productivity rate on one contractor site
Figure 6: Level of compaction achieved on selected labour-based roads
Figure 7: Thickness of gravel layer as measured on selected labour-based roads.
Figure 8: Camber achieved on gravel surface of selected labour-based roads
Figure 9: Relationship between mean input time ratio and casual labour composition
Figure 10: Dependence of gravel layer thickness on level of supervision
Figure 11: Dependence of gravel layer thickness on hourly rate of gravel spreading
2.5 Factors influencing the output of labour-based contractors in Ghana

Henry Danso, Deputy Regional Engineer, Department of Feeder Roads, Koforidua, Ghana

1.0 INTRODUCTION

Ghana’s experiment with the labour-based technology which started in 1986 and developed around the private sector has been transformed from a pilot phase to a large scale application. Currently, the project has been replicated in all the ten regions of the country with 54 out of the 93 trained contracting firms equipped. This paper discusses the factors influencing the current level of performance of the trained contractors and suggests ways to improve output.

2.0 TRAINING AND EQUIPPING CONTRACTORS

The Government of Ghana offers and subsidises training in the technology to selected contractors. Each contractor submits six (6) potential supervisors to the Department of Feeder Roads (DFR) for screening. The minimum educational qualification required of these potential supervisors is a GCE “O” level certificate or its equivalent in technical education. Based on interviews and a written examination, DFR selects four out of these six potential supervisors for training as supervisors. The duration of the supervisor training programme, which was originally 23 weeks, was later scaled down to 20.

Trained contractors are equipped either through funds received from Donors or Government of Ghana’s resources. Based on the assumption that each equipped contractor employs between 120 and 150 labourers, it was estimated that each contractor could achieve an annual target of 20 km and thus be able to pay off their equipment loan over a four year period.

3.0 WORK SECURITY

In order to enable contractors to pay their equipment loan, DFR guarantees adequate workload for four years. This policy was a result of experience gained from the 3rd Highway Project executed by the Ghana Highway Authority (GHA) whereby the Bank repossessed most of the equipment loaned to the contractors.

The use of Departmental rates for pricing labour-based contracts satisfies both the Client and contractors since the arrangement ensures that the Client gets value for money and the contractors are able to service their debts. Measures taken by DFR to ensure continuous work for contractors are to prepare new projects for award
when the contractor has completed 80% of the on-going contract. However, there have been some delays in project preparation with the increasing number of trained contractors and the low staffing levels within DFR.

4.0 CONTRACTOR’S FIELD PERFORMANCE

The assessment of the contractor’s performance in the field is illustrated with the results from four contractors involved in the first standard contracts during the Pilot Phase in 1988. Each of these contracts involved the rehabilitation of 25km of feeder roads by labour-based methods. Originally, based on the planned output rate of 2 km/month, a contract duration of 12 months was planned. However, due to problems with excessive rainfall, the planned duration was extended by four months, giving a revised output rate of 1.56 km/month. Fig. 1 shows the actual contract duration for each of the four contractors compared with the planned and revised contract duration. It can be seen that the actual rate achieved in the field is about 82% of the revised rate. These results led to a downward revision of the target rates to between 1.5 and 1.7 km/month for the second batch of contractors equipped on the programme. Following the realisation that most of the contractors could not achieve even these reduced rates, a further revision was made to bring the target output to 1.5 km/month, although some contractors were able to achieve output rates of over 2 km/month.

Table 1 shows the planned and actual output of each group of contractors for various periods from June, 1988 to September, 1994. This does not include another group of 28 contractors who were equipped in 1994 and were therefore executing only trial contracts. The results show that in all cases, the actual output falls short of the planned output.

The general low output of the contractors together with the large increase in the number of trained contractors led to a review of the size of the standard contract from 25 km to between 10 and 15 km per annum.
Table 1. Actual /Planned Output

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Actual</td>
<td>Planned</td>
<td>Actual</td>
<td>Planned</td>
</tr>
<tr>
<td>4</td>
<td>1988</td>
<td>99.10</td>
<td>108.0</td>
<td>70.5</td>
<td>144.0</td>
</tr>
<tr>
<td>3</td>
<td>1989</td>
<td>21.80</td>
<td>54.0</td>
<td>66.8</td>
<td>108</td>
</tr>
<tr>
<td>12</td>
<td>1990</td>
<td>NA</td>
<td>NA</td>
<td>168.4</td>
<td>324</td>
</tr>
<tr>
<td>5</td>
<td>1991</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>112.4</td>
</tr>
<tr>
<td>2</td>
<td>1991</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>31.15</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>120.9</td>
<td>162</td>
<td>305.7</td>
<td>576</td>
</tr>
</tbody>
</table>

NA: Not applicable
Total actual output accomplished: 1,058 km
Total planned output: 1,845 km

5.0  EQUIPMENT LOAN REPAYMENT

The loan repayment is another area of concern in our present situation. It normally takes most of the contractors about three months to execute work of substantial value for payment to be effected. In effect, the number of times that the contractor presents a cheque to the Bank for deductions to be made may not exceed five in a year. The Bank deducts 35% of the value of the cheque presented and not the contractor's outstanding debt on the repayment schedule, except in the case where the contractor had defaulted for a very long time. The end effect is that the contractor pays additional interest on the loan. This situation has been worsened by the prevailing high interest rate which has changed from 20% in 1988 to 35% in 1996 for loans in the local currency, and the Cedi–US Dollar conversion rate which has changed from ¢260.00 to ¢1,500 to US$1.00 during the period. Table 2 gives details of the loan repayments of four contractors of varying capabilities who benefited from the IDA Loan between 1988 and 1990.

The loan value represents the actual amount which the contractor would have paid, had he paid in accordance with the Bank repayment schedules. The table shows that, because the contractors could not meet the Bank's repayment schedules, they were paying more than the actual value of the loan. The difference between the loan values and what the contractors ended up paying is also tabulated. In fact, based on the magnitudes of the differences, Contractor A and B may be considered to have exceptionally good performance. The majority of contractors are actually comparable to Contractors C and D. These contractors may be said to have serious operational problems.
Table 2. Loan repayment details

<table>
<thead>
<tr>
<th>Contractor</th>
<th>Actual Loan (Prin. + Int) US$</th>
<th>Amount Paid By Contractor (US$)</th>
<th>Difference (US$)</th>
<th>Payment Period</th>
<th>Cedi-Dollar Disparity For Period</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>117,281</td>
<td>122,413</td>
<td>5,122</td>
<td>Sept. 89-Sept. 92</td>
<td>279.87-447.40</td>
<td>Complete</td>
</tr>
<tr>
<td>B</td>
<td>117,281</td>
<td>136,237</td>
<td>18,956</td>
<td>Sept. 92-Apr. 89</td>
<td>279.87-601.00</td>
<td>–do–</td>
</tr>
<tr>
<td>C</td>
<td>99,122</td>
<td>147,844</td>
<td>48,791</td>
<td>Nov. 88-Oct. 93</td>
<td>233.50-746.25</td>
<td>–do–</td>
</tr>
<tr>
<td>D</td>
<td>91,352</td>
<td>92,955</td>
<td>32,800*</td>
<td>Apr. 90-Dec. 94</td>
<td>–do–</td>
<td>Still paying</td>
</tr>
</tbody>
</table>

*Loan rescheduled for payment up to December, 1999.

6.0 FACTORS INFLUENCING CONTRACTORS’ OUTPUT

Below are some of the factors that have been identified as the major causes of low output in the field.

Labour Availability

Labour availability studies used to be carried out before awarding contracts to trained contractors at the start of the programme when one Project Engineer and his Deputy had the responsibility of administering and supervising six contractors. The practice has since either stopped or less attention is being paid to the studies with the increased number of trained contractors and the diminishing number of supervisors. The current situation one Project Engineer is responsible for between seven and ten contractors. Thus contractors are sometimes assigned roads where availability of labour becomes a major constraint to achieving any meaningful output. Contractors are therefore compelled to transport labour over long distances to their sites.

Frequent Breakdown of Rollers

In most rural areas, the back-up services required to minimise the problem posed by the frequent breakdown of the vibratory rollers are not available. Where mechanics are available, they are not adequately equipped to deal with the problem. This coupled with the non-availability of spares on the market within the vicinity of the sites has resulted in utilisation rates falling below 50 percent thus affecting the performance of the contractor. In some instances, the breakdown of rollers leads to suspension of earthworks and gravelling for more than two months.
**Poor Planning of Works**

Though contractors are taught the importance of good planning and how to plan, most of them do not apply the techniques to their works. For instance, most of them do not:

- draw up a cashflow plan for the contract and thus fail to make the necessary arrangements for the required funds before the commencement of works
- arrange for the delivery of material on schedule
- make arrangements for the required labour force before the commencement of works
- plan for the smooth execution of the works on the ground to avoid stoppages due to non-attendance to critical sections ahead.

**Attrition of Supervisors**

Lack of incentives, low salaries and delays in the payment of salaries, inadequate briefing or education during engagement, poor management practices and unrealistic demands from supervisors have contributed to the high attrition rate of supervisors from their parent companies. A survey carried out nation-wide has revealed that the rate of attrition averages about 50%.

**Delays in the Payment for Work Done**

Such delays affect the contractor’s loan repayment schedule. They are also a cause for supervisors leaving their companies. Such situations can erode the confidence that the casual labourers have in the company. The delays also affect payment schedules of wages to workers and can dampen the morale and enthusiasm with which workers go about their duty.

**Divided Attention**

The Managers of some of the earlier companies selected were also engaged in other ventures, thus depriving their labour-based works of the needed attention. The day-to-day running of such sites was usually left in the care of the supervisors but without delegated authority to effectively manage the site. This sometimes resulted in petty struggles among the supervisors over leadership, thus hindering progress at the site.

There is also the tendency to transfer funds into other ventures. Contractors do not reinvest money in their firms. They use very little working capital to run their contracts, instead of using the bulk of the money to facilitate the smooth execution of their works. Even though attempts are made to address the problem of divided attention through the contractor selection process, nothing stops a
contractor from engaging in other ventures after his selection and training.

**Undertasking**

Undertasking leads to delays in the overall progress of works. Because site activities are executed in a definite order, delay in the execution of one operation could lead to the delay or stoppage of the subsequent activities. It also leads to an increase in wage bills and more hands than expected being used to execute a particular operation. Undertasking is the result of:

- Poor site organisation
- Inadequate provision or absence of work incentives
- Quality of supervisors
- Inappropriateness and poor quality of available tools

**Roads with Excessive Earthworks**

As a general rule, roads with large volumes of earthwork are usually not recommended for execution using the labour-based approach. In recent times, most of the roads selected for rehabilitation by labour-based technology involved haulage of material over long distances and since the contractors have limited resources (equipment, hand tools and labour) to deal with such situations, the result is delay in completing contracts.

**Long Delays in Equipping Contractors**

Contractors’ supervisors who have just had their first experience in the technology after their training go through advance culvert works for a long time instead of putting into practice the knowledge acquired during their training.

Table 3 shows details of the time lapse between training and equipping of a number of contractors.
Table 3: Time lapse between training and equipping of contractors

<table>
<thead>
<tr>
<th>Group</th>
<th>No. Of Contractors Trained</th>
<th>No. Of Contractors Equipped</th>
<th>Year Trained</th>
<th>Year Equipped</th>
<th>Delay (Years)</th>
<th>Funded By</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>7</td>
<td>4</td>
<td>1987</td>
<td>1988</td>
<td>1</td>
<td>IDA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td>1989</td>
<td>2</td>
<td>IDA</td>
</tr>
<tr>
<td>II</td>
<td>6</td>
<td>6</td>
<td>1988</td>
<td>1990</td>
<td>2</td>
<td>IDA</td>
</tr>
<tr>
<td>III</td>
<td>8</td>
<td>6</td>
<td>1989</td>
<td>1990</td>
<td>1</td>
<td>IDA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td>1991</td>
<td>2</td>
<td>GOG</td>
</tr>
<tr>
<td>IV</td>
<td>8</td>
<td>2</td>
<td>1989</td>
<td>1990</td>
<td>1</td>
<td>IDA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td>1991</td>
<td>2</td>
<td>GOG</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td>1994</td>
<td>5</td>
<td>USAID</td>
</tr>
<tr>
<td>V</td>
<td>6</td>
<td>6</td>
<td>1990</td>
<td>1994</td>
<td>4</td>
<td>USAID</td>
</tr>
<tr>
<td>VI</td>
<td>6</td>
<td>4</td>
<td>1991</td>
<td>1994</td>
<td>3</td>
<td>DANIDA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>USAID</td>
</tr>
<tr>
<td>VII</td>
<td>14*</td>
<td>1</td>
<td>1992</td>
<td>1994</td>
<td>2</td>
<td>DANIDA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td>USAID</td>
</tr>
</tbody>
</table>

* 1 contractor yet to be equipped
GOG: Government of Ghana

These long periods of absence affect their site organisation ability to the extent that some even forget the correct approach to dealing with some critical situations. It would have been prudent for the Client to provide the required back-up support; however, this support is usually not available since there are not enough DFR trained supervisory staff to oversee works being executed by the contractors.

7.0 SUGGESTED REMEDIES

I. Client

a) Should increase supervisory role/capacity by the effective use of the available resources, i.e. up-grade the skills of its personnel especially the foremen through training, refresher courses and incentives.
b) Should recruit additional technical staff when necessary to help overcome problems associated with project preparation and administration.

c) Should ensure the availability of funds before the award of contracts, during the execution of contracts, and prompt payment for work done to prevent the delays in the payment of workers’ wages and associated problems.

d) Should identify problem areas of the programme, i.e. training and contractors’ performance in the field, and address these problems. The training school should design and organise appropriate refresher courses (for a fee) for the contractors’ supervisors in key areas of the technology.

II. Contractor

a) Should adopt and put into practice all project management techniques acquired during the management training programme. They should also follow up with the required refresher courses e.g. management courses offered by the DFR Training School or other recognised institutions in the country to address planning and site organisational problems.

b) Should give their contracts all the attention they deserve by way of resources and motivation to facilitate the execution of the works and the overall growth of the company.

c) Should arrange to have a qualified mechanic to carry out regular maintenance of equipment at the site and advise on the procurement of spares.

REFERENCES

COMPARISON OF ACTUAL AND EXPECTED OUTPUT
ON 1st STANDARD CONTRACT (25km OF ROAD REHABILITATION)

<table>
<thead>
<tr>
<th>FIRM</th>
<th>Actual Duration</th>
<th>Planned Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>20</td>
<td>12 (12 MONTHS)</td>
</tr>
<tr>
<td>B</td>
<td>19</td>
<td>16 (16 MONTHS)</td>
</tr>
<tr>
<td>C</td>
<td>19.5</td>
<td>12 (12 MONTHS)</td>
</tr>
<tr>
<td>D</td>
<td>21.5</td>
<td>12 (12 MONTHS)</td>
</tr>
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</table>

Series 3: Planned Completion Time
Revised Completion Time
FOREWORD

Poverty in Africa is essentially a rural phenomenon, with around 70 percent of the poor living in rural areas and engaged in agricultural activities. Improving rural transport infrastructure is, therefore, an essential component of agricultural development and poverty reduction. The World Bank has been working with other bilateral donors and African governments to address these issues through the Rural Travel and Transport Program (RTTP). This program is a component of the Sub-Saharan Africa Transport Policy Program (SSATP), which is a collaborative framework set up to improve transport policies and strengthen institutional capacity in Africa.

The use of labor-based methods for road works has been an important aspect of the strategy to improve rural transport infrastructure in Africa over the past 25 years. These methods not only produce gravel roads of quality equal to roads made by equipment-based methods, but can be used to generate rural employment in a cost-effective manner. In addition, labor-based methods save on foreign exchange, inject cash into the local economy, transfer knowledge of road works to the local community – a knowledge that will be useful for later maintenance – and reduce damage to the environment.

Although the benefits of labor-based methods are now widely recognized, contractors have been reluctant to use them. The work presented in this report was motivated by an interest in understanding why. The answer to this question is critical for the future rural development of Sub-Saharan Africa: utilizing local resources to improve rural transport infrastructure is essential for developing strong rural economies, increasing incomes, and facilitating access to markets and social services. This study challenges conventional wisdom in this area and shows that the success of labor-based programs hinges on the existence of a conducive market structure, targeting small contractors for training and paying them on time. Unless these requirements are addressed, the use of labor-based methods is likely to be unsustainable.
This report is being issued as a Sub-Saharan Africa Transport Policy Program (SSATP) Working Paper since its findings are relevant to many African countries. SSATP papers are addressed to policymakers and to managers and planners attempting to improve the performance of the transport sector in Africa. They are also intended to facilitate consensus building among the donor community and key policy-makers in Sub-Saharan Africa.

Jean H. Doyen, Chief
Environmentally Sustainable Development Division
Technical Department, Africa Region

ACKNOWLEDGEMENTS

This study was prepared by Elisabeth A. Stock, Rural Transport Specialist (Africa Technical Department). The study was initiated to satisfy the degree requirements for an M.C.P. and M.Sc. (in Technology and Policy) at the Massachusetts Institute of Technology. It has since been reviewed and reworked as part of the Rural Travel and Transport Program (RTTP), under the overall direction of Jean H. Doyen (Division Chief, AFTES) and Snorri Hallgrimsson (Infrastructure Advisor, AFTES). The RTTP is a regional initiative to improve rural transport services. It is financed by the governments of Switzerland, Norway, Sweden, and by the World Bank.

Substantive inputs to the initial report were made by Judith Tendler (MIT), Richard Tabors (MIT), Bish Sanyal (MIT), Anu Joshi (MIT Ph.D. student), Meenu Tewari (MIT Ph.D. student), Stefano Pagiola (World Bank), Howard Stock, and Evelyn Stock. The report was reviewed by staff from the Bank including Jean-Marie Lantran, Ian Heggie, Christina Malmberg Calvo, Gérard Paget, and Thor Wetteland.

Substantive inputs to this final version were made by Jan de Veen (ILO Geneva), Kwaku Osei Bonsu (Chief Technical Advisor, ILO), Charles Williams (Advisor, DFR), Gary Taylor (Director, IT Transport Ltd.), and Opoku Mensah (OPM Construction Works Ltd., Ghana). A number of other people also made important contributions including colleagues and technical staff from the ILO, and Snorri Hallgrimsson (World Bank).

Special thanks is extended to the interviewees in Ghana, especially Mr. Antwi-Boasiako and his family (of Gabasan Construction Works), Mr. Arthur (of Knatto Complex) and Mr. Mensah (OPM Construction Works Ltd.). In addition, thanks is extended to the engineers and quantity surveyors at the Department of Feeder Roads in Ghana. The report was edited by Ilyse Zable and formatted by Leita Jones, Senior Staff Assistant, AFTES.
<table>
<thead>
<tr>
<th>ACRONYMS</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGETIP</td>
<td>Agence d’exécution des Travaux d’intérêt Public Contre le sous-emploi</td>
</tr>
<tr>
<td>ASIST</td>
<td>Advisory Support Information Services and Training for Labour-Based Road Programmes</td>
</tr>
<tr>
<td>BHC</td>
<td>Bank for Housing and Construction</td>
</tr>
<tr>
<td>COSATU</td>
<td>Congress of South African Trade Unions</td>
</tr>
<tr>
<td>DANIDA</td>
<td>Danish International Development Agency</td>
</tr>
<tr>
<td>DFR</td>
<td>Department of Feeder Roads</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GTZ</td>
<td>Deutsche Gesellschaft fur Technische Zusammenarbeit</td>
</tr>
<tr>
<td>ILO</td>
<td>International Labour Organization</td>
</tr>
<tr>
<td>MIT</td>
<td>Massachusetts Institute of Technology</td>
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<tr>
<td>RTTP</td>
<td>Rural Travel and Transport Program</td>
</tr>
<tr>
<td>SSATP</td>
<td>Sub-Saharan Africa Transport Policy Program</td>
</tr>
<tr>
<td>UNDP</td>
<td>United Nations Development Program</td>
</tr>
<tr>
<td>USAID</td>
<td>United States Agency for International Development</td>
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</tbody>
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EXECUTIVE SUMMARY

Since the 1970s' donors and international organizations have promoted labor-based methods for road rehabilitation as one means of mitigating rural unemployment in developing countries. Labor-based methods create around 15 times more employment per km than equipment-based methods. Unlike other employment-generating programs, labor-based road rehabilitation programs can be justified on financial grounds and, therefore, appear to combine the employment-generating benefits of public works with the efficiency benefits of private sector delivery. Why, then, do private contractors continue to prefer equipment-based methods? This study offers an explanation by drawing on the experiences of a labor-based road program in Ghana.

The literature gives two explanations for contractors' reluctance to adopt labor-based methods. First, contractors believe the cost of learning this new technology is high. Programs designed to promote labor-based methods have always included subsidized training to address this problem. This study argues that focusing on training often diverts attention away from more substantive problems inherent in adopting labor-based methods. Second, and more fundamental, some have argued that the cost of managing large labor forces, which is difficult to quantify in unit-cost comparisons, makes labor-based methods less competitive than equipment-based methods. This study shows that although labor-based methods can be financially more attractive to Ghanaian contractors, market-structure conditions thwart their use. Unit-rate cost comparisons of labor-based and equipment-based methods, therefore, cannot predict firm behavior. In particular, there is a very important distinction between small and large contractors.

Labor-based methods are more attractive to small firms than to large firms. Small firms, because they are small, can supervise their sites themselves and thus find it easier to develop strategies to increase worker productivity and control truancy. Moreover, unlike large firms, small firms who wish to use equipment-based methods face high variable costs: they either own older, less-efficient equipment – with high maintenance costs – or must rent equipment at a high cost. Large firms, in contrast, find labor-based methods much less attractive. Large firms have high monitoring costs because of their size and because they often undertake many projects simultaneously. In addition, large firms have lower variable costs than labor-based firms which must make wage payments of up to 40 percent of their total costs. Thus, if large firms experience a lull, they can underbid small firms for small contracts ('fill in' work) and use their otherwise idle equipment. Thus, while small firms have the incentive to supervise their sites closely and learn to manage large labor forces,
large firms have little incentive to do so. Market structure clearly has a strong influence on the adoption of labor-based methods.

The other factor that makes firms resist using labor-based methods is the government’s habitual delay in payments. If payments are late, small labor-based firms are unable to pay their laborers and strikes ensue. Although donors often create mechanisms to ensure timely payments during the pilot phase, these mechanisms are often temporary; and delayed payments once again become common in the program phase. Prompt payments are less critical for large equipment-based firms because their wage bill is lower and because they undertake many projects at once and can thus ‘swap’ payments from one project to another to help fill the gap. Prompt payments, surprisingly, are also less critical for small equipment-based firms because, in Ghana, contractors are able to obtain supplies on credit (without paying interest in some cases) and can pay suppliers late if they are paid late. Thus, payment delays in Ghana make labor-based methods less competitive than equipment-based methods for both large and small firms.

Although Ghana’s experience with labor-based methods is recent, it provides important lessons. Labor-based rehabilitation programs can be useful for generating rural employment and promoting private sector delivery. However, the previous framework for comparing labor- and equipment-based methods – using unit rates – is not sufficient for determining the competitiveness of labor-based methods in the private sector. Instead, this study proposes a framework based on market structure and also emphasizes the importance of timely payments to contractors. The findings indicate that although program designers focus predominantly on training, the success of labor-based programs actually hinges on paying contractors promptly and addressing problems in market structure.

1. INTRODUCTION

Employment in Sub-Saharan Africa has become an ever-increasing concern for African governments and international organizations. For the last five years the population in Sub-Saharan Africa has grown at an annual average rate of 3.2 percent, while the economy’s ability to absorb labor has grown at only 2.2 percent (Gaude and Watzlawick 1992). Since the early 1970’s the World Bank and the International Labour Organization (ILO) have proposed labor-based road rehabilitation as one method to deal with the growing unemployment problem. For example, in Ghana, labor-based methods employ more than 150 laborers a day to produce 1.4 km of rehabilitated gravel road per month, which is 15 times more labor than is needed for equipment-based methods. In addition, studies have shown that labor-based methods not only produce gravel roads of equal quality to those produced with equipment-based methods, but in most developing
countries, they are economically and financially less costly. Why then have labor-based programs been so difficult to expand?

1.1 A Brief History of Labor-based Methods

The World Bank and the ILO were among the first international agencies to encourage developing countries to adopt a labor-based technology in the road sector. Although labor-based methods were used in the colonial era, by the 1960s most government officials and private firms in developing countries had a distinct capital-intensive bias. This had occurred even though these countries were labor-abundant and capital-scarce. The ILO and the World Bank blamed this bias on government policies that subsidized the cost of imported equipment and set wages above the marginal productivity of labor (Sadli 1974:368). These policies, they explained, made equipment-based methods appear cheaper than labor-based methods. The ILO and the World Bank argued that labor-based methods were justified on social and economic grounds and, later, that under certain conditions they were actually more competitive financially.

Economic and Social Justification

Labor-based methods were justified socially because they would reduce rural unemployment by providing jobs on the road sites. The need to address unemployment had become critical in the 1960's and 1970's. In 1971, widespread unemployment in Sri Lanka was linked to an eruption of violence; in Tanzania, urban migration caused social unrest, leading the government to forcibly remove unemployed workers from the cities. Researchers blamed this unrest on the migration of the rural underemployed to the cities, which were not capable of absorbing them into the labor force (Edwards 1974:4). Two factors made rural areas less attractive than urban areas: the increasing population growth in rural areas and the tendency of government to concentrate infrastructure and industry in cities. Labor-based road rehabilitation was one means of resolving both the need for rural employment and the urban bias in infrastructure investment. In Kenya, for example, between 1986 and 1993 the Minor Roads Program rehabilitated 3,240 kms of gravel roads and in fiscal 1990 alone, employed 20,300 casual laborers.23

Labor-based methods were economically justified because, when the financial prices for labor and imported equipment were replaced with

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23 The 3,240 km of gravel roads represent 5 percent of the total kilometers of classified road network based on figures from the Republic of Kenya Roads 2000 Program Objective Brochure (1994). The 20,300 casual laborers is based on figures from the Kenyan Rural Access Roads Program and Minor Roads Program Progress Report No. 11 (November 1991). The 20,300 casual laborers represent 0.18 percent of the total labor force based on figures from the World Development Report 1994. The total labor force is the 'economically active' population, including the armed forces and the unemployed.
their shadow prices, labor-based methods were shown to be less costly than equipment-based methods.24 Shadow prices were used during the early 1970’s because distortions in wages, caused by minimum wage legislation and in equipment costs caused by artificially low foreign exchange rates, made labor-based methods appear more costly than equipment-based methods. In addition, labor-based methods reduced a country’s expenditures on imported equipment, therefore reducing dependence on scarce foreign exchange (Department of Feeder Roads, 1989), and avoided delays in procuring imported spare parts (World Bank, 1991).

Based on these social and economic justifications, the World Bank and the ILO designed labor-based programs for public sector force account units. These organizations initially focused on the public sector rather than the private sector because distorted factor prices in the economy made equipment-based methods financially cheaper than labor-based methods for private sector firms, and many African countries had not yet developed local private sector capacity for contracting road works. For example, in Botswana, Kenya, Lesotho, and Malawi the government road agencies carried out all aspects of construction, rehabilitation, and maintenance themselves.

