Selective Experience of Training, Contracting and the Use of Intermediate Equipment for Labour-based Roadworks

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MANAGEMENT OF APPROPRIATE ROAD TECHNOLOGY

in association with

ILO

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Contents

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Preface: The Mart Initiative

The Management of Appropriate Road Technology (MART) initiative aims to reduce the costs of constructing, rehabilitating and maintaining road infrastructure, and vehicle operations in economically emerging and developing countries (EDCs). It is based on a research project funded principally by the Department for International Development (DFID) under its Technology Development and Research (TDR) provision. The initiative is led by the Construction Enterprise Unit of Loughborough University's Institute of Development Engineering, in association with two UK-based specialist consultants Intech Associates and I.T.Transport. The MART programme is currently implementing its initial 3 year programme.

The MART programme is concerned with supporting sustainable improvements in road construction and maintenance in developing countries. This implies the effective use of local resources, particularly human resources and readily available intermediate equipment (especially wheeled agricultural tractors and related ancillary equipment). To optimise the use of scarce financial resources, it also requires the effective mobilisation of the indigenous private sector (particularly small domestic construction enterprises), and the application of good management practices in both contracting and employing organisations.

The current phase of the MART programme will *inter alia* draw together existing expertise in labour - and intermediate equipment-based technology and the development of private construction enterprises to produce a series of guidelines on the four priority topics of:

- handtools;
- intermediate equipment;
- private sector development; and
- institution building.

The MART initiative is strongly research-based, and both the DFID and the MART partners see its main impact as providing analysis and codification to support practical project initiatives. Thus much of the output will be in the form of journal papers and other formal publications suitable as reference material and providing an independent and reliable record of the advancing state of the art. However, the MART team also appreciate the need to respond to the demand for preliminary information and data through the series of MART working papers. This paper is based on responses to questionnaires by staff working on national projects. Whilst we have not had the opportunity to fully cross check and reconcile the data, we feel that the conclusions are broadly valid and may be of assistance to promoting further work on these neglected topics.

MART welcomes dialogue with engineers, equipment designers and manufacturers regarding designs, products or experience of intermediate equipment with the objective of the promotion of a sustainable road sector technology and management approach for EDCs. MART partners can be contacted at; Institute of Development Engineering, Loughborough University, Loughborough, LE11 3TU, UK. Fax 01509 211079

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Abbreviations

ADB	Asian Development Bank OR African Development Bank
AGETIP	Agence d'execution des travaux d'interet public contre le sous emploi
ASIST	Advisory Support, Information Services and Training
CTP	Construction Technology Paper (ILO Geneva)
DANIDA	Danish International Development Agency
DCP	Dynamic Cone Penetrometer
DFID	Department for International Development (formally ODA)
DFR	Department of Feeder Roads (Ghana)
EDC	Economically emerging and Developing Countries
EQP	Equipment
EU	European Union
ETEAN	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
FINNIDA	Finnish International Development Agency
ILO	International Labour Organization
ITT	I. T. Transport (Consultants)
KfW	Kreditanstalt Fur Wiederaufbau
KTC/KTS	Kisii Training Centre/School
l-b	Labour-based / labour and light equipment based
LGED	Local Government Engineering Department
MART	Management of Appropriate Road Technology
MRP	Minor Roads Programme
NORAD	Norwegian Agency for International Development
ODA	Overseas Development Administration (UK)
PIARC	World Road Association (previously the Permanent International Association of Road Congresses)
PTO	Power Take Off
R&D	Research and Development
RARP	Rural Access Roads Programme (Kenya)
SIDA	Swedish International Development Agency
TDR	Technology Development and Research (DFID)
TRL	Transport Research Laboratory (UK)
UNDP	United Nations Development Program
USAID	United States Agency for International Development
UST	University of Science and Technology, Kumasi (Ghana)
WB	World Bank
2WD	Two Wheel Drive
4WD	Four Wheel Drive

1. Summary

The International Labour Office (ILO) and the Management of Appropriate Road Technology (MART) Initiative both recognise the need to achieve sustainable improvements in road construction and maintenance making effective use of the private sector and the optimum use of local resources and skills. In order to obtain an overview of the current practices in labour and light equipment based (l-b) roadworks in developing countries the MART programme team, in association with the ILO, devised 2 questionnaires to be completed by national road authorities:

1. Labour and Tractor Based Roadworks: Training & Contracting
2. Labour and Tractor Based Roadworks: Handtools and Intermediate Equipment

The overall aim of both questionnaires was to consolidate existing knowledge and to help identify future research and development needs regarding these institutional and technical issues.

The first questionnaire aimed to assess the future training needs and support required for the labour-based (l-b) roadworks sector on an international basis. In particular it aimed to establish the requirements for training government and contractors' staff to implement construction, rehabilitation and maintenance works using the private sector. It is anticipated that the information obtained from this questionnaire will assist with the preparation of guidelines on the development of domestic contracting capability and the implementation of