Resistance to Labor-based Programs

Despite World Bank and ILO arguments that these methods had both social and economic benefits, few governments showed interest in introducing labor-based methods into their road programs. Initially, most government officials and engineers held the common misconception that labor-based methods were a ‘backward’ technological alternative that used no equipment. But the ILO did not propose that African roads be built using no equipment. Rather, it encouraged governments to use the most cost-effective combination of labor and equipment for gravel road rehabilitation. In most countries, this advice translated into using labor and light equipment principally for haulage and compaction.

Yet even after these misconceptions were corrected, developing countries still resisted adopting labor-based methods. A review of the experience in countries such as Bangladesh, Botswana, Brazil, Colombia, Guatemala, Haiti, Kenya, Mexico and Thailand, reveals many reasons why government officials might prefer equipment-based methods to labor-based methods. To begin with, gravel road rehabilitation is comparatively faster using equipment-based methods than using labor-based methods. For example, in Ghana, equipment-based rehabilitation is approximately 1.5 times faster than labor-

24 See Coukis (1983:33-34) for an example.
based rehabilitation (Ashong 1994). Equipment-based methods, when properly executed, also are capable of achieving a better riding surface than labor-based methods, which is important for heavily trafficked roads.

Equipment-based methods minimize labor management problems because these methods typically require about ten permanent laborers per gravel road while labor-based methods require more than 100 casual laborers per gravel road (Edwards, 1974; Edmonds and Miles, 1984:30). Experience with labor-based programs in Asia has shown them to be plagued by problems of poor supervision, corruption, and low worker motivation (Riverson and others, 1991). Government officials who supervise the sites have added phantom workers to the payroll in some cases, and many projects have been referred to as ‘make-work’ projects because worker productivity has been so low (Gaude and Watzlawick, 1992; Bruton, 1974).

Equipment-based methods may also have political benefits because government officials can quickly mobilize equipment to do work for their supporters, whereas labor is more difficult to mobilize. Before elections, top government officials in one Southern African country used government tractors to plow farmer’s fields and thus garner votes. In addition, equipment-based methods offer more opportunities for rent-seeking since engineers and other civil servants have more contact with established contractors and can gain the benefits of such a relationship. Equipment-based methods also require less working capital, which is a concern for most cash-poor governments. Finally, equipment-based methods can command more funding than labor-based methods if donors will only finance the foreign exchange costs of a project (Tendler, 1979a). Therefore, governments that are aiming to maximize donor contributions will find labor-based projects less attractive than equipment-based projects.

Promoting Labor-based Methods

To develop stronger arguments for using labor-based methods, the World Bank and the ILO evaluated a number of projects to examine their costs. Whereas labor-based methods had earlier appeared more expensive in cost per kilometer than equipment-based methods, extensive studies based on unit rates for equipment and labor showed the reverse to be true in low-wage countries (less than US$2.50 a day).

25 The comparative speed of labor- and equipment-based methods depends upon the quantity of work to be executed. The longer the length of road to be rehabilitated, the faster equipment-based methods will be relative to labor-based methods.

26 In contrast to force account units, contractors using equipment-based methods often require a longer mobilization period than contractors using labor-based methods.
For example, in the mid-1970s the World Bank used a unit-rate analysis to re-evaluate a road construction project that had been completed using equipment-based methods in Kenya, a low-wage country. This analysis showed that the roads could have been built more cheaply using labor-based methods (Tendler, 1979a). Because this framework demonstrated that labor-based methods were cheaper then equipment-based methods in most of Sub-Saharan Africa, the World Bank and the ILO began to justify using labor-based methods on financial and not just economic grounds.

Surprisingly, even though labor-based methods were shown to be financially cheaper, private firms in Africa continued to use equipment-based methods. The literature suggests two reasons for this behavior. Contractors accustomed to using equipment-based methods assigned a cost to learning labor-based methods. Although this cost was not quantified, they viewed it as prohibitive (Tendler, 1979a). Also, the contractors saw the cost of managing a large labor force (that is, supervision to increase labor productivity and reduce worker truancy) as making labor-based methods uncompetitive with equipment-based methods. Although the competitiveness of labor-based works depends critically on labor productivity, the cost of managing labor is difficult to calculate (Sadli, 1974; Hirschman, 1958; de Veen, 1994).27

The ILO used targeted program interventions to address the problems stated above. They trained contractors, thus subsidizing their cost of adopting this new technology, and the ILO promoted the task-rate payment system – a system that pays laborers according to output rather than time – to increase worker productivity. Studies have shown that laborers are motivated to work harder when their wages are tied to output rather than to time.28 In some developing countries, instituting such a system is difficult because labor unions view it as exploitative. For example, in South Africa in the early 1990s, the Congress of South African Trade Unions (COSATU) initially opposed the use of a task-rate system which tied wages to productivity.29

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27 Unit-rate build-ups account for the cost of managing large labor forces through a provision in overheads or through an increase in the number of supervisory personnel.


29 In June 1993, COSATU finally agreed to using a task-rate system as part of a framework agreement between three major actors: COSATU, the South African Federation for Civil Engineering Contractors, and the South African National Civic Organization. The agreement says that public works projects will in future, wherever possible, employ people, using a ‘task rate’ system, instead of machines for construction work.
Introduction in Ghana

In 1986, Ghana became the first Sub-Saharan African country to launch a program introducing labor-based methods in the local road contracting industry. The government established a labor-based road rehabilitation pilot project in the Sefwi Wiawso district of the Western region. The World Bank and the United Nations Development Program (UNDP) provided financial assistance for the project; the ILO provided technical assistance. The program designers decided to target contractors rather than government force account units because, at that time, Ghana appeared to have an ideal environment for introducing labor-based methods into the local contracting industry.

Unlike many other African countries, a private road-contracting industry had existed in Ghana since the late 1950's, after independence. By 1986, Ghana's local road-contracting industry was already well developed, with private firms capable of executing road works of more than US$2 million and the public sector capable of administering the contracts. In addition, the Ghanaian wage rate was less than US$1 a day - below the World Bank and the ILO's stated threshold. Because the program targets private firms, it subsidizes the cost of learning labor-based methods by training contractors, and it introduces a task-rate system for paying labor. In addition, until 1994, the program allowed only program participants to execute labor-based contracts, which were awarded based on engineers' fixed rates, and not tendered bids. In this way the program protected its contractors from equipment-based contractors outside the program and placed them in a 'cost-based' market.

At first glance, the program seems to have been very successful: between 1986 and 1994 the program created about 2.6 million person-days of employment, paid US$1.4 million in wages, and rehabilitated 1,190 km of gravel roads. In addition—and most importantly—labor-based methods were shown to cost approximately US$12,035/km with an average rate of completion of 1.4 km/month while equipment-based methods cost approximately US$19,463/km with an average rate of completion of 2.1 km/month (DANIDA, 1995). Thus, not only are labor-based methods one third as expensive as equipment-based methods, they are also more profitable in a cost-based market, even though equipment-based methods are faster. This can be demonstrated by calculating and comparing the theoretical monthly profit for both types of contractors assuming they are both paid the

30 The cost per km of labor-based rehabilitation is based on contracts from 1987 to 1994. The cost per km of equipment-based rehabilitation is based on contracts awarded in July 1993 and July 1994.
equivalent sum of US $21,000/km. In this case, a small contractor using labor-based methods will make approximately three times more profit per month than a small contractor using equipment-based methods (Table 1).

Yet although the labor-based methods appear to be more competitive, many contractors were still averse to using labor-based methods. For example, by 1994, many of the labor-based contractors wanted to leave the program or use equipment-based methods on their sites if they were allowed. This paper attempts to answer why.

Table 1: Monthly profit for equipment-based and labor-based contractors

<table>
<thead>
<tr>
<th>Measure</th>
<th>Equipment-based</th>
<th>Labor-based</th>
</tr>
</thead>
<tbody>
<tr>
<td>payment / km (US$/km)</td>
<td>19,500</td>
<td>19,500</td>
</tr>
<tr>
<td>cost / km(^a) (US$/km)</td>
<td>17,694</td>
<td>10,941</td>
</tr>
<tr>
<td>profit / km (US$/km)</td>
<td>1,806</td>
<td>8,559</td>
</tr>
<tr>
<td>speed (km/month)</td>
<td>2.1</td>
<td>1.4</td>
</tr>
<tr>
<td>monthly profit (US$/month)</td>
<td>3,793</td>
<td>11,983</td>
</tr>
<tr>
<td>Monthly profit ratio</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

\(^a\) The cost for equipment-based contractors was calculated by assuming that they tender for works with a 10 percent profit margin. The cost for the labor-based contractor was calculated the fixed rate of US $13,500, which includes a 10 percent profit margin.

In reality, both types of contractors do not receive the same payment per km. Labor-based contractors are paid at a rate calculated by the government while equipment-based contractors tender their rates. No labor-based contractors have been paid US $21,000.
1.2 Principal Findings

Although managing large labor forces is a substantial problem for large firms (as was thought), it is not for small firms. The key to understanding why lies in the market structure for civil contractors. Although donors often use unit-rate cost comparisons of labor-based and equipment-based methods to persuade governments to initiate labor-based programs, these comparisons do not predict firm behavior. In particular, there is a very important behavioral distinction between large and small firms: large firms do not find labor-based methods attractive while small firms do. Large firms have high monitoring costs because of their size and because they often undertake many projects simultaneously. In addition, large equipment-based firms have high fixed costs and low variable costs. They would sooner underbid a labor-based firm and keep their equipment employed, than switch to labor-based methods and leave their equipment idle. Although large firms would only be able to underbid labor-based firms for a short time (or they would be unable to replace their equipment stock), this behavior is not unusual when there is a reduction in the work available in the sector. Thus, large contractors have little incentive to use labor-based methods and learn to manage large labor forces well.

Small firms, on the other hand, can supervise their sites themselves, and so find it easier to develop strategies to increase worker productivity and control truancy. Moreover, unlike large firms, small firms that want to use equipment-based methods still face high variable costs: they either own older, less-efficient equipment – with high maintenance costs – or must rent equipment at a high monthly rate. Thus, small contractors not only have the ability to learn how to manage labor well, they also have the incentive to do so.

Small Ghanaian contractors have successfully managed their large labor forces as demonstrated by the strategies they have developed to increase labor productivity and control truancy. For example, contractors found that group work raises productivity because camaraderie encourages the laborers to work harder. Although the Western ideal of employment is often contractual (for example, defining set conditions of service), the relationship between contractors and workers in Ghana is influenced more by trust than by a concrete contractual payment system. With respect to truancy, contractors have had more difficulty with supervisors than with laborers. Contractors, however, have developed strategies to monitor supervisors by either visiting the site themselves (top-down monitoring) or developing a group of informers (bottom-up monitoring).

32 ‘Small’ and ‘large’ are defined according to turnover, assets, and number of permanent employees. They do not refer to the number of casual employees.
The second principal finding is that it is the government's habitual late payments – frequent in so many developing countries – and not contractors' inability to manage large labor forces, that causes small contractors to favor equipment-based methods. Although program designers often create mechanisms to ensure timely payments during the pilot phase, these mechanisms are often temporary, and delayed payments become common in the program phase. Prompt payments are less critical for large equipment-based firms because their wage bills are lower and because they undertake many projects at once and can thus 'swap' payments from one project to another to help fill the gap.

Prompt payments, surprisingly, are also less critical for small equipment-based firms because Ghanaian contractors operate in a 'buyer's market' which enables them to obtain supplies on credit (without paying interest in some cases) and to pay suppliers late if they are paid late. For small labor-based contractors, in contrast, payment delays often result in strikes. Thus, when payment delays occur, equipment-based sites continue to operate (albeit, often with lower productivity), while labor-based sites often come to a complete standstill. Although the literature on labor-based road rehabilitation recognizes that payment delays are a major problem, it does not recognize how they can affect a small contractor's decision to use labor-based or equipment-based methods.

### 1.3 The Labor-based Road Rehabilitation Program in Ghana

Ghana's road network was originally constructed during the 1950s using capital-intensive methods. The British colonial administration viewed unskilled labor as relatively unproductive, and began constructing roads using the equipment-based methods practiced in Britain. After independence Ghana began developing its local road contracting capacity which, together with government force account units and timber and gold companies, continued to use equipment-based methods to construct the road network. By 1991, there were 146 contractors registered for equipment-based paved and unpaved road construction, rehabilitation, and maintenance. Of these, 10 could tender up to about US$2 million and four could complete works of any value. In addition, Ghana had 310 contractors registered for bridges and culverts. Of these, 15 could complete works up to about US$0.8 million, and five could complete works of any value.

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33 Although many of the comments on this paper have pointed out that this condition may be unique to Ghana and not common in the rest of Africa, a study by Taylor (1995) indicates that the same conditions exist in Zambia. Further research should be done to ascertain the prevalence of this condition throughout Africa.
The Program’s Emergence

During the late 1970’s and early 1980’s, the Ghanaian economy declined because of poor economic policies and a deterioration in the external terms of trade. Import volumes fell by one-third, real export earnings by 52 percent, and domestic savings and investment from 12 percent of GDP to insignificant levels.\(^{34}\) In addition, the repatriation of over one million Ghanaians from Nigeria in 1982/83, together with a prolonged drought, caused unemployment to rise to well over 20 percent. Because the government lacked foreign exchange to import spare parts, it did not maintain its 17,000 km of feeder roads; and by 1984, more than half of this feeder road network had deteriorated and needed rehabilitation. Poor road quality greatly increased the costs of transporting agricultural goods and therefore discouraged production (Department of Feeder Roads 1994). In some fertile farming areas, transportation costs, normally accounting for 15 to 20 percent of marketing costs, rose to as much as 70 percent of marketing costs. The deterioration of rural roads in other areas halted all movement of cocoa to the market (World Bank 1991).

In 1981 – during this economic crisis – the Department of Feeder Roads (DFR) was established as the focal institution for feeder road development. Prior to its establishment, feeder roads were the responsibility of various agencies, including the Ghana Highways Authority and the Ghana Cocoa Board. The DFR operated at four levels: the head office located in Accra; the regional offices located in the regional capitals; road area offices (responsible for three to four districts); and district offices. At the head office, the DFR planned and integrated feeder road rehabilitation and maintenance within the priorities of the Ghana Highway Authority and the Ministry of Agriculture. At the regional level, DFR engineers served as advisors to the regional secretaries and coordinated the distribution of resources among the road area offices. At the district level, DFR engineers provided the District Secretary and District Assembly with technical assistance for setting priorities and estimating the cost of rural road maintenance.\(^{35}\)

In 1984, while on a government-sponsored educational leave in Europe, Bashiru Sakibu, Director of the DFR, learned that the ILO and the World Bank had introduced labor-based methods in such African countries as Botswana, Kenya, Lesotho, and Malawi. Heretofore these methods had only been executed by force account in Africa. Upon returning to Ghana, Sakibu championed the use of these new methods because he believed that labor-based rehabilitation could upgrade the quality of Ghana’s rural roads and provide much needed employment in the rural areas. In addition, because labor-based

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\(^{34}\) Economic figures are from World Bank (1994a).

\(^{35}\) District Assemblies and Secretaries were not yet established at the time the labor-based program began.
methods could be justified financially, the private sector (Ghana’s already well-developed contracting industry) could be used to deliver these services.

Main Characteristics of the Program

Although the Ghanaian labor-based program was the first of its kind in Africa (not executed by force account), it shares many characteristics with programs in other African countries. The ILO designed the project so that the main beneficiaries would be the rural casual laborers living near the road works. The ILO and the DFR encouraged contractors to have a casual labor quota whereby at least 70 percent of the casual labor force were local laborers – ‘new hands’ – and fewer than 30 were ‘old hands’ – casual laborers who lived outside the vicinity but had worked with the firm before. This quota was intended to create more rural employment and reduce the contractors’ cost of transporting laborers. Furthermore, the ILO and DFR designed the project so that laborers could be paid using a task-rate system. Although this system of payment is normally considered illegal in Ghana – because it does not allow for overtime pay or for paid holidays – the Trades Union Congress did not object to its use, most likely because the casual laborers in the rural areas are not unionized, and therefore not represented by the Trades Union Congress.

The ILO also trained participants in labor management, both in the classroom and the field. And, finally, the ILO encouraged the government to reduce the width of rural roads to six meters or less. The government agreed to this change in design specifications because it was in line with the category and purpose of the road as well as the expected traffic levels.

The Ghanaian labor-based program is uniquely innovative in providing incentives for contractors to join. The program includes a subsidized training course for contractors and their supervisors. Supervisors complete six weeks of full-time classroom work, using mainly ILO training manuals. Contractors must send four supervisors to attend the course and pay for their living expenses.36 Unlike ILO programs in other African countries, the program in Ghana trains participants in financial management and tendering procedures. After completing the classroom work, contractors begin 14 weeks of practical field work involving the rehabilitation of a 10 km model road. Then, the contractors are given a trial contract to rehabilitate a 5 km road. If they perform well, they are awarded a standard contract of approximately 20 km.

The program also helps contractors secure commercial bank loans of up to US$160,000 for the necessary light equipment: three tractors (60

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36 The DFR reduced the amount contractors had to pay to support their trainee supervisors by paying them for their working time on the Model Roads.
HP), six trailers (3m3), one towed water bowser (2,250 liters), one water pump, two vibratory pedestrian rollers, one chainsaw machine, one tipper truck (5m3), one pick-up, and one set of hand tools (cutlasses, pick-axes, rakes, and so on). This loan was designed as a hire-purchase agreement through the Bank for Housing and Construction (BHC): the Ministry of Roads and Highways issues cheques jointly in the names of the contractor and the BHC.37 The BHC then makes deductions for the equipment leased to the contractor.

The program intentionally reduces the bias against small contractors by creating a special class in which labor-based contractors may be registered to compete for works, and reducing contract sizes in this class to US$350,000 or less to enable small labor-based contractors to bid. Finally, and crucial to this study, during the pilot phase, contractors were provided immediate payments for labor, thereby ensuring an adequate cash flow.38 These labor payments accounted for as much as 40 percent of the invoice value. At the conclusion of the pilot phase, the DFR stopped providing immediate payments for labor and centralized the payment system. Although centralization was intended to allow the BHC to administer the hire-purchase arrangement from its central branch in Accra, this change had a negative effect on the competitiveness of labor-based methods.

1.4 Methodology

The findings in this study are based on two months of fieldwork during the summer of 1994. This work included interviews with labor-based contractors, their supervisors, and their laborers in five regions of Ghana where labor-based firms were equipped: Western, Brong-Ahafo, Northern, Ashanti, and Eastern. The interviews focused on labor-based firms that were already equipped because these firms were the first to finish the training course and thus had the greatest experience with labor-based rehabilitation.

Of the 26 equipped firms, 13 were interviewed. Of these 13, two had been prominent equipment-based firms building bitumen and gravel roads before participating in the program; six had been small building...

37 The loans had a repayment period of four years and an interest rate of 20 percent if they were made in US dollars and 30 percent if they were made in Cedis. The Bank for Housing and Construction protected itself against default by requiring that contractors have collateral to participate in the hire-purchase agreement. The set of equipment and size of the loan varied slightly once DANIDA and USAID came in as donors.

38 The first six contractors who participated in the pilot project submitted labor bills at the end of the month for vetting by the project engineer. The project engineer then inspected the work and issued a check for labor costs so that the contractors could pay their workers on the third day of every month. Payments for work completed (minus the labor advance) were endorsed by the district and regional administrations, and final certificate payments were made at the DFR head office in Accra.
contracting firms; three had been small road contracting firms building small culverts before the program; one was an ammunition selling firm and one had undertaken only one contract before the program. This last contractor had been a permanent employee of one of the largest civil engineering firms in Ghana and created his own firm to participate in the labor-based program.

In addition to the equipped labor-based contractors, two unequipped road contractors and one prominent building contractor were interviewed as well as DFR officials, an opinion leader at the district level, and inhabitants in three villages whose gravel roads had been rehabilitated under the pilot phase of the program in the mid-1980s. All interviewees have been assigned pseudonyms to protect their identities.

For the remainder of this paper, ‘labor-based road contractors’ refers to those road contractors who have completed the DFR labor-based course. ‘Equipment-based road contractors’ refers to all those domestic contractors who, whether they have completed the DFR labor-based course or not, continue to construct and rehabilitate roads using the conventional capital-intensive methods – working with graders, excavators, rollers, and tipper trucks.

2. ARE SMALLER FIRMS BETTER AT MANAGING LABOR THAN LARGE FIRMS?

Labor-based methods can only be competitive with equipment-based methods if labor is managed well. As one Indonesian government official concluded, ‘reasonable levels of labor productivity’ are crucial to the success of labor-based programs (Sadli, 1974:369). An ILO technical advisor warns that if planners believe such skills to be lacking in a country, they may choose equipment-based methods, for which they can draw on international expertise (Hussain 1993:8).

Statements tying the competitiveness of labor-based methods to labor productivity are not new. Hirschman was one of the earliest theorists to raise this point. He argued that African managers viewed their supervisory role as ‘new, unfamiliar, and perhaps somewhat uncongenial’ and, therefore, were incapable of motivating workers (1958:146). Thus, he concluded that developing countries would have a comparative advantage in industries that do not require well-trained managers to motivate workers. For example, these countries will be better at smelting than at construction, because, in smelting, the machine can play the role of the manager in motivating the workers to keep a steady pace. Hirschman’s conclusion implies that managers in developing countries are incapable of motivating workers to be productive. Is this so?

In their efforts to demonstrate the competitiveness of labor-based methods, the ILO and World Bank have focused on the issue of labor management. Their approach to increasing labor productivity has
been two-pronged: institute a payment system that will motivate labor and increase productivity, and train site managers.

Changes in the Payment System

Kilby (1961) was one of the first researchers to attribute low labor productivity to lack of financial incentives. In his work, he implies that if managers changed the payment structures, African workers would become motivated, and productivity would rise. One such payment system is the task-rate system, whereby laborers are paid a daily wage for completing one task. Several studies conducted in the 1960's and 1970's suggest that a task- or piece-rate system increases worker motivation, and hence worker productivity.\(^{39}\) For example, a study of Indian road construction workers found that piece-work payment was associated with production levels 24 to 69 percent higher than work that was remunerated on a time-rate basis; that is, with daily wages (World Bank, 1974). Another study by the ILO in Nigeria and Tanzania confirms this result (Horton and King, 1981, cite ILO 1963).

These studies have led the ILO to support the task-rate system as the payment system of choice for labor-based programs. Although the ILO cannot dictate what payment system contractors must use after they have completed training, the ILO required contractors to employ laborers on a daily task-work basis and to agree with a training supervisory officer on a task level during training (Osei-Bonsu, 1992).

Training in Labor Management

Organizing and controlling labor is crucial to the success of labor-based programs. Past experiences with labor-based methods have been disappointing because they have been plagued by poor supervision and theft (Riverson and others, 1991). The ILO attempts to address these problems by providing specialized training in site organization and labor allocation. Managing large labor forces on a labor-based road site requires skills that are much different from those needed for equipment-based operations. These skills include leadership ability—a manager will need to organize, motivate, and control large groups of workers. Thus, the ILO argues that time and money must be spent on “substantial programs of managerial training” (Hussain, 1993:8).

The Effectiveness of the Two-Pronged Approach

Although the task-rate payment system and management training have helped contractors manage their labor forces, the primary indicator of labor-based contractors' performance is the amount of

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\(^{39}\) Task-work is slightly different than piece-work because in a task-work system the size of the task is calculated so that a laborer can complete only one in a day. In a piece-rate system, the pieces may be small and hence many pieces may be completed in one day.
time they spend supervising their sites and learning how to manage their labor forces after the training program. While large contractors provide little supervision themselves on their sites, which results in poor management, small contractors provide a great deal of supervision on their sites and learn to manage their labor force well. In fact, unlike the large contractors, these small labor-based contractors have developed their own strategies to increase the productivity of their work forces. For certain tasks, they amend the task-rate system used in the training course and raise production by substituting either group work or a flexible task rate. These small contractors have also developed strategies to mitigate truancy problems.

2.1 Why Large Contractors are Not as Successful at Managing Large Labor Forces as Small Contractors

The Ghanaian labor-based program has accepted many different types of participants: small house-building contractors, former civil servants, entrepreneurs from other sectors, and some small and large equipment-based road contractors. Of all the participants in the labor-based program, the large equipment-based road contractors have the poorest record for speed and quality, while the small contractors have been able to manage their sites well. The reasons for this distinction are twofold: large equipment-based contractors undertake many active projects simultaneously, and large equipment-based contractors have little incentive to learn how to manage labor well.

A large equipment-based contractor, for example, may have a bridge project in one district, a rehabilitation project 30 km away, and a maintenance project somewhere else. Large equipment-based contractors work this way because it helps them cope with the common problem of getting paid late. If a payment is delayed for one project, they can transfer, or ‘swap’, payments from another project. This strategy works well when all the ongoing projects are equipment-based because the sites employ only a handful of permanent laborers to operate the machines. This strategy does not work as well, however, when one of the many ongoing projects is labor-based because labor-based sites, with their hundreds of casual workers, require a great deal of supervision. By working on several projects at once, the contractor may be forced to neglect the labor-based site. Moreover, if a contractor wins a large equipment-based contract while executing a small labor-based contract, his focus will turn to the equipment-based site because larger losses or larger gains will be made there.40 Small firms, in contrast, execute only one project at a

40 A contractor can make more profit on the larger equipment-based contract even if it has a lower profit margin than the smaller labor-based contract. For example, a contractor will make more profit working on a US$3 million equipment-based contract with a 2 percent profit margin (profit=US$60,000), than on a US$300,000 labor-based contract with a 15 percent profit margin (profit=US$45,000).
time and can thus provide high levels of supervision; some contractors visit their sites almost every day, and some, three times a week. The contractor who had the highest speed for rehabilitation visited his site every day, even though it was difficult to reach from his home. This important aspect of comparing labor-based and equipment-based methods is overlooked by the current analysis.

Large equipment-based contractors have little incentive to learn how to manage labor well because their equipment holdings make them eligible to tender for large contracts that are barred to small contractors and when there are no large contracts available, they can still use their equipment to underbid smaller contractors as long as the project site is not too remote. Although, the ILO demonstrated that labor-based methods were 25 percent cheaper than equipment-based methods during the pilot project, this figure does not differentiate between fixed and variable costs. Large equipment-based contractors have high fixed costs and low variable costs, while small labor-based contractors have low fixed costs and high variable costs; for small contractors, wage payments often account for 40 percent or more of total costs. Thus, even if labor-based methods are cheaper than equipment-based methods overall, large contractors using equipment-based methods can tender a lower price for a small rehabilitation project than can labor-based contractors. As long as large equipment-based contractors can at least cover their variable costs (that is, costs for fuel, oil, tyres, maintenance of equipment, spare parts, and equipment mobilization), they will tender for the project rather than sit idle. Although large firms would only be able to underbid labor-based firms for a short time (or they would be unable to replace their equipment stock), this behavior is not unusual when there is a reduction of work available in the sector. Thus, because large contractors can be competitive for most small contracts using their equipment, at least on a short-term basis, they have little incentive to learn how to manage labor well. It is this fear of larger equipment-based firms underbidding labor-based contractors that has caused the DFR to continue to protect the labor-based firms from competing with equipment-based firms.

If large contractors can compete for small projects using their equipment, why are they signing up to learn labor-based methods as part of the labor-based program? Large contractors have shown and continue to show interest in the labor-based program because it assures them continuous work for four years (the duration of the hire-purchase repayment schedule) at a time when both large and small equipment-based contracts have become extremely competitive. For example, 17 equipment-based contractors tendered for a contract in the Western region to fill bridge approaches for only US$30,000. But

41 The only time this contractor does not visit his site is when he is ‘chasing’ a payment certificate.
large contractors’ interest in the labor-based program is only temporary; they see small labor-based contracts as only secure ‘fill in’ work and plan to return to equipment-based methods once more equipment-based contracts become available. For these reasons, the DFR started to exclude prominent equipment-based contractors from the program in 1988.

For small contractors, unlike their larger counterparts, labor-based methods are more competitive. Small contractors either own no equipment and must rent from the market at high rates, or own old, poorly-maintained equipment that frequently breaks down. For these contractors, the variable costs of using equipment will be greater than the cost of using labor so long as they can manage labor well. Thus small contractors have an incentive to learn to manage labor well.

2.2 Small Contractors’ Strategies for Raising Worker Productivity

The success of small Ghanaian contractors in managing large labor forces is shown by the strategies they have developed to increase worker productivity and reduce truancy problems. These strategies are often improvements on what the contractors learned during the training course and are fine-tuned through experimentation and innovation.

In the training course, contractors are taught that, for certain activities, such as excavation and building scour - checks, laborers should be assigned individual tasks to avoid freeloaders and hence lower site productivity. Many contractors, however, have found the reverse to be true - their laborers are more productive when they work in groups for certain tasks. For example, rather than assign each individual laborer the task rate of excavating 3m³/day, one contractor assigns a group of six laborers the task of excavating 20m³/day. A second contractor assigns a group of workers the task of excavating enough gravel to load the tractor-trailer 1.5 times. This assignment makes supervision easier because it is much easier to count how many times the tractor-trailer has been loaded than to measure out 3m³ of gravel for each laborer (Acheampong, head supervisor).

When building scour-checks in the drains to prevent erosion, some contractors assign four laborers the task of building four scour-checks per day rather than assign each laborer one because “when they work together as a team, they work harder” (Ofori, supervisor). Although the World Bank frowns on group work because it encourages freeloaders (Coukis 1983:164), contractors have avoided this problem by allowing laborers to form their own groups. “If [one laborer] is lazy,
the group will sack [him] or they will prefer to select someone else” (Acheampong, head supervisor). This finding supports other findings in the literature comparing individual and group work. Marriott's 1971 study of two car factories found that small groups of workers (two or three) who could choose their colleagues had higher productivity than individual piece workers.

Although the ILO defines an exact task rate for each activity based upon soil and terrain conditions, contractors make the task rate flexible so that the laborers feel they are being treated fairly. For example, contractors will reduce the size of the daily task one set of laborers must complete if the group is being delayed by another set of laborers. In some cases, contractors reduce the quantity of gravel the gravel spreaders must spread if the gravel pit laborers are excavating very slowly. Making laborers feel that they are being treated fairly is important for raising labor productivity.

The practice of making task rates flexible conflicts with earlier attempts by the World Bank to define an exact task rate for each activity. For example, in his guide to labor-based construction programs, Coukis presents a sample calculation for setting the rate for task work (1983:162). This calculation is based on the average measurements of the person-day output of daily-paid workers and is not meant to be changed by the site managers. Rather, Coukis recommends placing the authority to change task rates at the central level.

Contractors prefer to employ women for certain tasks. This preference is surprising given that many other development programs have had to make special allowances to employ women or have had to convince private sector firms to hire women against their wishes. In Ghana, however, labor-based contractors report that women are better than men at removing topsoil with a hoe because “women can bend down and work continuously for one hour without getting up [while] men will try to do [the grubbing] quickly so they can stand up and stretch” (Ofori, supervisor). Some speculate that women's wider hips allow them to better tolerate a bent position. Women are also better than men at camber formation - building up the road's profile so that rainwater will run off the road surface into the drains - because "women are more careful and have more patience" (Tenkorang, contractor). Some contractors have also assigned women to unload gravel onto the road surface because that task requires little physical strength.

These findings call for a new way of analyzing women's participation in labor-based works. In the past, researchers and donors spent a great deal of energy trying to prove that there is little or no difference between the performance of men and women (Howe and Bryceson, 1993, cite Brudefors, 1989, and Scheinman and others, 1989). This defensive posture implies that Africans view male labor as superior to female labor for all activities. But evidence from labor-based road
projects demonstrates that this is not the case. Future research should identify the tasks that women perform better than men and then ensure that women are paid fairly for their work.

Although in the training course only men were assigned to the activities that required considerable physical strength, some contractors have developed innovative ways to use both men and women for these activities. For example, one Ghanaian contractor had men do the more physically demanding task of excavating ditches and women do the less difficult task of removing the excavated material. When the task of ditching is divided in this manner, seven men can excavate 140 meters – twice the distance normally assigned – and only two women are needed to remove the excavated material.

Although equipment is often thought of as replacing labor, a few contractors argued that by using more equipment than provided in the hire-purchase arrangement they could actually increase the number of laborers they hire. For example, one contractor said he could hire more men to work in the gravel pit if he had another tractor-trailer to haul the increased quantity of gravel. In addition, contractors have experimented with combining labor and the different machines provided by the purchase-hire arrangement to increase productivity. For example, although contractors are expected to treat the tractors and trailers as separate pieces – using six trailers for loading and three tractors for hauling – some contractors have found that their sites function better if they treat the tractor-trailer combination as one piece and never unhitch the trailer. One contractor states that the tractor driver takes better care of the trailer if it is permanently hitched to his tractor because then he develops a sense of ownership, viewing both the tractor and trailer as his equipment (Obeng, contractor). These innovations may argue for greater care in determining the original set of equipment provided through the hire-purchase arrangement.

Although the task-rate approach is built on the Western ideal of employment being contractual and based on set conditions of service, many contractors increase worker motivation by drawing on cultural traditions. For example, many contractors bring food to share with the laborers each time they visit the site and give bonuses to their supervisors, such as cloth or money. Some contractors will even offer to help the workers with their jobs. These responses likely arise from the traditional African setting, where hired labor was used especially for planting and harvesting.

The hired worker was made to feel like a guest who, apart from his wage, was often entertained with food and drink. The farm owner and his family worked with the hired man and showed him gratitude.

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43 Akessiem's supervisor says during gravelling they will sometimes hire another tipper, especially when the gravel is far from the road site.
since, as far as the two parties were concerned, the hired man was working for the benefit of the owner. The agreed cash wage was thus only part of the unwritten bargain, gratitude and ‘return favors’ being an important part of the laborer’s remuneration (Onyemelukwe, 1973:115).

The fact that small Ghanaian contractors have developed strategies that improve upon the original concept of the labor-based program demonstrates that labor management is not a principal constraint for small contractors.

2.3 Small Contractors’ Strategies to Control Truancy

Of the many difficulties contractors experience in controlling workers on their sites, some are specific to supervisors, such as putting non-existent laborers on the payroll, favoring a laborer by reducing his or her workload, or quitting. Others are specific to local laborers, such as the reluctance of local villagers to work on the road because the work appears too physically demanding. And finally, some difficulties, such as stealing, arise for both supervisors and laborers alike.

Difficulties Specific to Supervisors

Despite the attention given to controlling laborers in the labor-based literature, contractors have had the most difficulty controlling their supervisors – not their laborers. Labor-based supervisors are extremely important employees because many contractors live and have offices in the cities, often far from their work sites and employees. Thus supervisors, the highest level employees on site every day, must oversee as many as 150 employees at once. For equipment-based contractors, supervisors are not as important, because the contractor can identify which of the ten machine operators is causing a problem or shirking, even without visiting the site. The supervisor’s ability can have a huge effect on the productivity of a labor-based site. World Bank (1975) studies of road construction in India found that ‘good’ compared with ‘fair’ supervision could account for a 33 to 125 percent productivity difference, and ‘good’ compared with ‘poor’ for a 91 percent difference. This study supports the work of Argyle and others (1958) who found that the type of supervision (general, democratic, or non-punitive) had a greater effect on the productivity in departments where an incentive payment scheme did not operate and work was not machine-paced.

Contractors have experienced three types of cheating problems with supervisors. In the first case, supervisors put non-existent causal laborers on the payroll – ‘ghost names’ – and then pocket their pay checks. Supervisors try to disguise ghost names from the contractor by increasing the tasks of those laborers who cannot measure. For example, on most sites, the daily task rate for ditching is 10 meters per day. If a supervisor knows that five of his laborers cannot measure, he can give each of them 12 meters of ditching per day, without their noticing. These five laborers will now complete 60
meters of ditching each day leaving 10 meters unaccounted for. This
amount then becomes the output of the fictitious sixth laborer.

Contractors use three different strategies to reduce this problem.
First, they visit the site and pay laborers themselves. Many
contractors described their anger the first time they went to the site,
called out the name of each laborer on the payroll, and discovered that
many of the names were fictitious. Second, contractors mix old hands
with new hands so that the old hands can teach the new hands how to
protect themselves from being cheated by the supervisor. For
example, the old hands teach the new hands that the shovels and
pick-axes are 1 meter long and can be used to measure task rates.

Third, contractors have created a special tier of casual laborers –
headmen – to control ‘ghost names’. Most contractors train their
headmen to know how to do certain tasks as well, if not better than,
their supervisors. Headmen then lead one group of workers (for
example, ten men excavating in the gravel pit) while continuing to do
the same work as the laborers. Supervisors, in contrast, do not do the
same work as the laborers because they are responsible for a number
of tasks in different locations. Thus, if a supervisor increases the
workers’ tasks in order to add ghost names to the payroll, the
headman’s task will also be increased. If the contractor has
developed an open line of communication with the headmen, the
headman will report the supervisor. This practice is a form of bottom-
up monitoring. Mr. Yeboah, a contractor who developed this strategy,
maintains “a relationship with the laborers so they feel free to report
incidents [by] chatting” with them. Thus talking with laborers
informally develops worker loyalty and makes workers less afraid to
approach the contractor to report incidents.

Contractors face a second difficulty if their supervisors favor laborers
by reducing their workload. For example, a male supervisor may ask
one of the women laborers to be his girlfriend and reduce her task at
the work site. This behavior adversely affects workers’ morale and
lowers the firm’s productivity. To combat this behavior, the contractor
will calculate exactly what should be accomplished and know which
supervisor is supervising each task. If the amount of work
accomplished falls short of the calculations, the contractor can punish
the supervisor who is responsible. But supervisors have found other
means of favoring workers that are acceptable to the contractor. For
example, supervisors will give their girlfriends easier tasks, such as
carrying water. Although this may affect the morale of the women
laborers, contractors have found that it does not affect the
productivity of the site substantially because this type of favoritism is
culturally more acceptable.

The third difficulty contractors face is their supervisors’ leaving the
firm because they have either found better paying jobs or do not want
to live on site in a rural area. Although this is a problem for all
contractors, the loss of a supervisor is a larger financial loss for labor-
based contractors because they, unlike their equipment-based counterparts, have directly financed their supervisors' living expenses during the training program. The two strategies contractors use to keep supervisors from quitting are selecting supervisors who are from small villages and do not mind living in a rural area and trying to avoid letting their supervisors remain idle. Boakye, a contractor in the Brong-Ahafo region, found that when supervisors are idle, even though they are being paid, they start to feel insecure and begin “shopping for a better-paid job.”

Difficulties Specific to Laborers

Although labor-based programs are often initiated to create employment in the areas surrounding the road site, contractors sometimes have difficulty attracting local laborers at the outset of the project. Based on the experience of the labor-based road program in Ghana, contractors predominantly draw their labor from the agricultural sector, filling their payrolls with by-day farm laborers – laborers who are hired by farmers to work the land for one day’s pay. By-day farm laborers earn approximately US$1/day, while contractors pay only US$0.80 per task, which is designed to take one working day to complete (See Appendix 1 for a comparison of casual wage rates across Africa). Laborers initially prefer farm work, not because the pay is higher, but because they feel the road work looks too physically demanding; they consider excavating gravel a much harder physical activity than weeding. But eventually laborers prefer road work to working by day as farm laborers.

Contractors have developed four strategies to make road work more attractive at the outset of a project. One contractor reduces the size of the daily task each laborer must complete so the local villagers gain confidence in their ability to do the work. He then slowly increases it (Nimako, contractor). Some contractors encourage old hands to socialize with the villagers to convince them that the job is not so difficult (Yeboah, contractor). Another contractor initially brings food to the site as an extra incentive. He states, “if [a laborer] comes six days in a row, [he] gets two cups of rice.” Once the villagers begin coming to ask for work, this contractor stops bringing rice (Ansah, contractor). Yet another contractor persuades the village chief and villagers that the result of the work “belongs to them” and not to the contractor or to the government. He explains, “we must know how to persuade people to do work...so that the person feels the work he is doing belongs to him” (Owusu, contractor). This particular contractor had worked as a community developer and felt that his past experience in organizing people to do self-help projects helped him attract labor for labor-based road rehabilitation.

Villagers eventually prefer road works to working by day as farm laborers for several reasons. Villagers prefer continuous work with lower pay to intermittent work with higher pay; employment on the road site lasts at least a few months and as long as one year, while by-
day work is unpredictable. In addition, villagers prefer getting paid monthly rather than daily because it forces them to save (Ababio, laborer). Laborers who are paid each day find it difficult to avoid family pressure to spend the money as soon as it is made. One laborer stated, “if you earn money at the end of the month in bulk, you can save something. If you're paid daily, then you cannot save” (Ababio, laborer). This same laborer used his savings to build a small mud house. In preferring monthly payments to daily payments, laborers do not consider the foregone interest on their accrued earnings because most informal credit schemes available to them in the villages (for example, Susu) do not accrue interest. Moreover, if villagers work on the road, which is a regular paid job as long as their performance remains high, they may be able to qualify for consumer credit from the Social Security Bank. If they work by day, however, they cannot do so. Being paid a monthly wage has additional social benefits. Laborers working on the road site, which is considered a somewhat permanent job, gain respect in their villages. One laborer commented that “people in the village regarded [him] better” once he began working on the road site (Addo, laborer).

Difficulties Common to Both Laborers and Supervisors

The primary difficulty contractors face with both laborers and supervisors is stealing. This problem is not unusual for labor-intensive activities (for example, restaurants). How have road contractors confronted this problem? They have developed two strategies to ensure that a supervisor does not steal materials from the site, both of which play the laborers off the supervisors. First, some contractors let the laborers know that they can move up in the company if they work hard and prove their loyalty to the firm. Those laborers who want to move up in the company, for example, old hands will prove their loyalty to the contractor by reporting stealing (Yeboah, contractor). In one case, a permanent employee stole cement, and three laborers approached a contractor individually to report the incident. Second, some contractors tell their laborers that if materials are stolen, the laborers will be blamed and dismissed immediately. Thus, if a supervisor steals material, the laborer will have nothing to lose by reporting the supervisor.

Contractors have also developed a strategy to prevent casual laborers from stealing tools (cutlasses, pick-axes, shovels, head pans, and rubber boots): laborers are required to show their tools before they are paid (Tenkorang, contractor). Obetsebi, a contractor in the Brong-Ahafo region, allows his laborers to keep their tools even when they go home; but when they come for their pay at the end of each month, they

44 The duration of employment on the road site for a laborer is dependent upon his or her performance and relationship with the contractor. Laborers who are old hands will be employed throughout the duration of the project while new hands will be employed for a few months depending on their performance.
must “deliver the tool.” Contractors have also developed a number of strategies to make the site run more smoothly in general. Contractors will hire one supervisor who is responsible for overseeing the other supervisors. Contractors will also hire their relatives who are loyal to the firm and do not feel too intimidated to report supervisors who are cheating.

3. **DO DELAYED PAYMENTS FAVOR LABOR-BASED METHODS OVER EQUIPMENT-BASED METHODS?**

If pay were prompter, I would use the labor because a grader is more expensive (maintenance, fuel consumption, spare parts). If they don't pay promptly, I'd rather use the grader because it would reduce my headaches with labor (Yeboah, contractor).

If small Ghanaian contractors can successfully raise labor productivity, why did many of them want to leave the labor-based program or use equipment-based methods on their labor-based sites? Evaluations of past projects offer few answers to this question. Before 1986, government road agencies were responsible for all aspects of rehabilitation and management in Africa; hence the literature on private contractors using labor-based road methods in Africa is scant. One of the few articles found evaluates ILO experience with small-scale contractors in Ghana, Madagascar, and the Philippines. This article argues that the major constraints to small contractors using labor-based methods, have to do “with the general problems faced by [all] small-scale contractors” – namely, obtaining credit, operating within very demanding contractual regulations, and being paid on time (Edmonds and de Veen, 1992:102). Evidence from Ghana demonstrates that this is not the case for two reasons – the first being specific to the Ghana program, and the second being more universal.

The first reason why Ghanaian labor-based contractors do not face the same problems as other small-scale contractors is because labor-based contractors are provided with equipment loans – something unique to the Ghanaian program. This provision of equipment loans puts an enormous strain on the DFR which must try to create a competitive environment while at the same time providing contractors with continuous work to service their loans. To provide continuous work, the DFR is forced to tender the same number of contracts as there are contractors in any given region. This led to collusion when contracts were tendered in the Ashanti region. The response to this collusion was to delay the awarding of the contracts until appropriate rates could be set, thereby leaving the contractors idle for over one year. This experience is often blamed for causing contractors to want to

45 Contractors participating in labor-based programs in Kenya, Tanzania, Lesotho, and South Africa must either find their own sources of credit in the open market or purchase their equipment with savings.
leave the program. Although this event did have an effect, the remainder of this chapter focuses on a second reason why many labor-based contractors expressed interest in leaving the labor-based program or using equipment on their sites – a reason much more universal and beyond the scope of the program. Labor-based contractors are affected more severely by delays in payment than equipment-based contractors.

Late payments are an inherent part of the road construction industry because many road building agencies in Africa award contracts without ensuring that the required funds will be available and have highly centralized and bureaucratic payment procedures (Edmonds and Miles, 1984:47; Ofori, 1991). In Ghana, for example, central government payments have been delayed for as long as six months. Edmonds and de Veen state that the problems facing contractors, including the problem of delayed payments, “remain the same whatever the technology” (1992:102).

This study found that delayed payments do not affect labor-based contractors and equipment-based contractors equally because in Ghana small contractors can obtain credit from suppliers and can pay suppliers late. Thus, payment delays cause small contractors to favor equipment-based methods over labor-based methods, and hence undermine the objective of labor-based programs. When payments are timely, as they were during the pilot phase of the program, labor-based methods proved cheaper per km and more competitive than equipment-based methods for small firms (Appendix 2). When payments are delayed, however, labor-based firms are unable to pay their laborers and strikes result. Equipment-based firms, on the other hand, are able to pay their machine operators and suppliers late if they themselves are paid late.

Small labor-based firms are more sensitive to delayed payments because the obligations they face are different from those faced by an equipment-based firm. Thus this section addresses the following questions: What happens when delayed payments occur on a labor-intensive road site? What strategies have labor-based contractors adopted to mitigate the effects of delayed payments? In addition, the differences in payment procedures used by the central government and regional level governments are discussed; unlike the central government, the regional level governments pay contractors on time.

### 3.1 Why Small Labor-Based Contractors are More Sensitive To Delayed Payments Than Small Equipment-Based Contractors

Although both types of contractors have similar obligations to suppliers and permanent laborers, only labor-based contractors have obligations to casual laborers, and this difference makes them more sensitive to delayed payments.
The literature often states that “suppliers will only consider credit arrangements for well-established firms” (Edmonds and Miles, 1984:69). But evidence from Ghana contradicts this statement. In Ghana, suppliers operate in a ‘buyer’s market’, meaning that a large number of Ghanaian sellers compete for the patronage of a few buyers. Suppliers compete with one another by offering contractors special rates, credit without interest, and ‘understanding’ when contractors’ payments are delayed. Thus, both large and small road contractors can get credit from suppliers of machinery, cement, and fuel even if they have limited access to formal credit. For example, in Kumasi, a small labor-based road contractor can buy as many as 200 bags of cement on credit (Tenkorang, contractor). Mrs. Akessiem, the wife of another small labor-based contractor, says she and her husband buy everything on credit from suppliers including “the tyres for the tipper trucks.” She attributes their ability to get credit from suppliers to their having “built a trusting relationship” with the suppliers.

Not only will suppliers provide contractors with materials on credit, they will also accept late payments if the contractors’ payments are delayed. For example, one contractor merely had to go to his suppliers and explain, and if he had known the supplier for a long time, he could just send a note (Mrs. Akessiem, supervisor). Even if the suppliers are not sure if they should trust the contractor, they can always verify the contractor’s statements. For example, if a contractor rents a machine from a plant pool, the pool supervisor can check around the DFR to see if it is indeed true that the contractor has not yet been paid (Yeboah, contractor).

If both labor-based and equipment-based contractors can delay payments to suppliers when government payments are delayed, why are labor-based contractors more sensitive to late payments? The primary factor distinguishing the effects of delayed payments on the two types of contractors is the differences in the types and quantity of labor these contractors employ.

Labor-based contractors employ mostly casual laborers, who demand timely monthly payments because they do not trust the contractor. Equipment-based contractors, in contrast, employ permanent laborers who will accept delayed payments, even for as long as one month, because they trust the contractor. This trust is developed because the contractor provides his permanent laborers with health insurance and, often, loans. In Ghana, a permanent employee expects to remain with the firm as long as it survives. This relationship discourages permanent laborers from leaving their jobs when their payments are delayed. As one contractor explained, when laborers are permanent, “they’re not as demanding that you pay on time. Permanent laborers know you more” (Obetsebi, contractor).

Unlike a supplier, neither a permanent nor a casual laborer can verify the contractor’s claim that the payment from the government is
delayed. As one contractor explains, “The laborers cannot come to Accra to see if you haven't been paid” (Yeboah, contractor). But the difference between a permanent and casual laborer is that a permanent laborer will trust the contractor's claim, while a casual laborer will “feel you've stolen the money” (Yeboah, contractor). In one case, a small labor-based contractor who had not been paid was able to pay his casual laborers by raising outside funds (by borrowing large sums of money from his family). This action made the laborers who were working for other small contractors grow suspicious of their contractors, thinking that they had been paid and had pocketed the money.

Labor-based contractors also differ from equipment-based contractors in the number of laborers they employ. Labor-based contractors employ as many as 150 laborers per gravel road, compared with about ten for equipment-based contractors. These large numbers increase the problem for labor-based contractors, who must pay approximately six times as much in wages as equipment-based contractors. Labor-based contractors also differ from equipment-based contractors in the number of laborers they employ. Labor-based contractors employ as many as 150 laborers per gravel road, compared with about ten for equipment-based contractors. These large numbers increase the problem for labor-based contractors, who must pay approximately six times as much in wages as equipment-based contractors. In addition, because equipment-based contractors employ few workers, in times of emergency they are able to get enough funds to pay each worker something. For example, the overdraft limit for both small equipment-based and small labor-based contractors at the Sunyani Bank for Housing and Construction is US$100. If both contractors received an overdraft for US$100, the equipment-based contractor could then pay each employee US$10 for the month (approximately 30 percent of their monthly salary). But the labor-based contractor could pay each laborer only about US$0.65 – not even one day’s wage!

When labor-based contractors’ payments are delayed and they cannot pay their casual laborers, the laborers either stop coming to the site or strike. When payments are timely, labor-based contractors construct one km of gravel road at three-fourths the speed and two-thirds the cost of an equipment-based contractor. Presently, equipment-based contractors are paid on average US$19,463 per km (tendered prices) while labor-based contractors are paid US$12,035 per km (fixed prices) for the same quality of output. If both contractors were paid the same amount per km, a labor-based contractor would make approximately three times as much profit per month as an equipment-

46 Labor-based contractors pay out an average of three million Cedis per month to all their employees, while equipment-based contractors pay only an average of 0.5 million per month to their employees.

47 Sunyani Bank for Housing and Construction's overdraft limit is 100,000 Cedis and, at the time this research was conducted, 1000 cedis could buy US$1. The National Investment Bank's overdraft limit is 60,000 Cedis. To borrow more money than allowed in the overdraft, one needs securities and needs to file six months in advance. Thus, one cannot get a loan fast (Tenkorang, contractor).

48 Although a grader operator (one of the highest paid employees in an equipment-based firm) would normally receive around US$35 per month, US$10 should be enough to tide him over until the contractor is paid.
based contractor given the rate of completion and the cost of labor-based compared with equipment-based works (Appendix 2).\textsuperscript{49} But if payments are delayed and the speed of labor-based rehabilitation falls, the net present value of the contractor's profit will fall. If the speed of rehabilitation at the labor-based site falls below a certain threshold, equipment-based methods become more profitable than labor-based methods.

In addition, it is more difficult for a labor-based contractor to recover from delays or stoppages because delayed payments damage the tenuous trust between the contractor and the casual laborers. "Once you have cash flow problems,...the laborers don't have confidence anymore so they won't come back to work for you" (DFR engineer). In contrast, delays or stoppages for equipment-based contractors are primarily a result of machine breakdowns, a problem a contractor can repair without having to rebuild confidence.

\subsection*{3.2 Strategies for Coping with Payment Problems}

\textbf{Contractors'}

Labor-based contractors have developed a number of strategies to confront payment problems. These strategies help contractors to speed up government payments, keep the site moving when payments are delayed, reduce worker discontent, and handle strikes.

\textbf{Speeding up Government Payments}

Contractors use two strategies to speed up government payments. First, they 'chase' their invoice certificates to accelerate the payment process. In other words, contractors personally bring the certificate to each of the required 13 government officials to sign rather than rely on the mail. Second, they use their association to press the Ministry of Finance to release the money so strikes do not result (Mrs. Akessiem, supervisor).\textsuperscript{50} In one case, the labor-based contractors' association sent a delegation to the Ministry of Finance to complain about delays in payment and the ministry released the money to avoid labor problems.

\textbf{Keeping the Site Moving when Payments are Delayed}

Contractors have developed two strategies to keep the site moving when payments are delayed: hiring several old hands and trying to build trust with the new hands. Contractors hire old hands because they will work despite delayed payments. When payments are late, the new hands stop coming to the site, while the old hands, who can

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\textsuperscript{49} Profit per month is substituted for a discounted cash flow analysis. Calculations assume this payment equals the cost of building one km of road using equipment-based methods plus 10 percent profit.

\textsuperscript{50} The ILO encouraged contractors to form an association for labor-based contractors during the pilot project.
make up as much as 30 percent of the casual labor force, continue to come. This formation of a permanent class of casual laborers is only seen among labor-based workers. Although most labor-based contractors have completed no more than three contracts, old hands have become a very important tradition.

Why are old hands willing to accept late payments? They do so either because they want to learn a trade or because they are trying to obtain a more permanent position, such as headman, supervisor, or machine operator (Yeboah, contractor). If an old hand is trying to learn a trade, such as masonry, he will follow the contractor from site to site so he can continually work with the concrete gang. If the old hand is trying to be promoted, he typically moves first to headman (US$19/month), then to roller operator (US$19/month), tractor operator (US$24/month), and finally supervisor (US$35/month). In one firm one of the supervisors and all of the machine operators (excluding the tipper operator) started as laborers.

The drive to be promoted makes old hands so loyal to the firm that when local laborers stop working, fresh old hands will migrate to the area to take their place (Yeboah, contractor). These fresh old hands are often laborers who missed the initial opportunity to follow the contractor to his new site. Even though they often have no relatives or support network around the contractor’s new site, they will accept delayed payments from the contractor and make ends meet by working as day laborers on the weekends or by getting contracts to weed someone’s farm. Some old hands are so important to the firm that the contractor will pay for their transportation to the new site and for their accommodations. This reciprocal relationship between old hands and the contractor is crucial to the firm’s survival.

Contractors also try to build trust with the new hands by attempting to appear honest to local laborers. Old hands help create this perception by assuring the new hands that the contractor is a good man. Contractors create this perception themselves by allowing casual laborers to keep the firm’s tools until they are paid. As two contractors said, “we allow them to keep the tools with them while they are doing a task. If we are not paying, then we have no right to collect the tools” (Tenkorang, contractor; Obetsebi, contractor).

In addition, contractors change the payment incentive structure if the laborers feel that it is working to their disadvantage. For example, contractors in the Ashanti region discarded the bonus system that they learned in the training course because the workers felt that it cheated them. Under the bonus system, if laborers work continuously for six (working) days and accomplish their tasks, they will be paid eight days’ wages. If they work for four weeks and complete their task each day, they earn an extra six days’ wages. Thus, a worker can attain a maximum bonus of 45 percent of the monthly wage (Osei-Bonsu, 1992). The laborers in the Ashanti region did not see why one laborer should receive a bonus when another did not. This behavior
supports the work of Davison (cited in Horton and King, 1981) who found that incentive payments increase tension in social relations because they underscore the differences in workers’ earnings and foster ill feelings.

Paying Laborers in a Particular Order

Contractors have also developed a strategy to reduce worker discontent when the contractor does not have enough money to pay all workers in full: they pay the casual laborers first, headmen second, supervisors third, and suppliers last. When paying off debts, contractors first pay the people with whom they have the least trusting relationship, moving across the spectrum toward the people with whom they have the strongest (Yeboah, contractor).

Handling Strikes

Contractors have developed strategies to handle strikes. For example, they promote the laborers' natural leaders to management positions. One contractor found that his laborers organized around the natural leaders. When payments were delayed, these leaders called a strike. The contractor stripped the leaders of their power by promoting them to salaried positions where they could obtain advances and would receive bonuses based on the firm’s profits. Once promoted, the leaders “realized that they were different from the other laborers” (Tenkorang, contractor). Contractors have also encouraged old hands to talk with new hands and end the strike or report the strike leaders.

Having a Last Resort

Contractors have a last-resort strategy to deal with delayed payments—leave the labor-based program entirely. Many contractors expressed an interest in leaving the program if payments continued to be delayed or if they were left idle for a long period again. But recently, many contractors began feeling enthusiastic because Denmark is planning to fund some labor-based roads. Contractors feel that payments will be timely when a donor is involved in funding labor-based rehabilitation (as during the pilot phase of the program), rather than when the financing comes from the general budget.

3.3 Central Versus Regional Government and Timely Payments

When all financing comes from the general budget, regional branches of the DFR are more likely than the DFR central office to pay contractors on time. Several forces are behind this. First, the regional branches tender contracts after receiving financing while the central office tenders contracts before receiving financing. The central DFR office produces annual estimates of the amount of work to be done and the Ministry of Finance allocates a portion of the fiscal budget based upon that estimate. The central DFR office then tenders contracts based upon this allocation and later, often does not receive the money
it was promised because this money is often diverted to other public programs. This creates a situation in the DFR where invoices cannot be paid. Contractors have to wait until the Ministry of Finance disburses its next quarterly disbursement to the DFR before the DFR can begin to meet its obligations. The DFR can either pay 50 percent of all invoices received and ask the contractors to wait for the balance or it can pay out the invoices in full in the order in which they were received.

The DFR’s regional offices, unlike the head office, receive funds from the head office before tendering work. After the regional offices prepare detailed cost estimates for all maintainable feeder roads in their region, the central office transfers funds to regional accounts. These accounts are audited ex-post by the DFR central office. Thus, in contrast to the DFR head office, the regional office tenders work after receiving the money necessary to pay the invoices.

Second, the contracts administered by regions have a more streamlined payment method than those administered at the central level. The close proximity of the regional administration to the actual road work means contractor’s interim payment certificates must pass through only two levels of vetting before they are paid. The central government, in contrast, will pay a contractor only after the interim payment certificate is vetted and signed by at least twelve government officials: two at the local level, three at the regional level, four at the DFR’s central office, and three at the Ministry of Roads and Highways. This process can delay payment for as long as three to four months (Nti, contractor).

These cumbersome procedures arise because of the central government’s distrust of local government officials – the complex web of vetting is intended to discourage regional government officials from overpaying contractors (Edmonds and Miles, 1984:47; Gaude and Watzlawick, 1992). But the results are just the opposite: rather than building accountability into the system, these procedures provide greater opportunities for bribes or ‘dashes’ – gifts. Dashing also exists at the regional and local government level, but the dashes are less expensive because payment certificates require fewer endorsements.

4. LESSONS FOR FUTURE LABOR-BASED PROGRAMS

Although labor-based programs have the potential to create employment in rural areas and can be financially competitive with equipment-based methods, both governments and private contractors have been averse to using them. Government officials have preferred equipment-based methods because they appear to be more ‘advanced’ rehabilitate gravel roads faster, meet higher engineering standards, minimize labor management problems, offer greater political benefits in an election year, offer more opportunities for rent-seeking, require less working capital, and command more funding when donors finance only the foreign exchange costs of a project.
The reasons why private contractors have been reluctant to use labor-based methods, on the other hand, have remained elusive. Some have suggested that the difficulty of managing large labor forces is to blame. This study challenges this explanation and demonstrates that market structure and institutional mechanisms are key factors. Unit-rate cost comparisons, therefore, while an important tool for comparing labor-based and equipment-based methods, are insufficient for predicting firm behavior. Instead, a new market-based framework should be used to examine this issue.

This study attempts to demonstrate that the financial competitiveness of labor-based compared with equipment-based methods varies with two factors. First, it varies with the size of the firm. Small contractors tend to execute only one project at a time, and are able to directly supervise their sites. Moreover, for small contractors, labor-based methods avoid the high costs of renting equipment or repairing their own old or poorly maintained equipment. Large equipment-based firms, in contrast, undertake many active projects simultaneously, and are incapable of providing their labor-based sites with much supervision. Moreover, large equipment-based firms have little incentive to use labor-based methods; if there is a lull in large contracts, they can use their equipment to underbid their counterparts who are using more labor-intensive technologies for less-remote rehabilitation contracts. Large contractors have access to efficient equipment and thus have lower variable costs than labor-based contractors, who pay 40 percent or more of their total costs in monthly wages.

The second factor affecting the competitiveness of labor-based methods is the promptness of government payments. When government payments are prompt, labor-based methods are cheaper per km and can be more profitable than equipment-based methods. If government payments are late, however, labor-based methods become more costly, even in countries like Ghana with low casual wage rates (below US$1/day). Late government payments fall more heavily on labor-based contractors because they delay payments to workers, which cannot be postponed, as opposed to a delay of payment to suppliers. Thus, when payment delays occur, equipment-based sites continue to operate (albeit, often with lower productivity), while labor-based sites often come to a complete standstill.

This research therefore adds a new dimension to the literature on small- and medium-size enterprise development. Although the literature posits that for the promotion of small firms, labor-based methods “make sense” because they require low capital investment (Lantran, 1990), the findings here turn this statement around. To promote labor-based methods, small firms make sense because only they have the motivation to provide a great deal of supervision to their sites.
These findings suggest three lessons that can be applied to labor-based programs in other countries. First, program designers should use a market-based framework to predict whether contractors will adopt labor-based methods rather than comparing labor-based and equipment-based methods using unit-rates. Before launching a labor-based program, program designers should determine the quantity and quality of the equipment stock in the sector, as well as the competitiveness among contractors. This analysis should help determine whether equipment-based contractors will underbid labor-based contractors for small, less-remote rehabilitation works. If there is a reduction in available work in the sector and large contractors own efficient equipment, they will underbid labor-based contractors, at least in the short term, to cover their variable costs. Training labor-based contractors for entry into the market at a time when there is little work available for well-equipped contractors may be unwise; labor-based contractors will only survive if they are protected from equipment-based contractors. If the reduction in the quantity of work in the sector only represents a lull, starting a labor-based program may be justified since graduates of the program will not be ready to compete in the market for a number of years. If the sector is expected to remain highly competitive for some time, graduates of the labor-based program will be unable to compete and the road agency will need to protect them from competition. This protection will result in a higher cost per km of rehabilitated road for the road agency, thus ‘promoting’ the use of labor-based methods at the taxpayers’ expense. Whether the socio-economic benefits of promoting labor-based rehabilitation outweigh the increase in cost per km of road is a question only policy makers can answer and is outside the scope of this study.

Second, program designers should develop an enabling environment in which small contractors can operate; that is, alter minimum wage requirements to reflect the market wage, win acceptance for task-rate payment schemes, reduce the bias against small contractors by slicing works into many small contracts, and give small firms access to working capital and equipment loans. How program designers go about equipping contractors is of great importance. The provision of equipment loans can make it almost impossible to set up a competitive environment for tendering. For example, in Ghana, the DFR quickly discovered how difficult it was to set up a competitive environment among the contractors while still assuring them four years of continuous work to repay their loans.

Third, program designers should find alternative institutional arrangements for paying contractors in those countries where government payments are habitually late. In the past, donors have addressed the issue of late government payments only in the pilot project: they have enabled the project engineer to release funds directly from a special account and sometimes even provided advance payments for labor. Failure to institute such mechanisms on a
permanent basis disregards one of the main difficulties facing small contractors who use labor-based methods.

Institutional arrangements for paying contractors on time must satisfy two requirements. First, financing for road works must be provided to the department administering the contracts before works are tendered, and be protected from being diverted to other public programs. Special accounts have become one means of satisfying this requirement. Special accounts are usually set up in a commercial bank in the name of the agency supplying the road services and are, therefore, kept separate from the general government budget. For example, in 1994, after the research for this paper was completed, the United States and Denmark set up a special account for the DFR in Ghana to pay labor-based contractors. This arrangement has enabled the DFR to pay contractors more promptly. Donors protect special accounts from being usurped by the Ministry of Finance through financial audits and other means of managing the accounts.

Second, payment procedures for contractors must be streamlined. In many developing countries, existing payment procedures require considerable paperwork, signatures, and vetting, taking weeks to complete. This study has found that contracts can be streamlined if they are administered at a local level and paid out of a local account. For example, when they had funds on hand, DFR regional offices paid contractors much more promptly than the head office. Contractor’s invoices only had to pass through two levels of vetting before they were paid, while at the central level, invoices must be vetted and signed by at least twelve government officials. Another institutional arrangement for streamlining payments to contractors is the AGETIP (Agence d’exécution des travaux d’intérêt public contre le sous-emploi), a contract management agency run by a non-profit organization. This type of agency, which was first created in Senegal and has since been replicated in many francophone countries, has a streamlined administration and a special account to ensure the timely flow of donor funds to local contractors (Lantran, 1991).

In conclusion, this study demonstrates that labor-based programs can be a successful device for rehabilitating gravel roads and generating employment. Their success, however, hinges on the existence of a conducive market structure. In countries with a large supply of equipment and a highly competitive market, labor-based contractors may have difficulty competing with equipment-based contractors. Successful use of labor-based methods also requires targeting small contractors for training and paying them on time. Since small firms are most likely to use labor-based methods, they should be targeted for training. Small firms, however, have limited access to working capital and thus timely payments must be ensured. If payments are delayed, labor-based sites are likely to come to a standstill because casual laborers will not accept late payments. Unless these
requirements are addressed, labor-based methods are unlikely to be sustainable.

REFERENCES


Hodgdon, Jonathan D., Riordan, James, T. and Zaman, Samiruz. 1984. The development impact of Title II (CARE) Food for work roads in rural Bangladesh. Prepared by Abt Associates Inc. for the Agency for International Development.


### Appendix 1: Wage Rates for Casual Labor

<table>
<thead>
<tr>
<th>Country</th>
<th>Wage rate (US$/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nigeria, Tanzania</td>
<td>0.30 - 0.50</td>
</tr>
<tr>
<td>Uganda</td>
<td>0.35 - 0.50</td>
</tr>
<tr>
<td>Zaire</td>
<td>0.50 - 0.80</td>
</tr>
<tr>
<td>Mozambique</td>
<td>0.80 - 0.90</td>
</tr>
<tr>
<td>Rwanda</td>
<td>0.90 - 1.50</td>
</tr>
<tr>
<td>Eritrea</td>
<td>2.00 - 3.00</td>
</tr>
<tr>
<td>Namibia</td>
<td>4.00 - 7.00</td>
</tr>
</tbody>
</table>

*Source: Rausch (1994: 25)*
### Appendix 2: Comparing Equipment-Based and Labor-Based Contractors

#### Table 2.1: Comparison Using Current Data

<table>
<thead>
<tr>
<th>Measure</th>
<th>Equipment-based</th>
<th>Labor-based</th>
</tr>
</thead>
<tbody>
<tr>
<td>payment(^{51}) (US$/km)</td>
<td>19,463</td>
<td>12,035</td>
</tr>
<tr>
<td>cost(^{52}) (US$/km)</td>
<td>17,694</td>
<td>10,941</td>
</tr>
<tr>
<td>profit (US$/km)</td>
<td>1,769</td>
<td>1,094</td>
</tr>
<tr>
<td>speed(^{53}) (km/month)</td>
<td>2.1</td>
<td>1.4</td>
</tr>
<tr>
<td>monthly payments (US$/month)</td>
<td>40,872</td>
<td>16,849.</td>
</tr>
<tr>
<td>monthly costs (US$/month)</td>
<td>37,157</td>
<td>15,317</td>
</tr>
<tr>
<td>avg. labor payment(^{54}) (US$/month)</td>
<td>500</td>
<td>3,000</td>
</tr>
<tr>
<td>monthly profit (US$/month)</td>
<td>3,715</td>
<td>1,532</td>
</tr>
</tbody>
</table>

---

51 The figures for payment, or cost to the client, are from DANIDA (1995).
52 This number was calculated by assuming that, on average, equipment-based contractors tender with a 10 percent profit margin.
53 Labor-based contractors can rehabilitate 1.4 km/month. Equipment-based contractors can rehabilitate 2.1 km/month. (Osei-Bonsu, personal communication)
54 An equipment-based contractor hires at most ten people a month and pays out 500,000 cedis in wages, while a labor-based contractor pays out around 3 million cedis a month. (Boakye, contractor)
Table 2.2: Comparison Assuming That All Contractors are Paid the Same Per Km

<table>
<thead>
<tr>
<th>Measure</th>
<th>Equipment-based</th>
<th>Labor-based</th>
</tr>
</thead>
<tbody>
<tr>
<td>payment / km (US$/month)</td>
<td>p</td>
<td>p</td>
</tr>
<tr>
<td>cost / km (US$/km)</td>
<td>19,463</td>
<td>12,035</td>
</tr>
<tr>
<td>profit / km (US$/km)</td>
<td>p–19,463</td>
<td>p–12,035</td>
</tr>
<tr>
<td>speed (km/month)</td>
<td>2.1</td>
<td>1.4</td>
</tr>
<tr>
<td>monthly profit (US$/month)</td>
<td>2.1(p–19,463)</td>
<td>1.2(p–19,463)</td>
</tr>
</tbody>
</table>

Table 2.3: Comparison of Monthly Profits Using Current Data

<table>
<thead>
<tr>
<th>Payment (US$/ km)</th>
<th>Equipment-based monthly profit (US$/ month)</th>
<th>Labor-based monthly profit (US$/ month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18,400</td>
<td>1,483</td>
<td>10,443</td>
</tr>
<tr>
<td>18,600</td>
<td>1,903</td>
<td>10,723</td>
</tr>
<tr>
<td>18,800</td>
<td>2,323</td>
<td>11,003</td>
</tr>
<tr>
<td>19,000</td>
<td>2,743</td>
<td>11,283</td>
</tr>
<tr>
<td>19,200</td>
<td>3,163</td>
<td>11,563</td>
</tr>
<tr>
<td>19,400</td>
<td>3,583</td>
<td>11,843</td>
</tr>
<tr>
<td>19,600</td>
<td>4,003</td>
<td>12,123</td>
</tr>
<tr>
<td>19,800</td>
<td>4,423</td>
<td>12,403</td>
</tr>
<tr>
<td>20,000</td>
<td>4,843</td>
<td>12,683</td>
</tr>
<tr>
<td>20,200</td>
<td>5,263</td>
<td>12,963</td>
</tr>
<tr>
<td>20,400</td>
<td>5,683</td>
<td>13,243</td>
</tr>
<tr>
<td>20,600</td>
<td>6,103</td>
<td>13,523</td>
</tr>
<tr>
<td>20,800</td>
<td>6,523</td>
<td>13,803</td>
</tr>
<tr>
<td>21,000</td>
<td>6,943</td>
<td>14,083</td>
</tr>
</tbody>
</table>

average ratio 1 3.4
3 APPROPRIATE TECHNOLOGY
3.1 Enhancing equipment loan repayment for small-scale labour-based contractors

E. Opuku-Mensah, Managing Director, OPM Construction Works Ltd., Accra, Ghana

1.0 INTRODUCTION

As far back as the early 1970’s, the ILO, supported by a number of donor agencies, has been involved in the use of labour-based technology for roads works. These programmes were executed using the force account (FA) system under which public agencies supervised, managed and controlled machines and labour directly. However, from about 1978, owing to bureaucratic bottlenecks, lack of adequate budgetary provision for tools, equipment and vehicles for staff, and low motivation leading to poor supervision, the focus began shifting from the use of force account to contracting.

Ghana, having taken a cue from the limitations of the FA system, took a bold step in 1986 to utilise the private sector/small-scale contractors in the implementation of her labour-based programme. The main objectives of the programme were threefold:

- to create employment opportunities as a means of mitigating the effects of the Economic Recovery Programme (ERP) embarked upon to resuscitate the economy after years of neglect,
- to provide a cost-effective alternative to the handling of a backlog of feeder roads that needed to be rehabilitated and/or maintained,
- to develop the capacity base of small-scale contractors.

Under the Ghana labour-based programme, a set of equipment costing about US $150,000 is loaned to a trained contractor for repayment in 4 years from earnings made on guaranteed work by the client (Government of Ghana) during the stipulated duration. The equipment consists of

- 3 Tractors (60 - 65 HP)
- 6 Tractor drawn trailers (3m3)
- 1 Tipper truck (5m3)
- 1 Towed water bowser (2,250 Litres)
- 2 Vibratory pedestrian /Ride-on rollers
- 1 Water pump
- 1 Chain saw
- 1 Pick-up
- A set of hand tools.
Since embarking upon the programme in 1987, a total of 93 Contractors from all ten regions of the country have been trained. Out of this number, 54 are fully equipped through local and donor funding. Each equipped contractor is capable of employing 100-200 workers on a typical road contract which normally lasts for one (1) year and produces between 1 km - 2 km of gravel road per month. As at the end of 1995, a total of 1,395 km of rural roads had been rehabilitated and 3,711 No. 1m-span box culverts had been constructed. This level of output created 4,371,815 mandays of employment of which 25.9% were female workers. It may be worth noting that 1 km of rehabilitated road by labour-based method costs between US $10,000 - US $13,500, while the same length of road costs about US $20,250 by capital intensive method.

One of the indicators of the success of both the novel Ghana programme and the contractor is the pace of repayment of the equipment loan. The purpose of this paper is to set out some recommendations to enhance the repayment of the equipment loan from the viewpoint of a practising professional contractor considering the three major players in the game, namely the Loan Management Bank, the Client, and the Contractor.

2.0 LOAN RECOVERY RECOMMENDATIONS

2.1 Loan management banks

Loan Currency: As much as possible the loan should be granted to the contractor in the country's local currency, especially where the local currency depreciates too fast or too often against the strong foreign currency under which the funding was made. Where the loan repayment is denominated in foreign currency, the multiplying effect of the depreciation of the local currency on the one hand, and the repayment interest on the loan itself, on the other hand, could be very devastating to the small scale contractor who would then be unable to catch up with repayment schedules.

For example, in Ghana, even though the local currency is the Cedi (GHC), the loans were contracted in dollars (US$). When the first batch of four contractors in the Western Region received their equipment in 1988, the dollar exchange rate was US $1.00=GHC175.00 but by December 1992 when full payment was supposed to have been completed, the rate was US$1.00=GHC519.00. The result was that the first contractor to pay off the loan, did so in approximately six years. With the second batch of contractors in the Western Region involving three contractors, however, all the contractors were able to pay their loans within the required four years with one contractor paying off his loan in a record time of exactly three years (September 1989 to September 1992). Even for the one
contractor who paid off his loan in three years, the exchange rate rose from US$1.00=GHC235.00 to US$1.00=GHC480.00 during the period of repayment. It is believed that the second group of contractors had to resort to special skills in financial management in particular and in construction management in general in order to overcome the exchange rate effects.

When it became apparent that the remaining 12 contractors in the Brong Ahafo and Ashanti Regions would not be able to make full repayment under the original agreement, the balances were denominated in the local currency at the end of the four year repayment period, at the cut-off rate.

Interest Rates: Special Loan interest rate ought to be arranged bearing in mind the small scale nature of the contractors involved, the advantage of building the capacity base of the contractors, and the fact that donors normally fund the projects under very concessional rates. A good approach may be to peg it at the lowest interest rate level applicable in the country's banks for similar special programs, if not lower. In Ghana, at the inception of the programme, the Bank for Housing and Construction (BHC), received dollars at 8% interest but hire-purchased equipment for contractors at 20% interest on the dollar when the going rate for similar loans was 27% on the Cedi. However, after the conversion of the loan balances from dollars to cedis, BHC still maintained an interest rate of 20% on the Cedi at a time when the bank's rate for similar loans was 32%.

The Agricultural Development Bank (ADB) on the other hand has pegged her rate at the rate applicable to small scale Agricultural Projects, in consultation with a Revolving Fund Board, which is the lowest in the Bank (approximately 8% lower than the going lending rate in the Bank).

Repayment Schedule: Hitherto, the arrangement has been a recovery of the loan in four years with a moratorium of three months (BHC) or four months (ADB), based on Diminishing Balance (BHC) or Annuity Method (ADB). Repayment schedules are consequently prepared on monthly basis attracting default charges (equivalent to 5% of the balance due in the case of ADB) on late payments, in addition to interest payable under the schedule.

The schedules prepared on a monthly basis directly or indirectly assume that one executes work, calls for inspection and processes payment certificates through the long bureaucratic mill (spanning through District DFR office, District Administration, Regional DFR Office, Regional Administration and finally Head office) and gets paid all in one month failing which 'interest on interest' (BHC) or default (ADB) charges are charged for each month's lapse. This situation, apart from being unfair, also loads the contractor to the advantage of
the Banks and becomes an inhibitor to the loan repayment (especially in the early years).

It is being recommended that schedules be prepared on a quarterly basis to reflect the situation on the ground. It is gratifying to note that BHC has currently adopted this approach after correspondence and consultations between the Labour-based Contractors Association (LABCA) and BHC.

It is also being recommended that the Diminishing Balance Approach be adopted to encourage contractors to use part of the amounts accruing from moratorium periods to defray part of the loan to put them ahead of schedule and reduce incidence of default. The Annuity method does not provide any incentive for early payment. It is worth noting that new machines can do more work in early years with very minimum maintenance costs, and hence more money to warrant more payment than provided in the schedule, all things being equal.

The case of default charges ought to be dropped since contractors lodge cheques prepared in joint names with Banks as and when they are paid by their clients. No contractor 'intentionally' defaults, and the onus lies on the clients to pay promptly.

The repayment period of four years with four months moratorium (ADB) is recommended. The above submission will remove unnecessary extra financial loads (created by the adoption of inappropriate repayment schedules) and enhance the repayment of the equipment loan proper.

Agreement/ Collateral Requirements/ Working Capital: Banks will naturally draw agreements in their favour to reduce their risk factors. They are also tempted to base their requirements on their experience in the usual capital intensive approach. Agreements drawn and collateral requirements ought to be studied and relaxed for the small scale contractors. A case in point is the 'default clause' discussed above, which is as unnecessary as it is inappropriate, if the proper schedules are adopted and clients honour their promise to pay on time. (No client serious about such a program will default in paying certificates in three months).

Also, part of the money accruing to the contractor during the moratorium period could be set aside in a savings account with the Bank as a collateral (additional or otherwise) and the value of the entire equipment normally insured in joint names of the Bank also taken as 'collateral'. This proviso should be adequate. The incidence of high collateral requirements could lead to financial arrangements by contractors leading to appointment of new shareholders and/or directors in the nick of time to the disadvantage of the company's proper administration and thereby affecting the loan repayment.
The Banks should also assess every company for working capital requirements and incorporate in the Agreement an overdraft facility equivalent to the working capital. This will enhance smooth and accelerated work output especially in the first 6 months after the moratorium period. Loan repayment in the early years (especially in the first six months) is very crucial since any delay increases interest charges and makes loan repayment more difficult in the ensuing years.

2.2 Clients (DFR in the case of Ghana)

Equipment Selection: In Ghana, Contractors sometimes have no hand in the selection of the type/make of the pieces of equipment they contract loans for. In such situations, any poor selection based solely on the lowest competitive bidder concept demanded by some donors could lead to very serious consequences and even derail the programme. It can also lead to difficulties in payment of equipment loans granted to contractors who had no hand in the selection of the said equipment.

A case in point is the selection of a type of tractor for Ghana. This type of tractor was supposed to have met all the technical specifications, but no sooner had they been in use than they started experiencing frequent breakdowns in the field even though they were at their prime period of performance (when maintenance costs were supposed to be lowest). These problems lead to poor output performance by contractors, and consequently the equipment loan repayment becomes difficult.

It is being recommended that either the tendering process for equipment purchase is made selective and pinned to only tried and tested types in countries with similar climatic conditions or straight negotiations made on specific equipment types found to be most suitable with the necessary after-sales service support. Also after use by some contractors, especially as in the case of Ghana, contractors' (or their association's) opinion ought to be sought for guidance for future orders.

Equipment Adequacy: The set of equipment listed elsewhere is more than adequate, except that the following recommendations are being made, based on practical experience to enhance equipment loan repayment.

i. Water Pump: Water pumps should be centrifugal ‘trash’ pumps not ‘clear water’ pump to take care of water containing debris or up to 25mm or 38mm in diameter in order to prolong the useful life of the pumps.

ii. Rollers: The roller is crucial in the application of the technology especially in both the camber formation, and gravelling stages, and gully filling. The tonnage determines the compaction effort and
the number of passes. Frequent passes (8 - 12) with lower tonnage (600 kg) lead to frequent breakdowns, and lower road production output and therefore lower payment certificate values not warranting any meaningful deductions for loan repayments.

iii. Bearing in mind cost considerations, it is recommended that one 0.7 - 1.0 ton roller (pedestrian) and one 1.0 - 1.5 ton (ride-on) be considered to enhance performance and hence loan repayments. The actual tonnage is to be determined by price considerations, towing and ease of site handling (especially mobility) notwithstanding.

iv. Trailer(s): It appears that at least one trailer could be dropped from the original list of six trailers (to make room, cost wise, for heavier rollers discussed above) since invariably only two Tractor Heads do most of the work with the remaining one using more or less one trailer (instead of two) most of the time for aggregate movement from point to point, formwork movement etc. and other times coupled to the pedestrian roller for movement, or coupled to the bowser for water haulage and watering. In fact, a system requiring the use of a maximum of four trailers had been in operation on some sites for the past five years.

Trial Contracts: Currently, in Ghana, a contractor is given culverts on contract while awaiting his/her equipment supply. Immediately the pieces of equipment arrive, arrangements with banks are concluded and the contractor commences his/her ‘trial’ contract with his/her full set of equipment. At this stage the contractor is confronted with the management of a large labour force, and a full set of tools and equipment. The result is that there is neither effective management of the manpower resource, nor that of the full set of equipment and tools at his/her disposal, leading to equipment idle time and low road production and hence inadequate work done to warrant reasonable payment certificate values for meaningful deductions for loan repayment.

It is being recommended that, in the interest of the Client, the Contractor, the Bank, and the citizenry, during the trial phase (where a Contractor could fail anyway), the Client (DFR, in the case of Ghana) manages the equipment and hires it out to the respective contractors at economic rates. By the close of the four-six months trial period, the contractor will have gained the necessary practical experience in manpower and machinery management and also proper site organisation and therefore will be ready at that point in time to enter into agreements with Banks for full equipment loan repayment. The recommendation is as necessary as it is crucial, if one wants to avoid a backlog of debts especially during the crucial first year of the loan repayment - which could spill over into ensuing years and make repayment an uphill task.
It is also being recommended that the trial contract (and at least the 1st standard contract) ought to be carefully selected to avoid exposing a contractor who has not found his rhythm to a contract with extensive earthworks suitable only for experienced contractors, or for capital- intensive application as the case may be.

Labour Advance Concept: Under this concept, contractors submit wage bills on the 26th of the month (adding 15% for overheads) to the Regional Engineer for vetting. In the meantime, the necessary arrangements will have been made for money to be deposited at the regional level and Contractors are paid between the 4th and the 6th of the following month in order to promptly pay, essentially, the casual labourers. The advances for labour so paid are immediately recovered in the next certificate raised by the contractor.

The advantages of this concept include the following:

- workers are promptly paid
- the incidence of ‘Cash Diversion’ by contractors is minimised, since relevant deductions for labour at regional level, and for equipment at Bank level, leave smaller amounts at the disposal of the contractor, and that, most importantly,
- Contractors are encouraged to employ a larger labour force for higher road production, since the major headache of meeting casual labour bills (without which a contractor can be lynched) is assured under the concept. This implies higher values of certificates so raised to ensure more deductions for equipment loan repayment.

The only disadvantage to the concept is that it puts an extra administrative load on the Client especially where payment for civil works is made from the central government.

Marrying the two situations above, and given the fact that the contractor must be left to develop the financial management skills relevant for survival in an open market situation, the concept could be adopted for the trial phase and for the first six months (up to one year as the case may be) of the first standard contract during which period loan repayment and interest payable are at peak. This scenario will greatly enhance the equipment loan repayment in subsequent years.

Prompt Certificate Payment: The necessity of prompt certificate payment and suggested mechanisms needed to be put in place are well covered in [2]. For example, it has been suggested that certificates payment be decentralised to allow payment at the regional level. In a situation where certificates are not promptly paid (and where the concept of Labour Advance is not in place as may be the case with established labour–based contractors) the resulting delays in payments by contractors of workers' wages could slow down work, lead to loss of labour force (a disincentive to continuous labour
engagement), reduce effective work and hence lower road production thus making equipment loan repayment extremely difficult.

Advance Mobilisation: In the context of labour-based road rehabilitation technology, advance mobilisation (AM), normally 15% of contract sum, is used primarily to cover bills for labour, fuel and lubricants, and materials for the first two to three months of contract execution. Invariably, the amount of AM is not adequate and one has to fall back on overdraft facility (O/D) if it was granted as part of the Bank agreement package suggested in 2.14. (See Appendix 1)

The obvious choice is either to increase the AM to 20%, say (which effectively comes to approximately 16.3% of face value of contract sum after removing 20% for contingency and about 3% for general items) or the 15% is maintained and applied on the face value of the contract sum. The latter is preferred since in essence it is the status quo with the modus operandi amended. This approach will ensure a reasonable amount is available for effective execution of labour-based contracts in the early months of the Contract. Needless to say the adoption of 15% AM on the face value of the contract sum still remains as a loan which is immediately recovered in subsequent certificates raised by the contractor.

The question of dropping guarantees requested by the client himself may be worth looking at (to avoid unnecessary charges by Banks) since invariably the confidence the client reposes in the contractor's ability to perform is the Bank's trump card for appending its signature to four-year Loan repayment agreements, besides work continuity assurances by the client himself.

2.3 The contractor's role

Road Production Rate: The contractor's ability to repay the equipment loan is crucially linked to his/her ability to perform in terms of kilometres per month. From a rough calculation (Appendix 2) the barest minimum monthly gravel road production is 1.3 km especially for those on loans and 1.0 km for those not on loans. Thus, under no circumstance should any contractor produce less than 1 km of gravel road/month, if the contractor wants to survive.

Contractors must demonstrate in practical terms the seriousness of their commitment to the programme by stepping up production to beyond 1.3 km/month. Periodic graphical representation of contractors' performance will ensure healthy competition for higher outputs.

At the pilot stage of the programme, some contractors were producing 2 km/month and beyond in some few instances, proving that given the right framework (labour advances, O/D as package of Bank agreement) a target of 2km/month is achievable (making 20 km/yr for 10 effective months).
Construction Management Practices: To enhance the repayment of equipment loans, any good contractor ought to maintain good construction management practices. With particular reference to labour-based technology this will among others include:

1. A proper tools management system to prevent or mitigate the incidence of tools theft.

2. A regular equipment maintenance system including regular oil changes and greasing etc.

3. Avoiding of misapplication or misuse of pieces of equipment.

4. Good manpower management with special reference to the care and retention of trained supervisors, without whom work scheduling and execution will be difficult if not impossible to achieve.

5. Good financial management generally and especially with reference to adequate cash budgeting to ensure prompt payment of workers - an issue which ought to be placed at the top of the contractor’s priority list of cash disbursement.

Private Credit Supplies: Another area worth considering by contractors is the ability to arrange for material and fuel supplies on credit. This is entirely dependent on the contractors’ faithfulness to his creditors. If properly harnessed, however, this resource will lead to an improved liquidity position until certificates are paid, and therefore could tremendously enhance accelerated road production/month and enhance loan repayment.

Association Formation/Involvement: The labour-based technology has its own unique problems and issues and therefore even in countries where there exists Road Construction Association, it may be extremely necessary to form a separate Labour-based Contractors Association (as in Ghana).

The aim of such an association will be (among others)

i. to uphold and improve the standard of performance of the technology,

ii. to bring all labour-based contractors under one umbrella to be able to manage them both laterally (among themselves on peculiar problems) and vertically with the client and related departments (Banks etc.),

iii. to protect the interest of members and related departments such as preventing supervisor movements and/or attrition.

In Ghana, LABCA has been a vehicle for discussion and resolution of problems. Through the association there has been useful interaction leading to rates review, organisation of relevant courses and sharing of ideas to the general good of all the players of the programme.
Much has been said elsewhere [3], but it may be worth to emphasise while here that members’ deep involvement and commitment to the Association is as important as it is crucial to the success of the programme and the very sustenance of individual companies themselves. Without the Association there will be no formal platform for conflict resolution and solution of day-to-day site problems (manpower, machinery, Contract execution etc.), and the Client will be bogged down with so many problems that he the client will virtually have no time to do other important business.

3.0 CONCLUSION

From the foregoing discussion, it is clear that in order to enhance the repayment of equipment loans, every player in the game (Bank, Client, Contractor) has a crucial supportive contribution to make.

Where there is a will, there is a way, and with every role player contributing his quota, loans repayment could be well facilitated.

After all, some people have made it, and others could do better under the framework of discussion and recommendation made in this presentation. In this way, any client government could reap the full benefits that the concept has to offer.

REFERENCES


APPENDIX 1
Adequacy of advance mobilisation for labour based road rehabilitation

1. Assume a ₦200m Contract for one year
2. Allow for the usual 20% deduction for contingency.

Provide allowance also for the 3% deduction (average) for General Items.

Then AM payable is

\[
AM\ payable = \frac{100 \times \text{₦200m} \times 15%}{123} = \text{₦24.4m}
\]

3. All things being equal the contractor is expected to produce work equivalent to ₦200m/12, or 16.77m/month or ₦33.3m in two months. Assuming a 10% profit margin, the ‘cost of works’ will be 90% of GHC33.3m or GHC 29.97m.

This means a cash shortfall of approximately ₦5.6m (29.97 - 24.4) at the end of the second month when certificates raised will not have been honoured yet.

Undoubtedly, paying 15% of face value of contract sum, in this case 15% x ₦200m or ₦30.0m, will improve the cash flow situation as against the current effective percentage of 100/123 x 15 or 12%
APPENDIX 2

Minimum monthly road production

1. Assume cost of 1km of road to be $18.0m
   (Range $16.0m - $20.m/Km) or (US $10,000 - 13,500/Km)

2. Assume equipment covers 35% of sum paid (incidentally this is the
   rate applied by ADB for loan repayment).

3. Assume an average payment towards equipment loan, including
   interest, to the Bank to be $8.2m / month.

Then value of work per month, for break even, all things being equal
will be $8.2m/0.35 = $23.4m (using ADB DANIDA Group, loan value
of $147m at 40% interest rate).

Equivalent km/month = $23.4m/month divided by $18.0m/1km

=1.3km

For those not paying for equipment the equivalent will be 75% of
1.3km = 0.98km. (65% plus 10% allowance for equipment
maintenance). This could be more since ageing equipment needs to be
replaced by those in this category.

Thus, under no circumstance should any contractor produce less than
1km/month, if the contractor wants to survive.
3.2 Should trained labour-based road contractors be equipped? The Tanzanian experience

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1.0 INTRODUCTION

In recent years, practitioners of the labour-based technology have expressed disagreement on the need for trained labour-based road contractors to be equipped. There are those who claim that a contractor is supposed to operate in a risky and competitive environment and should be left to develop according to nature's law of 'Survival of the fittest'. Others contend that in the true context of building up the domestic contracting capacity, it is imperative to initially support the emerging contractor operating in a business environment hostile to entrepreneurial development, and once developed, be made to operate in a truly contracting environment.

This paper deliberates on whether trained labour-based road contractors should be equipped, from the perspective of the Tanzanian contracting environment, and also draws on experiences from other countries. It is deemed that the parallel drawn resembles that of most developing countries with limited local contracting capacities.

2.0 ROLE OF CONTRACTING

With the continued deteriorating condition of the road network in Tanzania over the years, due primarily to the poor state of the economy and the institutional weakness within the Government implementing agencies to effectively carry out maintenance and rehabilitation of the roads, it became necessary for the government to institute changes in the road sector strategies to ensure that the rate of executing the roads programme matched that of the implementation of the investment programmes as well as keeping pace with the economic development of the country.

The road maintenance strategy which previously focused on direct labour (force account) operations was acknowledged to have failed and though a viable private sector work force capable of meeting the needs of the road sector was non-existent, the Government went ahead to adopt a policy of involving the private sector with the expectation that the private sector would augment the supply of road equipment to overcome the inefficiencies in the system.

It was thus realised that the development of the domestic construction industry would have to be gradual and consistent with the capacities
to develop which in a way ought to have favoured the use of the labour-based approach.

3.0 CONTRACTOR PROFILE

The Tanzanian road construction industry is and continues to be dominated by foreign contractors. A study carried out by the National Construction Council (NCC) in June 1992, revealed that there were only 43 ‘classified’ road contractors in Tanzania and as many as twenty eight times the number of building contractors. This low figure, compared with other developing countries in Africa, could be attributed to the fact that the Government policy prior to the liberalisation of the economy did not encourage the involvement of locally based contractors in the road sector programmes.

Under the sixth highway project, the NCC, which is mandated to monitor, co-ordinate and promote the development of the local construction industry, carried out 23 courses for 279 participants drawn from local building contractors aimed at improving their technical and managerial skills in the execution of road works. The courses were noted to have had limited success because the contractors were not given the opportunity to execute road contracts after the training to put into practice the skills acquired.

A study commissioned in 1995 by the Ministry of Works to assess the road maintenance plant and equipment owned by registered contractors in the country also painted a bleak picture. About 86 percent of all the plants analysed were over 10 years old and had outlived their usefulness. The study also indicated that the reliability of the 80 dozers in the country was equivalent to having 7 new dozers and similarly an equivalent of 11 graders. Thus, the initiative taken under the US$1 billion donor funded Integrated Roads Project (IRP) to develop the limited capacity among domestic road contractors was considered appropriate since it is still acknowledged that the construction industry in Tanzania is in its infant stage of growth and would require a considerable number of years to be in a position to carry out a significant proportion of road maintenance and rehabilitation works.

A contractor being developed is typically a small scale businessman, engaged in building works with an annual turnover of about US$40,000. The firm's working capital range from US$3,000 - 5,000 and if well established, have a tipper truck or tractor/trailer with a few pieces of hand tools. The firms invariably are mostly family run businesses with a few joint partnerships. The workforce may usually consist of a foreman, an accountant/storekeeper, and casually employed labourers with the Managing Director having full and absolute control over the day to day operations of the firm.
4.0 OBSTACLES ENCOUNTERED

There are a number of problems which continue to impede the development of labour-based contractors in Tanzania after contractors have acquired the technical and business skills through the structured 20 week training programme carried out by ILO and NCC.

4.1 Access to Equipment

A Contractor without access to equipment can be compared to a farmer forced to till land without a hoe. Access to basic light construction equipment consisting of roller, tractor, water bowser etc. is a pre-requisite for contractors achieving quality works and some meaningful output to ensure profits. Imparting knowledge and skills alone to contractors without any back up equipment support as experienced on the Kilimanjaro project makes it extremely difficult for contractors to effectively execute their contracts. There are basically a number of options that one could consider in accessing equipment to contractors as follows:

a) Hiring from government plant pool
b) Hiring from private plant pool
c) Hire purchase arrangement or direct sales

Under the IRP, the government agreed to the formation of a state owned plant hiring company (PEHCOL) to operate strictly along commercial lines. PEHCOL inherited most of the heavy obsolete and non functional equipment from the Ministry of Works and has not managed to get off its feet since its establishment in 1990. It does not also have most of the light equipment needed for the execution of labour-based road works and has failed to assist in the contractor development programme. Although there are two NORAD funded Ministry of Works workshops under operation at Tanga and Mbeya, they mainly service the direct labour operations and have limited equipment for hire to the trained contractors.

No established private plant hire firms are in existence and the few established contractors do not favour the development of the small contractors since they pose a threat to the monopoly of contracts they have enjoyed over the last five years. It is now acknowledged that the presence of trained labour-based contractors in the regions has resulted in substantial lowering of bids submitted for the execution of road works. Consequently, these established contractors charge exorbitant rates to discourage the emerging contractors from hiring their equipment even if it is not being utilised. Those who are bold to hire them eventually end up channelling most of their profits to the equipment owners because of the extremely high hire rates. A typical case is the hire rate of US$ 42 per hour quoted for a 1.2 tonne roller by a firm in the P-1 and G-1 (Highest Road Classification) category compared to the PEHCOL rate of US$ 40 a day.
Recently two companies in Dar es Salaam have provided opportunities for hire purchase arrangement to contractors for mainly tipper trucks and rollers. Each prospective customer is expected to deposit 40 percent of the equipment cost and to pay the balance within specified periods varying from 6 to 15 months.

4.2 Credit Facilities

Stiff conditions imposed by Banks in Tanzania and likewise most developing countries do not favour the development of emerging contractors with limited assets or collateral. Interest rates are as high as 35 percent and most Banks have literally ceased granting overdraft facilities since they are yet to recover billions of Shillings loaned out over the years. Until 1993, the Banks had no recourse to repossessing assets used as collateral from defaulting debtors.

Currently most of the Banks are undergoing restructurings exercises and have declined even to manage equipment loans for contractors on a revolving fund scheme.

4.3 Steady Work Load

One has to appreciate that a contractor is foremost a businessman and must strive for a reasonable profit. Profits can only be realised if one manages to efficiently execute works.

Labour-based contracting is a new concept to Tanzania and to the contractor may seem like a risky venture. The absence of a steady work load makes it difficult for a contractor to opt for investing any substantial amount in equipment. For example, a businessman should be able to calculate the returns of investing $20,000 to import beer from Kenya as opposed to investing it in a 1.2 tonne pedestrian vibrating roller which can only be used for executing road works when one is lucky enough to be awarded a contract.

4.4 Tendering Requirements

Demands by the client for contractors to provide bonds and sureties, though justified, have been found to be a major constraint for emerging contractors participating in road works. For instance, in one of the regions where the trained labour-based contractors were operating, the demand by the Banks that contractors deposit the equivalent amount of money to be advanced by the client in a fixed account before being provided with the guarantee letters delayed the start of the contracts for two months since none of the contractors could honour such unrealistic demands. The intervention by the project for the client to relax the condition accelerated the commencement of the contracts. The question one would like to ask is, ‘if the contractor had that sum of money to put in the fixed account would it not have been prudent to use the money to start the works instead of the hassle in relying on the client for the advance mobilisation loan?’
It may appear unsafe for the client to dish out money without any sureties bearing in mind the bad experiences of the Banks, but then in such a hostile banking environment, the client must find a solution to the problem (par 5.0) and be prepared to **shoulder some of the risks in the industry**.

Another area of concern is the delayed payment to contractors. Although the situation has improved within the last three years, the procedures in place are generally not geared to prompt payments, which can lead to chaos on contractors’ sites.

### 4.5 Commitment and Awareness

The lack of awareness and commitment to the labour-based technology by key stakeholders is another problem adversely affecting the development of contractors.

It is not surprising to find engineers and technocrats referring to the technology as ‘Going back to the Stone Age’, and thus refusing to accept it. The mentality that building a good road requires a grader and heavy compactor is sometimes even more difficult to dispel in some technocrats than in people from the rural areas. The project, with its numerous constraints, has managed to convince those who have had the opportunity to visit the contractors’ sites the cost effectiveness of the technology, yet some of these technocrats would like to **see favourable results within too short a period of time** and thus do not see anything wrong in packaging short spur feeder roads to be rehabilitated by international firms.

### 5.0 WHY SUPPORT?

It is often said that contractors in the building sector are performing well so there is good reason to hope that they will be able to do likewise in the road sector.

The question usually asked is, since contracting is a risky business and who ever enters into it must be prepared to take the risk, why must a contractor be supported? Secondly, if building contractors are not supported, why favour labour-based road contractors? Furthermore it is said that the support given to a contractor may lead to the continued dependency to support, ‘supportmania’ and the contractor would be incapable of fending for himself and go bankrupt once the support ceases.

To be able to judge whether there is the need to provide support for the trained contractor within the context of the Tanzania situation, it is important to understand the prevailing conditions in the country and what the support is focused at achieving.
Limited capacity amongst domestic contractors to undertake road rehabilitation and maintenance work has been identified as a major constraint in contractors’ participation in the IRP.

Why the limited capacity? As outlined previously, the main reason for the limited capacity is attributed to the fact that the Government policy was not initially geared towards encouraging the involvement of local contractors in road works. Secondly, as a result of the restructuring exercise, most financial institutions are reluctant to grant credit to people trying to create their own businesses.

Thirdly, unlike building contractors, road contractors deal with only one single client accounting for the reluctance of private investors to involve themselves in the road sector.

On the issue of why labour-based road contractors should be supported while those in the building industry are not, the answer is simply that a small scale contractor in the building industry can start without the need for much investment on equipment while in contrast, the road contractor must possess some basic equipment e.g. roller, bowser or tipper truck before first being classified to qualify for consideration in the award of contract by the client.

The current situation makes it imperative for a contractor to own some equipment to satisfy the conditions set by the client and since the amount involved is beyond the means of the contractor, one will need to be assured of a steady workload to be able to get returns on the investment.

It needs to be stressed that having access to equipment does not automatically guarantee good quality work and good productivity (our colleagues from Ghana will confirm the decline in contractors’ monthly output from 2 km to 0.7 km). On the contrary, with no access to equipment, contractors are bound not to achieve any significant output to justify their continued participation in road works since all their efforts will only lead them to bankruptcy.

A classic example of the steady decline of output registered by trained contractors on the project as a result of lack of access to equipment is illustrated in figures 1 and 2.

The reduction in productivity of trained contractors from 1 km to 0.45 km/month was attributed to the insufficient capacity of PEHCOL to meet the increase in demand for equipment. With the increased capacity of trained contractors in the region from 6 to 12 contractors within eight months, the market, which seemed to satisfy the initial demand was soon flooded with a demand it could not fulfil.

What can be done to surmount these obstacles and therefore develop contractors?
It is assumed that the labour-based contractor would have gone through the structured training programme and thus one is considering constraints external to the contractors’ performance.

- It is in the interest of the implementing agency to convince financial institutions of the credit worthiness of the small contractors through assured workload. The assured workload would in itself be sufficient guarantee to encourage contractors to solicit loans with fair conditions to access the basic equipment required. The repayment scheme could be monitored by the implementing agency to ensure full recovery. Experience from other projects has shown that it is possible for a contractor to make full recovery for an equipment loan amounting to US$150,000 if the contractor gets a steady work load for four years on a fixed rate contract. Setting up a revolving fund which would cater for other contractors from the proceeds of the loan recovery, would foster the development of more contractors.

- Provision of equipment mobilisation loans with flexible conditions would also benefit contractors, though its effectiveness is dependent on the value of contract awarded. The approach used by the Kilimanjaro project involved advancing a 15 percent equipment mobilisation loan in addition to the normal 15 percent advance mobilisation loan granted to enable the contractor to mobilise to the site.

- Loans are granted upon deposit of a car registration card or landed property belonging to the firm or individual owners. The equipment loans are paid upon submission of invoices directly to the suppliers to avoid funds being diverted.

- The contractors in Kilimanjaro were granted equipment mobilisation loans for contracts involving the rehabilitation of on the average 5 km of road worth US$65,000 which only resulted in contractors purchasing small pieces of second hand equipment some of which had outlived its economic life span.

- Recovery rate for the system adopted was 100 percent and proved to be of less risk to the client and did assist in partially fulfilling the equipment requirements of the contractors.

- The Government must announce its commitment to labour-based contracting and then the market will respond by providing business opportunity for plant hire, hire purchase or direct purchase. The Government could also support the industry by reducing taxes charged on construction equipment to make the equipment affordable and also encourage the establishment of local industries in the manufacturing of appropriate equipment.
• The involvement of the labour-based contractors in the execution of road works can be enhanced if the Ministry of Works sets up a fully fledged section responsible for labour-based road works.

• This section should be charged with the review of the inflexible and unrealistic demands of the contract conditions, ensure the provision of steady workload and timely payments to contractors as well as raising awareness on labour-based contracting.

• It is also deemed necessary that the trained labour-based contractors form an association which could be used as a forum for discussing and seeking solutions to problems facing the construction industry with the client.

6.0 THE WAY AHEAD

The rationale for any project attempting to establish labour-based road contracting should be that at the end of the project, contractors would have competently established themselves by owning some equipment and not continue to rent for ever. This does not in any way mean that one is advocating the adoption of the Ghana model where 54 contractors have already been equipped and the Department of Feeder Roads continues to grapple with the problem of providing additional equipment for the remaining trained contractors or the Ugandan model where a contractor is to be equipped to the tune of about $250,000.

There are two immediate options which are considered feasible for accessing equipment to trained labour-based road contractors in Tanzania.

In the design of future projects, provision has to be made for the project to acquire at least eight rollers (the equivalent of 12 work months of technical assistance input to the project) and then contracts of value $150,000 be awarded to each selected potentially promising trained contractor as trial contract. The contractor should be given the option to buy the roller on hire purchase for which recovery of the amount could be realised within the one year contract period.

Option two is to advance the trained contractor at most 25 percent of the contract value to enable the firm to buy outright the roller for which the contractor would have to use part of the profits in accelerating the pay back of the loan as illustrated in appendix 1.

It is in the interest of any nation that intends to develop a domestic road contracting capacity to create the right and enabling environment which should be geared towards supporting emerging inexperienced contractors, until fully developed. Once the capacity is created, the support could be withdrawn since the continued support could lead to ‘support fatigue’ (with due apologies to the Ghana model).
and then the contractors be made to operate in a truly contracting environment according to the law of 'survival of the fittest'.
Fig. 1: Performance of outstanding contractors - The beginning

- Standard Output
- Contractor I
- Contractor II
- Contractor III
Fig 2a: Result of increased capacity

![Graph showing the result of increased capacity with different contractors and periods against chainage in kms.

- Standard Output
- Contractor I
- Contractor II
- Contractor III

The graph illustrates the output over time, with each contractor showing a different pattern of increase in capacity as the chainage progresses.
Fig 2b. Comparison of contractor performances

![Comparison of contractor performances graph](image)
APPENDIX 1

Analysis of repayment schedule for a 1.2 tonne pedestrian vibratory roller.

\[ \text{CIF} + \text{taxes (30 \% of CIF)} + \text{local cost (5 \% CIF)} = \$20,520 \quad (1) \]

Average cost per kilometre of rehabilitated road = \$15,000

Assuming a contractor is awarded 10 km as trial contract

\[ \text{Contract value} = \$150,000 \quad (2) \]

\[ \text{Direct cost (i.e. less overhead and profit)} = 75\% \text{ of (2)} \]

\[ \text{Road works constitute about 86.7\% of the direct cost} = \$150,000 \times 0.75 \times 0.867 \]
\[ = \$97,538 \quad (3) \]

\[ \text{Equipment input 38\% of cost of road works} = \$37,064 \quad (4) \]

Breakdown of equipment inputs

- Tipper truck 50.8\%*
- Roller 25.2\%*

\[ = \$9,340 \quad (5) \]

- Tractor & Bowser 24.0\%*

Over head and profit 25%

Assuming the contractor uses 7.5\% of above in accelerating the pay back

Amount to be realised:

\[ \text{Equipment input} \quad \$9,340 \]
\[ \text{Profit (7.5\%)} \quad \$11,250 \]
\[ \$20,590 \quad (6) \]

Therefore comparing (1) and (6), it should be possible for the contractor to pay back the cost of the roller within the one year contract period.

* Data based on a road contract executed by the project.

If on the other hand, the contractor is advanced 25 percent of the contract value as mobilisation loan, the contractor should be able to procure the roller outright and then have a surplus of over \$16,000 to cater for labour, materials and other miscellaneous items.
3.3 Counterparts and technology transfer. Can we improve the system?

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INTRODUCTION

I think we would all agree that the acid test of the success of any development project is whether or not it can survive once the large inputs of finance and personnel which often accompany such projects dry up. There are many reasons for this; one of them is that national staff are left with insufficient skills and experience to run the project. Here I discuss some ways to remove this particular barrier to success. The method usually adopted to produce a group of national staff with sufficient experience is to import technical assistance. This usually comes in the form of advisers employed directly by the development agencies, or from consultants. These advisers work with nationals - COUNTERPARTS - who will learn to run the project.

GENERAL APPROACH

In theory the system would seem to be the correct approach to the problem. However, the goal of sustainability is seldom achieved within the time scale that was initially planned. If we are to improve matters, we need to examine the reasons for this.

- Difficulties in locating a counterpart at the start of the project
- Counterpart does not feel a part of the project - a lack of ownership
- Adviser has insufficient experience or ability to do the job
- Inability of the adviser to pass on his skills and knowledge to his counterpart
- Inability of the counterpart to absorb these skills and knowledge
- Lack of resources to allow counterpart and adviser to work simultaneously
- Relationship between counterpart and adviser does not allow learning to take place
- Lack of motivation on the part of the adviser or counterpart
- Insufficient time allowed for learning to take place
- Donors regard advisers as an investment safeguard and executors rather than trainers.
I am sure we can all think of a depressing number of examples of each of these situations. It is no coincidence that most of these reasons for failure involve the lack of ability to pass on skills and other factors associated with inter-personal relationships. It must not be forgotten that projects are at times conceived solely as projects, without sufficient consideration as to how they will operate without external support. This has a demoralising effect on counterparts.

METHODS

There are various methods of structuring the adviser–counterpart relationship

**Apprenticeship**

The counterpart performs tasks with a gradually increasing level of complexity. The arrangement is informal and not particularly structured.

**Timed handover**

A timetable is prepared for the transfer of responsibilities for various areas of workload from adviser to counterpart.

**Sink or Swim**

The counterpart assumes full responsibility for everything from the beginning, and relies on a decreasing level of assistance and advice from the adviser to fulfil those responsibilities.

Whatever the method used, it is helpful to use the following steps to define the role of the counterpart, and what support they need in order to take control.

1. Identify all the tasks necessary to perform a job. The unforeseen emergencies, personnel problems and all those other small tasks which prevent you getting on with the main, more easily defined part of your job must not be forgotten.

2. For each of these tasks, define which the counterpart is currently performing and attempt to evaluate the degree of success.

3. Identify the skills necessary to perform each of these tasks, and the best method(s) to learn them - Formal Courses, lessons given by the adviser, guidance from the adviser or practice at the task during a real work situation.

4. Prepare a programme for training in and handing over of areas of responsibility.

5. Monitor this programme, taking action where necessary to resolve problems which are identified.
6. Although these steps all appear formal and ordered, they should be carried out in an informal manner, as we shall see shortly. Counterpart and adviser must be involved jointly in this definition.

LEARNING ENVIRONMENT

We have seen that the majority of problems with the counterpart system involve inter-personal relationships, and we must therefore examine this area more carefully. Training during a formal course is carried out in a classroom. When we enter that room we feel that we are there to learn, because of the organisation and atmosphere of the room. If that atmosphere does not exist, the training is unlikely to be successful. Counterpart training also needs a certain atmosphere to work. We can call this a LEARNING ENVIRONMENT, which has to be created jointly by the adviser and their counterpart.

Let us look at the factors which are important in the development of this environment:

- Development of mutual respect and a working relationship between Counterpart and Technical Assistant
- Maximising communication by sharing an office and choice of working language
- Existence of sufficient work to keep both parties reasonably fully occupied
- Sharing of workload in such a way that interesting tasks and chores are fairly divided between both parties.
- Ensuring that successes as well as failures are duly acknowledged
- Equitable division of resources between both parties
- Counterparts are given a sufficiently free hand to allow them to develop their own methods of working and to learn from their mistakes
- Mutual understanding of and sensitivity to the needs of the counterpart and adviser, inside and outside the workplace
- Monitoring of the progress of the counterpart must be carried out in a stress-free way, so that any tensions existing will not be increased. Reasons considered for poor progress must include poor performance by the adviser.

A CHANGE OF SYSTEM

I believe that many of the problems in running the counterpart system stem from the contrasting nature of the skills required. Engineering ability is needed to do the job, but for the technology transfer strong teaching and interpersonal skills and sensitivity are needed. These
non-engineering skills often have a low priority when it comes to the selection of technical assistance staff.

Let us examine in more detail the system in which technical advisers function:-

- The advisers are usually provided through consulting companies, or individuals, interested in retaining their contracts.
- Success in terms of development is measured by a short period of technical assistance, whereas most of the providers of technical assistance have an interest in prolonging their involvement.
- Pressures on technical assistance teams or consultants to produce results can mean that the PTAs feel obliged to carry out tasks alone or in ways which prevent the counterpart from gaining knowledge.
- There is thus a definite conflict of interest in the case of these first two points. Perhaps technical assistance contracts should be remodelled to provide incentives for successful counterpart training. The knowledge that there is a time limit on the provision of assistance is often not sufficient.
3.4 Summary of workshop on intermediate equipment for labour-based roadworks

Derek Miles, Paul Larcher, Rob Petts, and Gary Taylor, Management of Appropriate Road Technology (MART), U.K.

INTRODUCTION

Since the early 1970’s the ILO and other organisations have promoted the development of efficient labour-based roadworks, initially through the road administrations and more recently encouraging the development of domestic private contractors.

Although the road programmes are based on the use of labour, certain intermediate types of equipment are required to support the labour operations. These include, for example, items required for compaction and haulage, for which labour is not well suited.

INTERMEDIATE EQUIPMENT

Simple or intermediate equipment designed for low initial and operating costs, durability and ease of maintenance and repair in the conditions typical of a limited-resource environment, rather than for high theoretical efficiency. It is preferable if the equipment can also be manufactured or fabricated locally.

It has been realised that the development of intermediate equipment is lagging behind other aspects of the sector. Since the 5th Regional Labour-based Roadworks Seminar was to be held in Accra during April 1996 under the joint auspices of DFR and ASIST, the opportunity was taken to promote a two-day workshop immediately preceding the seminar to discuss these issues. The Accra workshop, jointly run by MART and ILO and supported by DFR provided a unique opportunity for experts to come together to review the current situation and further development needs for intermediate technology equipment. Participants included representatives of road authorities, agencies, contractors, consultants and manufacturers involved in the equipment aspects of the labour-based roadworks sector.

It is intended that the results of the workshop set out in this working paper, together with follow-up research, will enable recommendations to be made and disseminated to practitioners in road authorities, advisory organisations, contractors and suppliers. The aim is to improve knowledge, availability, acceptance, diversity and quality of intermediate equipment for use on roadworks.

Both the ILO and the MART initiative will welcome comments on this working paper, including information on successful (and unsuccessful)
operational experience with intermediate equipment. Suggestions are also welcome for other topics which should be tackled in order to enable labour-based technologies to be fully competitive and sustainable.

WORKSHOP SUMMARY
The workshop approach and conclusions can be summarised as follows:-

### APPROACH

- Identification of Issues related to Intermediate Equipment for Labour-based Roadworks
- Identification of Equipment Items to be covered by the MART guidelines
- Identification of available information/useable designs/specifications on each Equipment Item
- Identification of items on which more R&D work is required - prioritised
- Agreement on actions required to promote R&D, standards, and availability of intermediate equipment

The workshop follow-up should support the development of:

Guidelines on specification, procurement and management/support of intermediate equipment.

A number of key issues were identified as influencing the availability, cost and performance of intermediate equipment. These can be grouped as:-

### KEY ISSUES

- Institutional
- Operational
- Training
Due to the time constraints of the workshop, following identification of key topic areas, the participants focused on the operational issues relating to the priority groups of intermediate equipment.

Intermediate equipment items suitable for use in labour based roadworks were identified and grouped in the following categories for assessment and development of MART guidelines:
<table>
<thead>
<tr>
<th>EQUIPMENT CATEGORIES (PRIORITISED)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Haulage</td>
</tr>
<tr>
<td>• Compaction</td>
</tr>
<tr>
<td>• Structures</td>
</tr>
<tr>
<td>• Others</td>
</tr>
</tbody>
</table>

Further actions on R&D and dissemination were agreed for the priority equipment items.

**WORKSHOP STRATEGY**

The workshop programme is attached as Annex 1, and the opening address by Mr C. D. Antwi is attached in Annex 2. The objective of the workshop was to produce ‘Detailed recommendations and action plan regarding the production of a document setting out guidelines on Intermediate Equipment for Labour-based Small Scale Contracting in the road sector’ (Reviewing & consolidating experiences to date). The guidelines are to cover both rural and urban road sectors.

The initial expectations of the participants are set out in Annex 3. After explanation of the respective roles of ILO/ASIST (see Annex 4) and MART, the workshop reviewed the following background documentation:

- ILO - MART questionnaires on intermediate equipment - results and analysis of returned questionnaires received to date (draft MART Working Paper No 2).
- Papers submitted for BPWA/MART competition under the headings ‘Intermediate Equipment’ (Messrs Hamper, Hancox, Hodge and Wedd) and ‘Handtools’ (Murty).

The workshop identified topics under the three headings of Institutional, Operational and Training issues as set out in the pages.

Although participants recognised the importance of both institutional and training issues, it was agreed that, in the limited time available, it would be most productive for the workshop to focus on the detailed identification of operational issues and priorities.

Both MART and the ILO recognise the need to stimulate conceptual work on the various topics that were identified under the institutional heading. This work will proceed in parallel with the work programme on operational issues set out in Sections 6 and 8. Conceptual work on institutional issues will aim inter alia to draw attention to the importance of practical research and development on intermediate equipment; this can rarely be achieved within the context of operational
projects without additional dedicated resources, however it is essential if those projects are to be effective.

Several participants drew attention to the need for teaching and training material based on comparative operational data on equipment performance.

**SUMMARY OF EQUIPMENT ITEMS**

Following the identification of key issues, the workshop proceeded to discuss problems, practices and needs related to specific items of intermediate equipment.

This was initially carried out by compiling a list of 11 roadworks operations. In order to facilitate discussion these operations were ranked in order of importance. The top 5 operations were agreed to be:

- Haulage
- Compaction
- Structures
- Spreading
- Supervision

For each of the 11 operations the workshop prepared a list of all intermediate equipment items that were known to the group. These lists are shown on the chart overleaf. The number of equipment items was considered too large for the participants to discuss every item within the two day workshop. This resulted in an additional ranking exercise which identified items of equipment that were not considered a high priority, and would therefore not be discussed during the workshop. These low priority items, that include a number of standard ‘off the shelf’ items, are shown in shaded boxes on the chart.
### INTERMEDIATE EQUIPMENT ISSUES

<table>
<thead>
<tr>
<th>INSTITUTIONAL</th>
<th>OPERATIONAL</th>
<th>TRAINING</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOCAL MANUFACTURE</td>
<td>DESIGNS</td>
<td>EQP. MAINTENANCE TRAINING</td>
</tr>
<tr>
<td>QUALITY ASSURANCE CONTROL</td>
<td>SPECIFICATION</td>
<td>EQUIPMENT MANAGEMENT</td>
</tr>
<tr>
<td>JOB CREATION</td>
<td>PROCUREMENT</td>
<td>USE OF EQUIPMENT</td>
</tr>
<tr>
<td>FINANCE AVAILABILITY</td>
<td>PERFORMANCE ASSESSMENT</td>
<td>OPERATOR TRAINING</td>
</tr>
<tr>
<td>DONOR (TIED) FUNDING</td>
<td>PERFORMANCE DATA</td>
<td></td>
</tr>
<tr>
<td>DONOR EQUIPMENT FUNDING POLICY</td>
<td>COSTING</td>
<td></td>
</tr>
<tr>
<td>R &amp; D</td>
<td>APPROPRIATE MIX OF EQUIPMENT</td>
<td></td>
</tr>
<tr>
<td>USE OF LOCAL RESOURCES</td>
<td>RECOMMENDED MODELS</td>
<td></td>
</tr>
<tr>
<td>PROCUREMENT</td>
<td>EQUIPMENT FOR MAINTENANCE</td>
<td></td>
</tr>
<tr>
<td>TECHNOLOGY ENVIRONMENT</td>
<td>MAINTENANCE OF EQUIPMENT</td>
<td></td>
</tr>
<tr>
<td>AVAILABILITY OF EQUIPMENT FOR HIRE</td>
<td>EQUIPMENT CHOICE (CULTURAL)</td>
<td></td>
</tr>
<tr>
<td>GOVERNMENT FISCAL POLICY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CREDIT / LEASE ARRANGEMENTS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
EQUIPMENT CATEGORIES

The items of equipment that were considered by participants to be of a high priority were discussed in four categories, representing what were seen as the three most important operations in labour-based roadworks:

• Haulage
• Compaction
• Structures

plus a group referred to as:

• Other Priority Items

For each of these four categories the workshop:

• Identified the information that is currently available.
• Highlighted areas for further research and development.
• Agreed the action required and the organisation(s) that should undertake the work.

These findings are summarised in the charts on the following four pages.
### Intermediate Equipment Categories

<table>
<thead>
<tr>
<th>Haulage</th>
<th>Compaction</th>
<th>Structures</th>
<th>Spreading</th>
<th>Supervision</th>
<th>Excavation</th>
<th>Bitumen</th>
<th>Ancillary Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tractor 2WD</td>
<td>Pedestrian Vibrating Roller</td>
<td>Culvert Moulds Steel</td>
<td>Towed Grader</td>
<td>Recycle</td>
<td>Disc Plougher</td>
<td>Bitumen Heater</td>
<td>Chainsaw</td>
</tr>
<tr>
<td>Tractor 4WD</td>
<td>Towed Deadweight Roller</td>
<td>Culvert Moulds Wood</td>
<td>Ripper Trailer</td>
<td>Motorbike</td>
<td>Scarifier</td>
<td>Bitumen Hand Sprayer</td>
<td>Water Pump</td>
</tr>
<tr>
<td>Tipper Truck</td>
<td>Jack-Up Vibrating Roller</td>
<td>Precast Fabricated Formwork</td>
<td>Towed Drag</td>
<td>Petrol Pump</td>
<td>Fire Plougher</td>
<td>Bitumen Truck Sprayer</td>
<td>Jackhammer</td>
</tr>
<tr>
<td>Flat Truck</td>
<td>Towed Vibrating Roller</td>
<td>Concrete Mixer</td>
<td>Grader Plate</td>
<td>3-Wd Pickup</td>
<td>Screw</td>
<td>Chipping Distribution</td>
<td>Compactor</td>
</tr>
<tr>
<td>Dumper</td>
<td>Towed Bower</td>
<td>Concrete Vibrator</td>
<td>Tipper Truck</td>
<td>Caravan</td>
<td>Scraper</td>
<td>Slurry Box</td>
<td>Cutting Tool</td>
</tr>
<tr>
<td>Power Tiller</td>
<td>Hand Drawn Roller</td>
<td>Simple Crane</td>
<td>Tipper Truck</td>
<td>Caravan</td>
<td>Scraper</td>
<td>Slurry Box</td>
<td>FUEL BOWSER</td>
</tr>
<tr>
<td>Plan</td>
<td>Laden Truck Traffic</td>
<td>Concrete Dumper</td>
<td>Concrete Dumper</td>
<td>Concrete Dumper</td>
<td>Concrete Paver Press</td>
<td>Concrete Dumper</td>
<td>Concrete Dumper</td>
</tr>
<tr>
<td>Trailer</td>
<td>Water Pump</td>
<td>Concrete Paver Press</td>
<td>Water Pump</td>
<td>Concrete Paver Press</td>
<td>Concrete Paver Press</td>
<td>Concrete Paver Press</td>
<td>Concrete Paver Press</td>
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<tr>
<td>Hitching System</td>
<td>Vibrating Plate</td>
<td>Water Pump</td>
<td>Concrete Paver Press</td>
<td>Water Pump</td>
<td>Concrete Paver Press</td>
<td>Concrete Paver Press</td>
<td>Concrete Paver Press</td>
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<tr>
<td>Stand For Towed Items</td>
<td>General</td>
<td>Hand-Operated Mobile Crusher</td>
<td>Concrete Dumper</td>
<td>General</td>
<td>Hand-Operated Mobile Crusher</td>
<td>Concrete Dumper</td>
<td>General</td>
</tr>
</tbody>
</table>

### Survey & Testing Eqp.
- Template
- D.C.P
- Schmidt Hammer
- Rotorator
- Dumpy Level
- Density Meter

### Soil Stabilisation
- Caterpillar
- Dumper
- Mobile Crusher

### Crushing
- Mobile Crusher
<table>
<thead>
<tr>
<th><strong>HAULAGE</strong></th>
<th><strong>INFORMATION AVAILABLE</strong></th>
<th><strong>MORE R &amp; D</strong></th>
<th><strong>ACTION REQUIRED</strong></th>
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<tbody>
<tr>
<td><strong>TRACTOR 2WD</strong></td>
<td>Kenya Report on 3 tractors '87</td>
<td>Write up existing projects - experiences - force account &amp; contractor</td>
<td>MART ILO working paper on equipment selection, procurement, management &amp; support</td>
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<tr>
<td></td>
<td>Asist brief no 1 page 36</td>
<td></td>
<td>Individual Technical briefs on equipment items - Asist-Mart plan of action</td>
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<td></td>
<td>WB 1978 study</td>
<td></td>
<td>Write up experiences of procurement &amp; mechanical support Ghana</td>
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<tr>
<td></td>
<td>Trailer Offloading study '94</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kenya</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frans Blokhuis Tanga 1990</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Photographic report</td>
<td></td>
<td></td>
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<tr>
<td><strong>TRACTOR 4WD</strong></td>
<td>None</td>
<td>Determine situations (limited) where 4wd req'd for haulage</td>
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<tr>
<td><strong>TIPPER TRUCK</strong></td>
<td>Kenya RARP (Walter Ill)</td>
<td>Write up Lesotho &amp; Tanzania experiences</td>
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<td></td>
<td>KTS study 1985</td>
<td>Could lead to more R &amp; D</td>
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<td></td>
<td>WB 1978 study</td>
<td></td>
<td></td>
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<tr>
<td><strong>FLAT TRUCK</strong></td>
<td>Frans Blokhuis report</td>
<td>Comparative performance Flat bed Tipper Tractor-Trailer</td>
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<td></td>
<td>Tanga 1990</td>
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<tr>
<td><strong>DUMPERS</strong></td>
<td>No experience on L B projects in Africa</td>
<td>Not a priority</td>
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<td><strong>POWER TILLER</strong></td>
<td>Lars Karlsson</td>
<td>DFR propose trials 1997</td>
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<td></td>
<td>CTP 44, 62, 63 64</td>
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<td></td>
<td>CRRI</td>
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<tr>
<td><strong>ITEAN</strong></td>
<td>Draft Report by</td>
<td>African Trials (Ghana?) Req’d</td>
<td>MART ILO/DFR/Kenya to investigate trial project possibilities</td>
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<td></td>
<td>Shone &amp; Edmonds - Cambodia</td>
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<td></td>
<td>I.T. Transport Studies in Cambodia, Laos, Indonesia</td>
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<td><strong>TRAILER</strong></td>
<td>ILO document Tech Brief No 1</td>
<td>Literature Review Roq’d</td>
<td>MART to carry out review Comments by all to ILO/ASIST on technical brief No 1 immediately Published May '96</td>
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<tr>
<td></td>
<td>Jim Hamper paper</td>
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<td></td>
<td>Peter Rentall Paper July 1993</td>
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<td></td>
<td>Namibia Shone Makowera report</td>
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<td></td>
<td>Vavan Gisha Self - Tipping</td>
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<td></td>
<td>Trailer Trial Jim Hamper</td>
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<td></td>
<td>Nepal Trailer - Dr T Jones</td>
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<td><strong>HITCHING SYSTEMS</strong></td>
<td>ILO technical brief No 1</td>
<td>Monitoring trials required e. g. Kenya coast</td>
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<td></td>
<td>Jim Hamper paper</td>
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<td>Bill Hancox paper</td>
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<td><strong>STAND FOR TOWED ITEMS</strong></td>
<td>No written up documentation</td>
<td>Write up experiences</td>
<td>Charles Williams discussion paper</td>
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<td><strong>WHEELBARROW</strong></td>
<td>ILO Handbook</td>
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<td>Urban Infrastructure unit</td>
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<td>Literature review by R. Dennis</td>
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<td>IT Transport (Bearings and tyres issues)</td>
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<td>Norconsult modified Armstrong wheelbarrow April 1994</td>
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<td>Asist will publish Norconsult report  write up experiences</td>
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<td>ASIST Finalise Technical brief MART(ITT) to consolidate data for MART guidelines</td>
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<td><strong>HAND CART</strong></td>
<td>Use of handcarts in Kisumu -</td>
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<td></td>
<td>IT Kenya</td>
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<td></td>
<td>Ron Dennis References</td>
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<td><strong>ANIMAL CARTS</strong></td>
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<td></td>
<td>McCutcheon</td>
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<td>Walter Ill Feb '89 Kenya</td>
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<td>Karlsson - CTP 42-64 &amp; 64</td>
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<td>Blokhuis '95 Donkey Panniers</td>
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<td>Barwell IT - Harnessing systems</td>
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<td>Howe J - Tools &amp; Equip. Study '83</td>
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<td></td>
<td>Starky '93 Animal tractor</td>
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</table>
COMPACTION

INFORMATION AVAILABLE

PEDESTRIAN VIBRATING ROLLER
Lars Karlsson
CTP 44 & 62/63/64
ILO Lesotho seminar 1991
ASIST Seminar 1996 paper
Lesotho, Guthrie, SWKP
pre 1984
TRL ? Sisese ?

TOWED DEADWEIGHT ROLLER
Karlinsson CTPs,
Kenya Roads 2000 1994
Bangladesh LGED
XEN BOGRA
Simon Done Sisese '95
Lesotho database
CRRI documents
Tractor Attachment
India+Ferguson

RIDE ON VIBRATING ROLLER
No documentation

TOWED VIBRATING ROLLER
Lars Karlsson Reports

HAND DRAWN ROLLER
Kenya
- Jacob Jensma '88 - '91
- Roads 2000 '95
Bangladesh
O'Sullivan - ITT

INFORMATION AVAILABLE

MORE R & D ?

PEDESTRIAN VIBRATING ROLLER
Review experiences
Ghana + Lesotho
Further Trials if necessary
ITEAN experiences
Optimum weight, Minimum
weight, Whole life cost, Life
span , Cost / Productivity data

TOWED DEADWEIGHT ROLLER
Review Zambia experiences
(Sturla Elsvoe) Roads 2000,
follow up
Zimbabwe experiences
(Review)

RIDE ON VIBRATING ROLLER
Review Ghana (Benford)
experiences

TOWED VIBRATING ROLLER
Review Hydraulic / Engine
Vibration systems

HAND DRAWN ROLLER
Specifications
- corrosion protection
- valves
- spray bar
investigate potential
wheel removable tank
Document - animal drawn
borders in Kenya

INFORMATION AVAILABLE

ACTION REQUIRED

PEDESTRIAN VIBRATING ROLLER
Review experiences
Ghana + Lesotho
Further Trials if necessary
ITEAN experiences
Optimum weight, Minimum
weight, Whole life cost, Life
span , Cost / Productivity data

TOWED DEADWEIGHT ROLLER
Review Zambia experiences
(Sturla Elsvoe) Roads 2000,
follow up
Zimbabwe experiences
(Review)

RIDE ON VIBRATING ROLLER
Review Ghana (Benford)
experiences

TOWED VIBRATING ROLLER
Review Hydraulic / Engine
Vibration systems

HAND DRAWN ROLLER
Specifications
- corrosion protection
- valves
- spray bar
investigate potential
wheel removable tank
Document - animal drawn
borders in Kenya

TOWED BOWSER
Kenya MRP Technical Manual
Vol II

LADEN TRUCK TRAFFIC
RARF Technology Unit Report

WATER PUMP
Options
- Portable Open Impeller
- Portable closed Impeller
(clean water)

GENERAL
Department of Transport RSA
Research on Compaction

PRODUCE REVIEW DOCUMENT OF EXISTING EXPERIENCES

NO DOCUMENTATION

DISCUSS FUTURE R & D WITH TRL/CSIR

ISSUES:
- Appropriate Compaction
- Specifications
- Compaction Options
- Performance
- Costs

GENERATE REVIEW DOCUMENT OF EXISTING EXPERIENCES

DISCUSS FUTURE R & D WITH TRL/CSIR

ISSUES:
- Appropriate Compaction
- Specifications
- Compaction Options
- Performance
- Costs

GENERAL

REVIEW ALL OPTIONS

TRIAL ON EFFECTIVENESS

PRODUCTIVITY

RESEARCH ON COMPACTION
<table>
<thead>
<tr>
<th>STRUCTURES</th>
<th>INFORMATION AVAILABLE</th>
<th>MORE R &amp; D</th>
<th>ACTION REQUIRED</th>
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<tbody>
<tr>
<td>CULVERT MOULDS WOOD</td>
<td>Uganda 600mm Odenigbo 1992 KTC currently carrying out trials ILO ASIST document Sept '96</td>
<td></td>
<td>ASIST 1996 document on Steel &amp; Wooden mould systems</td>
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<tr>
<td>PREFAB. FORMWORK</td>
<td>Arch culvert Kenya MRP structures manual Ghana Standard Culvert Slabs - ILO report Mehta</td>
<td></td>
<td>Include in ILO Options Assessment document</td>
</tr>
<tr>
<td>CONCRETE MIXER</td>
<td>Labour operated mixer Swaziland For Concrete &amp; Slurry Sealing Standard item</td>
<td>None required</td>
<td>ASIST will obtain Swazi documentation</td>
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<tr>
<td>CONCRETE VIBRATOR</td>
<td>Standard item</td>
<td>None required</td>
<td></td>
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<tr>
<td>SIMPLE CRANE</td>
<td>ILO Tools &amp; Equipment Royal Engineers' Field Handbook Gin Pole &amp; Shear Legs</td>
<td>None required</td>
<td></td>
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<tr>
<td>CONCRETE DUMPER</td>
<td>See Dumpers</td>
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<tr>
<td>CONCRETE PAVER PRESS</td>
<td>Dr. Jones Thailand Kumasi University Research Fly Press I.T. Workshops Press DBSA Cement &amp; Con Association RSA &amp; Australian documents</td>
<td>Trials R&amp;D required Develop moulds Vibration (simple) Testing apparatus</td>
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<tr>
<td>WATER PUMPS</td>
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<tr>
<td>HAND OPERATED MOBILE CRUSHER</td>
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<td>ASIST will obtain Swazi information</td>
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<tr>
<td>OTHER PRIORITY ITEMS</td>
<td>INFORMATION AVAILABLE</td>
<td>MORE R &amp; D</td>
<td>ACTION REQUIRED</td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------------------</td>
<td>------------</td>
<td>-----------------</td>
</tr>
<tr>
<td><strong>TOWED DRAG</strong></td>
<td>OS Road notes TRL LR 1112, RR 91 (Ghana DFR ongoing trials)</td>
<td>DFR write up trials, experiences, design, fabrication, performance, costs</td>
<td>DFR report on trials MART consolidate this &amp; existing TRL data</td>
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<td>Review Document Disseminate</td>
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<td><strong>FUEL BOWSER</strong></td>
<td>MRP Technical Manual Vol II</td>
<td>None required</td>
<td>Determine copyright issue &amp; disseminate if possible - ILO</td>
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CLOSING COMMENTS

Before the official closing of the workshop and the expressions of gratitude to the organisers and participants, the participants were given the opportunity to make any further comments relating to the workshop and its follow-up. The following comments were made:

- Training is required on the handling and management of intermediate equipment for contractor’s personnel.
- When new equipment is delivered, there should be pre-delivery training of operators and mechanics. The cost of this training should be allowed for.
- Manufacturers should be encouraged to understand the equipment needs of the LB roadworks sector and to co-operate with LB programmes in the development and testing of intermediate equipment.
- Practitioners should feed back experiences of technical problems to the equipment manufacturers, to enable improvements to be made.
- The MART questionnaires will be an important feedback on the experience of LB projects.
- The possible roles of universities and training institutions in equipment R&D should be investigated.

NEXT STEPS

A. Institutional issues

As the MART initiative proceeds, conceptual papers and case studies will be generated in order to provide a broad perspective on institutional issues related to intermediate equipment. It is intended that these items should eventually be consolidated to provide a comprehensive overview of action required in order to secure a productive environment which will encourage continuing development of appropriate equipment. MART’s work on institutional issues related to intermediate equipment will link closely to handtools and the promotion of the private sector. MART also recognises the need to coordinate closely with other organisations with an interest in institutional issues, including the ILO, the World Bank, international assistance agencies and the World Road Association (PIARC).
B. Operational issues

General

1. MART/ILO to discuss proposal to prepare a working paper on equipment selection, procurement, management and support.

2. ASIST/MART to collaborate on plan of action for preparation of technical briefs on individual equipment items.

3. A document describing the experiences of procurement of intermediate equipment, its use and mechanical support in Ghana to be prepared as a case study by Soren Fosberg, DFR. This document will act as a model for further case studies to generate productivity and operational data.

Haulage

4. MART to carry out a review of trailers.

5. ASIST to finalise and distribute Technical Brief No 1 (Standard Trailer and Hitch).

6. Charles Williams to prepare a discussion paper on stand for towed items.

7. ASIST to finalise Technical Brief on wheelbarrows.

8. MART (I T Transport) to consolidate data for guidelines on wheelbarrows, handcarts and animal drawn carts.

Compaction

9. MART/ILO to discuss proposal to prepare review document on experiences with pedestrian vibrating rollers and other compaction equipment.

10. R&D requirements to be discussed with TRL/CSIR and other interested organisations under the headings:
    - Appropriate levels of compaction for labour-based roadworks
    - Guidelines for preparing appropriate compaction specifications
    - Compaction options
    - Generating realistic performance and cost data.

Structures

11. ASIST to publish a document on options for small drainage structures (by end 1996).

12. ASIST to formulate future work programme for technical briefs on individual drainage options.
13. ASIST to publish document on steel and wooden culvert mould systems (by end 1996).

14. ASIST to obtain information from Swaziland on hand operated concrete mixer and hand operated mobile crusher.

Towed grader
15. Following a review of existing information, MART to discuss with TRL the preparation of a 1996 TDR bid based on R&D and field trials in (tentatively) Ghana, Kenya and Zimbabwe.

Towed drag
16. DFR, Ghana to write up experiences of ongoing trials (design, fabrication, performance and cost data) for MART to consolidate with existing TRL data.

Bitumen heater and hand sprayer
17. MART to prepare review document based on existing information. MART will also run an equipment challenge competition to design a bitumen heater-distributor.

Fuel Bowser
18. MRP Technical Manual Vol. II has hitherto been distributed by ASIST. However it is now out of print. ILO/ASIST to determine copyright issue and arrange for reprinting if possible.

Concrete paver press and testing equipment
19. Designs and trials are required to develop manually operated concrete paver presses for manufacturing concrete paving bricks by small enterprises for urban and village application. A simple field system of testing the strength of pavers is also required. MART will run an equipment challenge competition to design a concrete paver press and testing equipment.

Note
Some of the foregoing actions have cost implications which cannot be met with the existing resources of MART, ILO or other partners. Where necessary, project proposals will be prepared once work programmes can be defined and quantified.

C. Training
Participants highlighted the dearth of basic information, manuals, case studies, performance and cost data for use in teaching and training as well as project planning, regarding intermediate equipment. The lack of opportunities for training and professional development in the procurement, use and maintenance of intermediate equipment is seen as
a severe long term constraint to sustainability of the technology. Although training issues could only be briefly reviewed in the course of the Accra workshop, both MART and ILO recognise the need to emphasise this aspect of dissemination. The preparation of a plan of action should be facilitated by inter-university network contacts and the emerging results of the proposed R&D programme under sections A & B above.
ACRONYMS

ASIST  Advisory Support, Information Services and Training
BPWA  British Public Works Association
CRRI  Central Road Research Institute (India)
CSIR  Centre for Scientific and Industrial Research (RSA)
CTP  Construction Technology Paper (ILO Geneva)
DBSA  Development Bank of Southern Africa
DCP  Dynamic Cone Penetrometer
DFR  Department of Feeder Roads (Ghana)
EQP  Equipment
EU  European Union
ILO  International Labour Organisation
ITEAN  A small truck powered by a 5-15 hp two stroke engine, capable of carrying up to 2 m$^3$, manufactured in Thailand and used throughout S.E. Asia
ITT  I. T. Transport (Consultants)
KTC/KTS  Kisii Training Centre/School
LB  Labour-based
LCU  Labour Construction Unit (Lesotho)
LGED  Local Government Engineering Department
LR  Laboratory Report (TRL)
MART  Management of Appropriate Road Technology
MRP  Minor Roads Programme
ODA  Overseas Development Administration (UK)
PIARC  Permanent International Association of Road Congresses (now known as "World Road Association")
PTO  Power Take Off
R&D  Research and Development
RARP  Rural Access Roads Programme
RSA  Republic of South Africa
SWKP  Scott Wilson Kirkpatrick and Partners

Technology Development and Research (ODA)
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<td>TDR</td>
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4 URBAN DEVELOPMENT
4.1 Labour-based contracting in the Durban Metropolitan area of South Africa

J. M. Omwansa, Lecturer, Eastern Cape Technikon, and R. D. Little, Senior Lecturer, Department of Civil Engineering, University of Natal, South Africa

1.0 INTRODUCTION

Durban is one of the major cities of South Africa. It is situated on the eastern coast of South Africa; Durban started as a tiny trading station in 1823.

1.1 Demography

Accurate population surveys carried out recently by the Urban Strategy Department of the city of Durban reveal a population of 2.3 million people in the Durban Metropolitan Area.

1.2 Infrastructure Services

There is a wide variation in the provision of services between different parts of Durban. Some parts have highly sophisticated infrastructure while some have none at all.

Durban is characterised by a generally hilly terrain, making infrastructure provision relatively more expensive than other metropolitan areas in South Africa [Tomlinson, 1993]. Frequent flooding in the area underscores the water and sanitation problems in many parts of the area which are inadequately serviced.

The level of unemployment is also very high, especially in the township and informal settlement areas. These areas are again the ones plagued with lack of infrastructure services.

Townships around the Durban city are settlement areas which range from urban/semi-urban to informal settlement areas formally administered by local councils, depending on the magisterial district under which each falls.

 Provision of services to these areas was hampered by the fact that these local councils did not have any allocation for the provision of services and that they were not able to generate enough revenue on their own to do this.

55 Urban Strategy Development Department, City of Durban.
1.3 Community Upgrading

There has been a shift in emphasis from concentrating development in a few selected areas to a systems approach to development. This has given rise to an upsurge of projects to upgrade the areas which were formally neglected.

Community/township upgrading encompasses the provision of all kinds of services but those that may interest civil engineers are water supply, sanitation, and access roads, among others.

1.3.1 Labour–Intensive Construction

In order to address the question of unemployment at the same time as community upgrading, the use of labour–intensive methods in the provision of infrastructure was considered. This was applauded due to successes achieved in a number of projects which had earlier been carried out in South Africa, and that in several nation-wide programmes in other parts of the developing world.

Two factors which are viewed with interest in the use of labour–intensive construction in South Africa are the Cost and Social Benefits in terms of employment generation and the effects this has on the overall economy of the country.

Costs

It is generally accepted that labour intensive construction methods are more costly than conventional construction (by about 10%). Equipment hire rates are at an all time low because of a recession in the construction industry [Watermeyer, 1995] and it is predicted that labour–intensive methods will be cheaper in the long run when the economic trend reverses.

Wage Levels

Wage levels are relatively high in Durban. They range from R14 to R50 (US$4 to US$15 ) per day, skewed more to the higher side.

Considering the World Bank criterion that the labour–intensive method should be used wherever the unskilled wage rate is below US$ 4, Durban then marginally qualifies to use labour intensive methods. However, considering that this criterion was put forward in 1979, inflation that will have taken place since then may have increased this figure. Assuming a compound interest rate of 4 percent per annum, the wage level above which a decision should be made will be 4 (1+0.04)\(^{16}\) which is US$7.5 (R27). This value is still below the average wage level of R35 in Durban. The current statutory minimum wage for continuing employees is R38.8 (US$ 10.8) and the one for new unskilled workers is R43 (US$12).
1.3.2 Community Involvement

While the interest of involving people in all matters that may affect them is growing in the world today, this has a greater meaning in South Africa considering its past. Indeed, it is government policy now that people have to be involved in whatever development that takes place. The degree of involvement differs from sector to sector but in the field of township/community upgrading, total community involvement is desired. The communities are involved both in decision making and implementation.

Within the short period over which community involvement has come into the limelight in Durban, some advantages and disadvantages have been observed.

For example, in the Phoenix infill project\(^{56}\), all negotiation between the City of Durban, the community and the project manager were completed and culminated in the formation of a social compact. At the implementation stage of the project, the community opposed it! Some members of the community were opposed to the conversion of open spaces, which they had started using as parking areas in residential areas and garnered support from the overall community to oppose the project. The project was thus suspended after a few months of implementation commencement as negotiations were restarted.

In one of the RKDP [Omwansa, 1995] projects, the project manager was required to repair a community social hall whose roof was leaking before the community would discuss what services and level of service they need and desire!

In the Maqumbi community water supply project, the community sacked the consultant/project manager after completing a feasibility study. Discussions held between the community, the promoter, and the manager underscored the need for a feasibility study, and it was mutually agreed that it should be carried out. However, on presenting the bill for the work, the community turned round and said they wanted water and not a study! They thus declared the consultant/manager was not wanted in that area!

Even though the field has not been adequately researched, it is felt that involving the community adds to the overall cost of the project. It is therefore worthwhile to weigh the advantages and disadvantages of full community involvement before embarking on a project and being prepared for the extra cost.

In terms of cost, some community members have to be paid to leave their daily chores and attend to project matters. They have to be

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transported to and from project meeting venues. Delays in project implementation are not uncommon due to lengthy periods taken in discussions with communities. These discussions are often centred on technical matters which the community is not well placed to easily comprehend!

1.3.3 Level of Service

In the community upgrading projects, a decision is required as to the level of service of facilities to be provided before project design and implementation commences. This decision is made by the project promoter in agreement with the community and local authority, taking into consideration the available resources from implementing the project, technical constraints, operation and maintenance costs of the facilities, and the community's ability to operate and maintain the facility (or pay for its operation and maintenance).

Level of service is the type of service or facility provided. For example, water supply to a community would be up to individual house connections [Level 4]57, or it could be a communal standpipe serving a group of housing units in the community over a given radius [Level 1]. In the case of access roads, the facility could be a paved road with kerbs and shoulders [Level 5], or just bush clearance to create an access to a given service or facility [Level 1]. Level of service is different from quality which is a measure of whether the desired standards, both workmanship and design, are achieved.

1.4 Contracting

The shift of emphasis to the use of labour based construction methods in South Africa took place when there was a lot of excitement all over the developing world concerning the development and use of small contractors for the construction and maintenance of small projects in the rural road sector.

Both the World Bank and the ILO were at the forefront in championing the development and use of small, labour based contractors for road maintenance activities58. At the same time, both the ILO and the World Bank had developed a lot of interest in informal settlement upgrading in urban areas using community participation approaches, and community contractors. A number of successful projects had been carried out in the three continents of the developing world (Asia, Africa, and South America) on a pilot basis. (Kalerwe in Kampala, Uganda, Hanna Nasif in Dar es Salaam, Tanzania etc.).

57 Guidelines for the provision of engineering services and amenities in residential township development. CSIR, Division of Building Technology. 1995

58 Labour intensive methods were initially aimed at the construction and maintenance of low traffic rural roads!
The issues of community/township upgrading, labour intensive construction and maintenance, development and use of small labour-based contractors and community involvement were therefore inevitably considered simultaneously in South Africa.

### 2.0 LABOUR-BASED CONTRACTING

Attempts have been made with some degree of success to develop and use small contractors in community upgrading projects in Durban. Government departments, Durban City Council and NGOs have tried to develop small contractors and use them on labour-based projects wherever possible. It is government policy to develop and support small businesses [Department of Trade, 1995], which includes contractors.

However, it is not a very easy exercise to develop and use small contractors, especially by clients who need to maximise output. (Government departments and municipal authorities act as clients on many occasions!). This is further complicated by the current policy that the community has to be fully involved. The issue of output maximisation has to be overlooked therefore until such a time that the contractors are fully developed and experienced for some of the liabilities of non performance to be put on them. A number of approaches have been used to overcome these constraints.

### 2.1 Contracting Approaches

Approaches that have been used for the development of small contractors include:

- Project Manager Approach
- Main Contractor Approach
- Direct Labour-Intensive Contract
- Joint Venture Approach
- Franchises.

#### 2.1.1 Project Manager

A project manager, who may be a consultant, a contractor, NGO, or a specialised project manager, is appointed to train and supervise small contractors on a project. The project manager is viewed as an extension of the client and therefore bears no responsibility. It is therefore the client who carries all the risk under this type of contract where the small labour-based contractors are used.

This approach has been used in the 8,100 sites, Besters Project at Inanda, the Phoenix Infill Project, and the Piesangs Valley Development Project [Omwansa, 1995]
2.1.2 Main Contractor Approach

An established contractor is employed as a main contractor and required to subcontract part or all of the work to small contractors. The main contractor therefore carries the responsibility for non-performance of the sub contractors. Under this arrangement, the small contractors may benefit from the experience of the main contractor who may also provide bridging finance to the small contractors who are usually riddled with cash flow problems.

An attempt was made to use this approach in the Piesangs Valley Development Project but did not succeed because the community rejected the use of small contractors with the claim that they are exploitative in nature (maybe from past experience!).

The approach is currently very attractive for conventional projects with small proportions rendering themselves appropriate for labour intensive construction. An example is the construction of the N2 freeway between Durban and Richards Bay where the main contractors were pre-conditioned to use small contractors for works like kerbing, side drainage and re-grassing the banks. Another example is the proposed Sheleni road project where some works have been prescribed for implementation by small contractors using labour-intensive methods.

2.1.3 Direct-Labour Intensive Contract Approach

Small contracts are let out directly to the small contractors. Due to their lack of experience and bridging finance to solve their cash flow problems, this approach is suitable for very small works. It has been used in a number of RKDP projects, especially in spring protection works. VIP Toilet construction in the 8,100 sites Besters Project also used this approach.

2.1.4 Joint Venture Approach

In this system, small contractors enter into joint venture relationships with major established contractors and tender for projects in which labour-intensive method of implementation is given in the specifications. The small contractor benefits from the major contractor’s experience with contracting procedures and ease of obtaining sureties and bridging finance, whereas the small contractor manages the large labour force which is feared by many major contractors who only have experience in dealing with large fleets of equipment and not large labour forces.

No such case of contracting procedure was encountered in the study area though there is evidence to suggest that it has been used elsewhere in the region and that it is viewed as a very good approach to small contractor development.
Generally, the government is encouraging small businesses to form joint ventures with major ones as a means of capacity building [Department of Trade][59].

2.1.5 Franchises
There has been a lot of talk of established contractors selling rights to small upcoming contractors to use their names at a nominal fee. No known franchise exists in Durban but word has it that a number of small contractors are operating in rural Kwazulu Natal under this arrangement.

It is not clear how this operates but it may help the small contractor in gaining confidence from potential benefactors.

2.2 Developments in the City of Durban
In the early part of 1993, a working group was set up by the two units to look into ways of effectively using labour-intensive methods in the city [James Crosswell and Associates, 1994][60]. The working group recommended that

- The city administration should adopt more flexible approaches in its tender procedures to permit the use of labour-based methods.
- Executive directors should be allowed flexibility to prescribe labour-based methods where appropriate.
- The corporation should be able to split projects into parts which can easily be handled by small entrepreneurs

Adopting these recommendations meant the acceptance of:

- The use of labour-intensive methods in city projects.
- Development and use of small contractors.

Consequently, three developments took place:

1. Executive directors were allowed to prescribe the use of labour-intensive methods and small contractors. This called for a revision of the contract procedures. Simplified documents were developed.
2. The tender procedures were also relaxed to give the required flexibility. The directors are allowed to directly give out a contract, valued up to R100,000, on condition that they obtain at least three quotations and select whichever they deem best.

3. A database of small contractors was developed by the two units. (The Physical Environment Unit, and the Water & Waste Unit). This database is updated continually. The contractors are categorised from A to C in ascending order of their capacity, and the responsibility that can be put on them. From this database, the contractors are selected and invited to tender whenever an appropriate project arises.

Among the projects that have been carried out as a result of the above developments is the Phoenix Infill Project which is discussed below.

2.2.1 Phoenix Infill Project.

Historical background of this project may be obtained from Kimber and Meyer [1996]61, and Omwansa [1995].

Work in the project comprised the extension of 14,250 m of sewer mains, 7,653 m of storm water drainage system, and 10,604 m of roadways.

An estimate for the works using conventional methods was put at R22.7 million. A feasibility study conducted in respect of using labour intensive methods and more appropriate materials resulted in an estimate of about R8.5 million.

Implementation of the project commenced in July 1995. A project manager approach was adopted for the sake of training contractors from scratch. A consulting engineer was appointed to act as the project manager but design and supervision are provided by the city council. The project manager trained the contractors who are then guided to tender for the works on simplified documents.

Institutionally, the city council acts as the client who carries out the design work and site inspection for acceptance. The project manager carries out day to day training and supervision of the small contractors, work measurement for their payment, and also organises payment from the client. With approval from the city council, the manager has developed an automated payment system in which both the contractors and their employees receive their payment directly into their bank accounts. This calls for a close association of each of the contractors and the project manager to establish the payment due to each worker depending on work output.

Notable achievements (Advantages)

- Contractors are paid promptly, on a fortnightly basis, to solve their cash flow problems. Work measurement is therefore also carried out on a fortnightly basis.
- Payments are made by electronic transfer to the labourers' accounts. Contractors only receive the money due to them, relieving them of the burden of paying the workers and the temptation not to pay on time, which may yield some problems.
- Material, tools and equipment are supplied to the contractor, hence labour only contract.
- Labour intensive methods still very successful
- The community was involved from the beginning [Kimber and Meyer, 1996; Omwansa, 1995].
- The City Council's accepting the recommended changes to implement the project by labour-intensive methods, and develop small contractors, is a milestone in itself.

Disadvantages

- The contractors are working more or less like foremen and not contractors. Due to lack of responsibility being put on them, they may never develop competitive contracting skills
- Adequate communication with the community not done at the beginning leading to a later disagreement resulting in delay of the project for some time as the parties went back to the negotiating table. [Kimber and Meyer, 1996; Omwansa, 1995].
- Project manager cost is 15 percent of project cost. Consulting engineers cost is on average 12 percent of project cost.

2.3 Support to the Small Contractors.

2.3.1 Training

A number of training institutions have offered training for small contractors [Omwansa, 1995]. These include NGOs (or Section 21 Companies) and established training institutions. Some of those that are operational in the Durban area include KwaZulu Training Trust, Sunflower Projects, Natal Training Centre, etc. The training offered ranges from technical to managerial skills.

2.3.2 Financial

The difficulties faced by small contractors in obtaining loans or overdrafts from banks or other financial institutions has long been realised. A number of arrangements have been made to overcome this. Apart from the prompt payment of the contractors on short period
intervals, some institutions offer short term loans to the contractors. These include the Kwazulu Finance Corporation (KFC), and the Small Business Development Corporation (SBDC) which are both affiliated to the Government.

3 CONCLUSION

The progress made in a short time towards appropriate labour-based construction and small contractor development in South Africa is great.
4.2 Appropriate technology management of labour-intensive work in Greater Johannesburg

Emile Horak, Director, Murray and Roberts Civils, C. Ras, Acting Director, Road Engineering, West Greater Johannesburg, and M. Dlamini, Acting Head, Metropolitan Service Delivery, Greater Johannesburg Transitional Metropolitan Council, Johannesburg, South Africa

SUMMARY
The Executive Committee of the recently established Greater Johannesburg Transitional Metropolitan Council (GJ TMC) identified various Strategic Initiatives and a dedicated short term capital fund of R92 million to address imbalances and shortfalls in services in the Greater Johannesburg area. Strategic foresight work in labour-intensive friendly road construction technologies was implemented during these strategic interventions. Waterbound Macadams, Slurry Penetration Macadams, Foamed Bitumen with natural gravel and Gravel Emulsified Mixes (GEMs) were used on ‘unbundled’ road contracts in Greater Soweto funded by the 1995/96 budget. This ‘gearing up’ of RDP and Public Works Programme work led to the development of fast-track labour-intensive construction technologies. Machine-intensive construction was mixed with the identified appropriate labour-intensive construction technologies to deliver cost effective good quality end products. The community and emerging contractors were involved in approximately 70 percent of the total value of work on these ‘unbundled’ labour-intensive contracts. A cost analysis showed that such intelligent mixing of appropriate road construction technologies could compete cost effectively with normal standard road construction with the same high quality end products.

INTRODUCTION
The Greater Johannesburg Transitional Metropolitan Council (GJ TMC) was established on 8 December 1994. This development took place in a political and social climate where there were great expectations regarding equitable service delivery across the whole area of the newly established GJ TMC. The newly elected Executive Committee of the GJ TMC, at a strategic breakaway in February 1995, evaluated the situation regarding service delivery and found that there was a severe imbalance in service delivery and standards across the GJ TMC area. The Executive Committee identified the need for strategic initiatives to intervene and restore service delivery.

A R92 million Strategic Initiative capital fund was created by the Executive Committee from savings on the 1994/5 capital budget. The
intent with these Strategic Initiatives was to address imbalances in service delivery, levels of service and distribution of resources in the newly established GJTMC area. The distortion of service delivery was so severe in a number of cases that it had to be given emergency attention. The delivery process was fast-tracked by streamlining the calling for tenders and contract awarding process of the Council. Coordination and management were done by Metropolitan Service Delivery.

As much as 60 percent of the funding was allocated to the provision of basic services like roads, stormwater, water and sanitation. With the exception of the CBD upgrade initiative, the full force of the Strategic Initiative was to focus on the traditionally disadvantaged areas like the Greater Soweto area, Alexandra and informal settlement areas.

ROADS AND STORMWATER BACKGROUND

The Roads Directorate of the Johannesburg Administration of the GJTMC took a strategic foresight decision in 1993 to prepare for a situation where labour-intensive technologies can be implemented (Horak et al, 1995). Research was done on areas like labour-intensive maintenance procedures as well as various labour-intensive construction activities. The focus of this preparatory work was on road construction, but valuable work was also done on stormwater facility construction (Balmaceda, 1995).

Waterbound macadam roadbase construction was identified as a labour-intensive construction friendly technology which also provided acceptably high quality end products. The majority of roads in the old Johannesburg were constructed using Macadam construction with very good structural capacity and good performance over more than 40 years (Horak et al, 1995). This construction technology had to be re-introduced in a labour-intensive application situation. Own work forces were used initially to effect a smooth technology transfer. A pilot project of 150 metres on Xavier Street was followed by a 300 metres plus labour-intensive ‘gearing up’ project on Club Street in Johannesburg (Calitz, et al and Horak, et al, 1995).

In parallel with this, other labour-intensive Waterbound Macadam construction was monitored in 1994/95 in Kliptown, funded by the then Central Witwatersrand Regional Services Council (CWRSC) (Gertzen, 1996). Other technologies, with possible labour-intensive friendly application, were also identified and monitored as applied elsewhere.

The work done in preparation for an official National Public Works Programme (NPWP) at local government level in the GJTMC proved to be fortuitous. The R92 million Strategic Initiatives provided an ideal opportunity to implement technologies identified and to manage the implementation in a programmed approach.
A prerequisite for the credible advancement and application of labour-intensive work is that it must deliver durable, high quality end products. A Choice of Technique Analysis (COTA) should preferably be done to ensure that the appropriate mix of technologies is used in the most economically viable way in the situation being planned for (Pintusewitz et al, 1994). The strategic foresight research and technology transfer work done (mentioned previously) indicated that there are a number of technologies which optimally utilise labour-intensive applications and deliver durable, quality end products.

MACADAM TYPE CONSTRUCTION

It is well known that large stone (aggregate) type base construction has a track record of high quality bases with good performance. It has historically also been done labour-intensively, although efforts were later made for it to become more machine-intensive (Horak, 1983). These sections were tested extensively with the Heavy Vehicle Simulator (HVS) of the DoT. (Horak and Triebel, 1986). Waterbound Macadam construction experienced a revival as a good labour-intensive construction technique in the early 1990's (Philips et al, 1991). Waterbound Macadam is historically the most well known of these Macadam type construction techniques. It is basically a single sized aggregate of 63 or 53 mm with a maximum size of 75 mm with a typical gap grading and virtually no aggregate below 19 mm size. Typical gradings and material qualities are specified in TRH14 (CSRA, 1985). Macadam bases get their structural strength from the large single size aggregate interlock which ensures high internal angle of friction. Traditionally the large aggregate is hand-laid with ballast forks on a prepared subbase.

After initial levelling of the large aggregate layer, it is sometimes compacted, prior to the voids being filled with fines, more recently, vibratory rollers are being used (Horak, 1983). Fines with a prescribed grading (TRH14), (CSRA, 1985) are then spread on this layer to flow into the voids to provide stability for the large aggregate matrix. Traditionally, the fines had high plasticity indices. A clay soil, for instance, was used in the technology transfer on the Xavier Street project ((Calitz et al, 1995). This type of material and associated construction technique (thin layer applications, dried in the sun, vibrated in with typically Bomag 90 compactors until all voids were filled) was ideal for the waterbound slushing finishing as water could not penetrate the base and influence or cause failure of unstabilised subbases. Subbases are mostly stabilised to provide good work platforms, but historically prior to the 1960's to 1970's, subbases were not stabilised. Later, (as in the Club Street project) fines which adhere to the TRH14 specifications of limited plasticity (CSRA, 1985) were used. Such roads require a stabilised subbase to counter the possible penetration of water through the base during the slushing...
action. A Waterbound Macadam constructed with such fines can sometimes be used as a designed drainage layer due to its high permeability (Horak and Triebel, 1986).

The concept of **Drybound Macadam** was developed, partly based on the work done on Club Street with cohesionless mine sand as a filler (Calitz, et al, 1995). In essence, a Macadam base with its voids filled with low plasticity sand and vibrated in does not need to be slushed as there is already aggregate interlock and the fines only enhance internal matrix stability. It is believed that the slushing waterbound action in the past was in the absence of vibratory rollers which ensures the void filling without water application. Drybound Macadam does, however, leave a surface which can easily be disturbed by construction traffic. A thin slurry layer as a work platform can alleviate this problem. Previous work done for the DoT (McCall et al, 1990) developed a kind of slurry penetration which fills the top 10 to 25 mm of exposed large aggregate voids as a type of penetration hybrid Macadam.

This can serve as the riding surface and is labour friendly in application. It is believed that such construction techniques enhance low water needs in construction which could be applicable in drought stricken areas of South Africa. Considerable work was also done on more realistic material hardness specifications and tests for large aggregates (Roux, 1993). This offers the scope for the use of material for large aggregate construction which is presently classified as marginal. Natural gravels offer great potential to be used as quality macadam type base construction. More research work is required in this area.

**Penetration Macadam** developed from waterbound macadam construction, due to the need for a waterproof surfacing in the 1950's. These types of Penetration Macadams performed very well over the years. The voids in the prepared large aggregate base were filled by hand with hot bitumen or tar binder and later by mechanised spray bars. The development of a cold bitumen process (Potgieter et al, 1995) enhanced the labour friendliness of this construction process considerably. This type of slurry penetration construction requires a layer of only 75 mm. A very light vibratory plate compactor is needed which enables a lowering of the entry barrier for emerging contractors with only about R3,000 to R10,000 worth of equipment needed initially (Potgieter et al, 1995). This also enhances the concept of machine-absent construction as a first step towards small, medium and micro enterprises (SMME's) empowerment. This type of revitalised and modernised slurry penetration Macadam construction is also referred to as slurry bound macadam (SBM). Surfacing types, such as slurry surfacings, which are labour-intensive friendly, have been used on these Macadam type road bases (Balmaceda et al, 1995). Sand seals and chip and spray has the same potential.
GRAVEL EMULSIFIED MIXES (GEMs)

GEMs is the modification of medium to marginal quality natural gravels with the addition of 2 to 3 percent emulsified bitumen, 1 to 2 percent of cement and sometimes 1 to 2 percent lime. GEMs were developed from research funded by SABITA and tested under the Heavy Vehicle Simulator (HVS) (Grobler et al, 1994 and De Beer and Grobler, 1995). Guideline documents on the mix design, specifications and material tests were also provided via this SABITA funded technology transfer action (SABITA, 1993).

The CSIR proved that this quality end product was well suited for labour-intensive friendly construction (Hendriks, 1995) on a pilot project in Phutaditjaba in Qwa Qwa in the Orange Free State. This type of base does not need immediate surfacing applied to it and is able to be opened to traffic virtually immediately. Even though HVS tests proved that it can carry considerable traffic (2 to 3 million standard 80 kN axles), it is believed that GEMs would be best suited for local streets (access streets) and not major streets (major collectors) or bus routes. The traffic friendliness during construction makes it ideal for construction in an urban environment where residential area access can be provided even during construction. This type of base construction has the advantage that it can also be done in a machine (heavy) absent construction way. The natural gravel is mixed on site in batches and typically constructed in layers of 75 mm with manual labour. It is also ideal for appropriate surfacing types ranging from slurry surfacing to sand seals to chip and spray done labour-intensively.

FOAMED BITUMEN

Bitumen binder, when heated to 165°C and with 2 percent diatomised water added in a small chamber, just prior to its being sprayed through a nozzle, foams and increases its volume more than tenfold. In this foamed state, it is sprayed through a special nozzle.

At this stage it also has low viscosity which enhances good mixing with aggregates. It keeps this foamed state for a period of, on average, 40 seconds before it reverts back to its original volume. The mixing in with the aggregate is, therefore, achieved in typically a pugmill within the predetermined half life of the foamed state (±20 seconds). Once the foamed bitumen is mixed in with the aggregate it cools off and can be placed immediately or stock piled for up to 2 or 3 months before beingconstructed in a layer (Lewis et al, 1995 and Hotte, 1995).

Considerable research work was done on this technology to stabilise cohesionless sands in Namibia, Botswana and recently on the Makhatini Flats sands in KwaZulu-Natal (Lewis et al, 1995). The emphasis has, however, lately shifted to using recycled concrete and
natural gravels (Hotte, 1995). The potential for this material to be used labour-intensively with natural gravel, was proved on a number of community based construction projects in KwaZulu-Natal (Lewis et al, 1995). The stock piled material is constructed like any natural gravel by compacting a moistened mixture with small Bomag type compactors in layer lifts of 75 to 100 mm.

The technology transfer of foamed bitumen in KwaZulu-Natal, was monitored by the Roads Directorate. Available waste materials and natural gravels were also tested in the laboratories of Bitutek (KwaZulu-Natal) and the Roads Directorate (Hefer, 1995). Specific attention was given to the shelf life or stock pile life of the prepared natural gravel foamed bitumen. This was considered important as the mobile plant to produce foamed bitumen can produce large quantities at a strategically positioned borrow-pit whereafter construction can be done from the stock piles at a different tempo. Initial results proved the potential for good shelf life (Hefer, 1995). Natural gravel sources, with the preferred grading (Lewis et al and Hefer, 1995) were not readily available initially in the Greater Soweto area. Consultants were appointed whereafter good quality natural gravel was located. A borrow-pit or material management project, to manage natural gravel in the Greater Soweto area, was subsequently initiated which will alleviate similar problems in future.

Work done in KwaZulu-Natal, indicates that foamed bitumen, with natural and recycled asphalt, is not only labour-intensive construction friendly, but also traffic friendly during construction. It can be opened to traffic immediately after initial compaction with further benefits to compaction. It can also be phase constructed with no surfacing required in medium to low traffic volume situations (Lewis et al, 1995). Labour-intensive surfacing friendly construction, like sand seals, slurry seals or even chip and sprays, are also ideal surfacing types.

BALANCING APPROPRIATE TECHNOLOGIES AND CAPACITY BUILDING

The pressure for visible service delivery in the period leading up to the November local government elections necessitated the speeding up of delivery. The concept of fast-track labour-intensive construction was developed to balance these contradicting requirements.

Fast-track labour-intensive construction sounds like a contradiction in terms. It actually means that the elements of machine-intensive construction techniques are used in the niche where labour-intensive technology does not compete effectively. Labour-intensive elements are used where good quality end products are ensured plus a retention of high money content in the community. With regard to fast-track delivery, local labour and emerging contractors cannot economically,
efficiently or effectively construct earthworks to bring the road to subbase level in a short period of time. These conventional construction activities (machine-intensive) only make up approximately 30 percent of the contract amount.

The consulting engineers were instructed to prepare the tender documentation for projects to specifically provide for a main contractor to construct those parts of the work above the subbase layer, which make up approximately 70 percent of the contract amount. The type of road works scheduled for labour-intensive construction included waterbound, drybound and slurry bound macadams (SBM), foamed bitumen (FB) and gravel emulsified mixes (GEMS). These latter two labour-intensive friendly construction techniques are viewed as experimental and in need of further technology transfer management. Only pilot projects were done with these technologies. A separate contract was let for the manufacture of the foamed bitumen with good quality natural gravel in Soweto. A total of 4,000m³ of natural foamed gravel was produced to be used by various contracts in pilot project fashion.

The Executive Committee of the GJ TMC, additionally, gave instructions to ‘unbundle’ the contracts in order to ensure that as many emerging contractors or local labour as small, medium and micro enterprises (SMME’s) could be incorporated in the work given out. Consequently, tenders were invited for five areas in the Greater Soweto area with budgets limited to about R3.6 million of actual work in each area. In the true spirit of the RDP and Public Works, even the consultant teams were appointed with capacity building in mind. Established firms with expert knowledge in the field of labour-intensive technology and the preferred technologies of the client formed joint ventures with previously disadvantaged firms.

Established contractors acting further as managing contractors, using sub-contractors and emerging local contractors for labour-intensive work on the base and surfacing work, was further part of this ‘unbundling’. The same was true of related stormwater work (e.g. kerbing cast in-situ). Soweto administration has done valuable work in the past on emerging contractor development (Watermeyer et al, 1975). It was discovered that, due to the lack of familiarity with the construction techniques used with Waterbound Macadam, SBM and specifically foamed bitumen and GEMs, these contractors had to receive strong assistance initially with the construction to transfer skills properly.

The managing contractors developed a mix of day work and task based workers to become fully fledged sub-contractors. This enabled the workers to acquire the skills necessary for the next possible set of contracts. The necessary training of the emerging contractors on contract administration, the tendering process and pricing of documents were also done to capacitate them for future projects.
CONCLUSION

The R92 million capital fund, to address Strategic Initiatives in the Greater Johannesburg Transitional Metropolitan Council (GJ TMC), created an opportunity to apply RDP and National Public Works Programme (NPWP) objectives. It also created the opportunity to implement appropriate technologies in the roads and stormwater field which were identified via strategic foresight actions.

An audit on such appropriate user friendly labour-intensive technologies showed that there are a number of such technologies available. These selected technologies were used on pilot projects in the GJ TMC and proved that, if applied in identified niche areas, good quality end products are possible, which enhances the image of labour-intensive work in general.

An intelligent mix of machine-intensive, normal construction techniques by established contractors, with labour-intensive, small plant-intensive (or big machine-absent) construction has led to the development of the concept of fast-track labour-intensive construction. Up to 70 percent of the total contract worth can be done labour intensively with obvious benefit to the community from which the emerging contractors come.

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4.3 Kawangware road improvement and the lessons learnt

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INTRODUCTION

Kawangware, the project area, is an urban slum situated about 10 km west of Nairobi city centre. It is bordered by the posh Lavington to the east and Dagoretti to the west.

It is served by Gitanga Road which is of bitumen standard and of fairly good condition save for a couple of potholes and blocked drains.

Kawangware harbours a population of urban poor whose housing is mainly composed of temporary structures fabricated out of corrugated iron sheets for both walls and roof. A common family dwelling is one room in such a structure.

Facilities for waste collection are absent in this area. It is therefore dotted with heaps of garbage and shallow toilets with overflowing sewage.

It is in this slum that an NGO known as the Institute of Cultural Affairs (ICA) has set up a project under the name of Kabiro Youth Polytechnic. The polytechnic trains the youth from the slum in various skills such as carpentry and joinery and produces such items as solar jiko (cooker), and furniture which are then sold to generate funds for the polytechnic. The objective of this training is to equip the youth with such skills as can enable them to start self-employment.

In addition Kabiro houses a primary health care programme covering the two administrative locations of Kawangware and Riruta Satellite. This programme, sponsored by USAID/CEDPA (Centre for Development and Population Activities) since 1979 provides the following services to these two communities:

- Immunisation
- General treatment
- Education for sanitation and breast feeding
- Family planning and
- Counselling of HIV/AIDS prevention

Hence the objective of the Kabiro Road was to provide linkage with the main Gitanga road to facilitate better communication between the centre, the community it serves and the rest of Nairobi city centre.
**PROJECT DESCRIPTION**

The Kabiro Youth Polytechnic is joined to Gitanga Road by about 400 m length of partly track and partly completely deteriorated bitumen standard road.

From Gitanga Road, the first 200 m length of previously bitumen standard road had completely deteriorated such that at sections, residents had even erected their dwellings or business kiosks on it. The drainage was not there. Trouble spots were either dotted with stones or gullies. Access here was only by lorries bringing merchandise such as charcoal or building materials or by four wheel drive vehicles.

The next 200 m was indeed a track. No road ever existed here before. Temporary dwellings were erected without planning thereby reducing the track to even less than 4m width at sections.

Generally, the area had slow self draining characteristics but which emptied its water just beyond the polytechnic.

The soil along the whole length of 400 m is red coffee soil, but which changed to black cotton soil just after the polytechnic.

The whole 400m length section was littered with garbage all along. Waste water from domestic consumption was often emptied into this area.

Nairobi, the project area, has an altitude of 1,798 m with an average rainfall of 1,058 mm per year. The highest rainfall is experienced during the period April to June of every year.

**SCOPE OF WORK**

From the very onset it was assumed that at best this was an access road and that at an appropriate time the Nairobi City Council would upgrade the road. It therefore needed limited engineering design covering alignment, drainage and compaction. The technological level to be adopted was such that more labour-intensive methods could be used.

- A new alignment was proposed to avoid the problem of having to ask the residents to pull down their dwellings. Tensions are usually high whenever demolitions have to be called in. In the last 200 m sections, residents were required to relocate their fences to allow a maximum possible 6 m width.
- Land acquisition was ruled out on account of limited funds.
- A completely new drainage was required for the whole 400 m length of road. After consideration of cost, availability of skill and project duration, it was agreed that the drainage be constructed with invert concrete drains, and sides lined with stone masonry.
The size was enough to cater for an expected discharge of about 0.035 cubic metres per hour.

- The classification of Kenyan subgrade material shows that red coffee soil (red friable clays) fall within class S3 - S5 (at 4 days soak or at onerc) with a CBR of 7 - 13 for S3 or 10 - 18 for S5 and are recommended for subgrade material.
- Further such material are recommended for subbase construction if their CBR at 95 percent MDD (modified compaction) and at 4 days soak is at least equal to 30 percent.
- Natural gravels for base shall have a CBR of at least 80 at 95 percent MDD (modified AASHTO) and after 4 days soak. It is also reported that natural materials meeting these requirements are very scarce in Kenya.
- The road base was a 150 mm gravel (murrum) stretch from an approved but not tested quarry about 4 km away. The gravel was supported at the edge with stone kerbs with joints not completely filled the full height to allow for free drainage of the gravel layer. It was observed that subsequent lorry loads passing over laid gravel did not break up the gravel but simply compacted it.
- The sub-base was to be built of material obtained from the side drains through ditching and backsloping at the existing moisture content. It was estimated that this would give an uncompacted camber of about 10.47 percent crossfall.
- Over a period of time, residents of the area had constructed water pipelines criss-crossing the project area and which needed to be relocated in some sections.
- The project needed to generate employment for the community as an additional social benefit and as a result it was decided that a labour approach was technically possible. In addition, the size of the working area was too small to allow any form of construction machinery other than a roller for compaction.
- Finally, a priced bill of quantities was produced for a project estimate of Ksh.1,531,200. The work commenced on 3/7/95 and was scheduled to take four weeks.

**IMPROVEMENT WORK**

Key activities which were identified for this improvement work included:

- setting out
- excavating waste dump
- cutting away waste dump and spreading
• 256
• filling excavated mud spots with hard-core
• ditching
• camber formation
• initial compaction
• gravel base
• final compaction
• constructing side drains
• constructing culverts

EXCAVATION
This activity concentrated on the stripping of the top 150 mm of spots dotted with vegetation growth. However it turned out that more waste dump had been deposited on the route and this became the main activity on excavation. A spoil area was identified beyond the polytechnic about 400 m away from the start of the road.

FILLING MUD SPOTS
This was a kind of spot improvement activity to allow subsequent passage of required material on site. Mud spots were excavated till firm bed was reached. Hardcore filling from local stone quarry was brought in and handpacked to fill the excavation. Layers of about 300-400 mm were filled with such hardcore then gravel was put on top before compacting. This was repeated until the excavated section was level.

DITCHING/CAMBER FORMATION
To initially obtain material to raise the road level and lower the ground water table, a trapezoidal ditch of about 1200 mm top by 400 mm bottom by 400 mm high was proposed giving an uncompacted crossfall of 10.47 percent. This was followed with the first compaction.

GRAVEL BASE
An untested gravel 150 mm thick but from an approved quarry previously used for construction was used in building the road base. This gravel spread to the previous camber of the compacted sub-base and supported at the edges with a line of stone kerbs with open joints at every 1m length was wetted and compacted with a minimum three passes of a 5 ton vibrating self propelled roller.
Local women’s groups were hired to supply water and sprinkle on the laid gravel and after about one to two hours compaction was applied.

Seven months later the crossfall has been found to average 4-10 percent.

**SIDE DRAINS**

The side drains were constructed with concrete invert drains 600 mm by 450 mm by 225 mm with the inside diameter of 300 mm. The drain sides were lined with stone masonry.

A total 1,360 mandays were consumed during the six weeks period.

**MATERIALS**

The following material quantities were used:

<table>
<thead>
<tr>
<th>Item</th>
<th>Estimate</th>
<th>Actual</th>
<th>Total Cost (Kshs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td>138 bags</td>
<td>208 bags</td>
<td>84,820.00</td>
</tr>
<tr>
<td>Sand</td>
<td>15 m³</td>
<td>35.2 m³</td>
<td>48,000.00</td>
</tr>
<tr>
<td>Ballast</td>
<td>30 m³</td>
<td>44 m³</td>
<td>57,000.00</td>
</tr>
<tr>
<td>Building stones</td>
<td>6,400 ft</td>
<td>10,000 ft</td>
<td>148,000.00</td>
</tr>
<tr>
<td>Gravel</td>
<td>240 m³</td>
<td>598</td>
<td>498,500.00</td>
</tr>
<tr>
<td>Invert chains</td>
<td>1600</td>
<td></td>
<td>414,400.00</td>
</tr>
<tr>
<td>Quarry fines</td>
<td>240 m³</td>
<td>75 m³</td>
<td>51,000.00</td>
</tr>
<tr>
<td>Culverts</td>
<td>35 cm diameter</td>
<td>80</td>
<td>73,800.00</td>
</tr>
<tr>
<td></td>
<td>60 cm diameter</td>
<td>82</td>
<td>21,000.00</td>
</tr>
<tr>
<td>PVC Pipes</td>
<td></td>
<td></td>
<td>4,600.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td><strong>1,401,120.00</strong></td>
</tr>
</tbody>
</table>
Costs

The improvement cost for the 400 m road can be broken down as follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost (Kshs)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td>189,465.00</td>
<td>10.1%</td>
</tr>
<tr>
<td>Material</td>
<td>1,401,120.00</td>
<td>75%</td>
</tr>
<tr>
<td>Equipment hire</td>
<td>68,500.00</td>
<td>3.7%</td>
</tr>
<tr>
<td>Tools</td>
<td>50,000.00</td>
<td>2.7%</td>
</tr>
<tr>
<td>Supervision</td>
<td>101,000.00</td>
<td>5.4%</td>
</tr>
<tr>
<td>Others</td>
<td>58,049.00</td>
<td>3.1%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,868,134.00</strong></td>
<td></td>
</tr>
</tbody>
</table>

Conclusion

In tackling the project over a 6 week duration at a cost of Kshs. 1,868,134.00, the following lessons have been learnt.

i. Due to high rate of unemployment, there was a very high pressure from the local people to take over the short employment opportunity. In fact, there was a specific request not to allow the notice go beyond the actual project site area.

ii. There was difficulty in choosing skilled labour. First there were only a few masons showing up with or without proof of skill. Time was lost in assessing their skill by giving out trial sections. Next when the rates were adjusted from Kshs. 150 to 200 to attempt to attract more, good turnout was experienced. Then there was an attempt to go slow to realise more money since it was evident that the project was soon coming to an end.

iii. Routine maintenance needed to be set up immediately. The approach needed to reflect on a bilateral arrangement between the Youth Polytechnic and the community. Every household along the road was going to use the side drains for emptying regular domestic fluid waste. Hence the agreement to maintain every position next to the dwelling. However, this was to be supplemented by at least twice weekly regular drain cleaning by contractors from the polytechnic.

iv. The problem of the waste dump was huge. In preparing estimates for the work, this item needs a very careful assessment and might even be considered an extra activity. Perhaps there was need for a parallel programme to tackle the waste dump.
v. The abundant labour force is without any skill. There is a need to allow for a short training period on procedures for carrying out various activities. For example, the constraint in emptying water from the side drains or culverts, means that urban road improvement requires more consideration of waste channels than rural roads and training must consider this seriously. Replacing operators and machines with labour and tools to produce similar results must equally receive training.

vi. The scope for developing small labour contractor capability seem to be abundant. Most roads in residential areas seem to have problems of potholes, fully silted side drains, and blocked culverts. These problems can be tackled by a labour contractor with gangs only equipped with basic tools and a manually operated bitumen sprayer with perhaps some form of heating. The approach herein taken could well provide a training field for such would be contractors.

vii. The following improvement rates were calculated:

- Cost per Km = Kshs. 4,670,335
- Total Labour = 1,360 mandays
- Productivity = 3,400 mandays per Km

viii. Other benefits observed taking place adjacent to the project area were like new housing structures and more kiosks. The Kabiro staff have also put aside their rubber gum boots.
4.4 Research and development in labour-intensive construction of medium to heavy volume trafficked roads in South Africa

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INTRODUCTION

South Africa is a highly urbanised country in comparison to the rest of Sub-Saharan Africa (SSA). The bulk of infrastructure is also concentrated in the urban areas. South Africa's political history of decades of apartheid led to the lopsided development of different infrastructure standards for the different races with the lowest standards for the majority black population.

Unemployment in the country is very high at 35-50 percent. The elections in 1994 that brought about democratic rule have led to high expectations in the formerly disadvantaged communities with respect to job creation and infrastructure provision. The base document that describes the new development direction in South Africa today is the Reconstruction and Development Programme (RDP) (ANC, 1993) that emphasises meeting the basic needs and growing the economy. The nation now emphasises job creation in all its programmes and policies. Similarly, the development of small, micro and medium enterprises (SMME's) is given serious mention. Labour-intensive construction methods have been identified as being key to the development process as conceived in the National Public Works Programme (NPWP) (Kwesiga et al, 1995).

Traditionally in South Africa, road construction and maintenance has been machine intensive and the research and development in this area is of very high international standard. There was historically a deliberate effort to reduce the use of labour and encourage the increased use of machines. The road construction industry today is dominated by a few large plant-intensive contractors. With the new development emphasis directed to the use of labour-intensive methods and small contractors in the delivery process, there has arisen an urgent need for increased research and development in this area.

RATIONALE FOR RESEARCH

The research in South Africa is largely focused on medium to highly trafficked surfaced roads for the following reasons:
a) More money is being allocated to the construction, rehabilitation and maintenance of surfaced roads and gravel roads at local, provincial and national levels. The proposed new massive urban housing construction programme will produce an increased demand for new surfaced roads. There is also a greater demand by the communities for the upgrading of township roads to surfaced standard.

b) There is therefore greater scope for employment creation in the medium to higher volume roads than in gravel and earth roads. A small increment in the percentage of the costs going to labour creates more employment in the high volume roads than a corresponding increase in gravel roads.

c) High standards of construction are required similar to those existing ones that have been established for machine-intensive construction.

d) The risks associated with failure of these roads are higher because of the large amounts of money at stake. Small contractors who have little or no experience are to be involved in the delivery process.

**RESEARCH AREAS**

Research and development play a significant role in resolving transportation and broader national problems. The research areas have largely evolved as either crisis resolution or demand driven to provide technically sound and economically efficient labour-intensive road construction and maintenance of medium to highly trafficked roads. Theoretical technical research and pilot project studies have been carried out on basecourse materials such as waterbound macadam (Horak, 1996, Phillips 1994), penetration or bitumen bound macadam (Potgeiter, 1995), granular emulsion mixes (GEMs) or emulsion treated bases (ETBs) (SABITA, 1993), foamed bitumen, block paving; labour-intensive application of bituminous surfacings such as slurries and dust palliatives (SABITA, 1994).

**RESEARCH BODIES**

The research is being carried out by a number of organisations including universities such as the University of the Witwatersrand (McCutcheon, 1996), the Council for Scientific and Industrial Research (CSIR), private bitumen manufacturers such as COLAS Ltd and a small number of private civil engineering consulting firms. Some of the research is commissioned by the national Department of Transport, South African Bitumen and Tar Association (SABITA), the Development Bank of Southern Africa (DBSA) client organisations such as the Greater Johannesburg Transitional Metropolitan Council (GJ TMC) (Horak, 1996).


**Research Output**

The research has produced some guidelines, design data, specifications for design and construction by clients using force account operations, large contractors, project managers and small contractors. Seminars, workshops and conferences to disseminate the findings to a wider audience have been and continue to be held, organised by the University of the Witwatersrand, the CSIR, SABITA and the Annual Transportation Convention (ATC). This research has proved that it is technically feasible to increase both the scope and the percentage of labour in the construction and maintenance of medium to heavily trafficked surfaced roads, and is now slowly forming a nucleus of technological capacity in this area.

**Research Implementation**

One of the major problems of research is the implementation of the research findings. A delivery system to implement the research findings is of crucial importance otherwise the findings will remain mere publications. Firstly, a major client must be committed and willing to undertake the implementation with its associated costs and risks and secondly, a champion must exist within the client organisation to spearhead and carry forward the process. In this regard the Greater Johannesburg TMC Roads Directorate has led the way, in building capacity within its internal technical staff through their participation in the conceptual design, pilot projects and undertaking experimentation with the use of small contractors on a number of projects. The national Department of Transport (DoT, 1996) and the Department of Public Works have in policy committed themselves to the use of labour-intensive methods and SMME’s in the delivery of infrastructure, but no pilot projects involving surfaced roads have yet been commissioned.

**Use of Small Contractors**

Horak (Horak, 1996) describes the use of small contractors (emerging contractors) in the Greater Johannesburg area in the Fast Track Projects in Soweto. Similar experimental work with waterbound macadam, penetration macadam and GEMs is ongoing in a few other areas of the country. The technical feasibility of using small contractors in high volume roads in an urban environment and for medium to high volume surfaced roads has now been demonstrated.

The approach adopted has been to construct trial sections using directly employed labour under council departmental staff to test and refine the construction methods, and then put out the work to open tendering. The delivery systems used range from using a managing contractor who support and supervise small contractors, to conventional arrangements where the small contractors are...
subcontractors. There has also been an attempt to build the capacity of emerging consultants in the form of joint ventures with existing large consultants. However, some projects have continued as force account operations with the hope that the training and experience gained by the local labour will enable them to in future turn into contractors.

These attempts have been experimental and of a project nature. There are problems in productivity monitoring, reporting and quality control. There has also been problems experienced by small contractors in tendering such as in one case, of the 15 emerging contractors who tendered, only five understood what was required with respect to documentation and scope of the work (Weinmann, 1995). This calls for longer and better programmed training in tendering methods, productivity improvement, construction methods and quality control.

RECOMMENDATIONS

There is a need for a holistic approach to transportation research and development that looks at the broader picture set within the national objectives, the existing research, the gaps and the implementation of the findings.

In comparison to the amount of money being invested in road infrastructure, South Africa spends only a small percentage on research. With the introduction and reintroduction of labour-intensive friendly construction methods and materials, more funds need to be allocated to this research.

There is a need for a national strategy for the development of small contractors in the road sector. There is a need to define and provide training and support of contractors.

Independent evaluation of the implementation of the research work on the pilot projects so far carried out is necessary.

There is a need to adopt a long term programme at both the national and local levels to avoid the ‘syndrome of recurring pilot projects’.

There is a need for a large national multi-site research and implementation project in the line of the World Bank's study on the substitution of labour for equipment with work and method studies being carried out to set productivity norms and refine design and construction methods for medium to high volume roads.

A new risk management approach that encourages risk sharing must be adopted to take care of the twin introduction of small contractors and ‘new’ construction materials and methods.

The major obstacle to technology transfer is the lack of capacity to utilise the technology. This calls for greater attention to be paid to more human resources development in this area, capacity building of
the clients and consultants and technology transfer both within South Africa and in the Sub-Saharan Africa region.

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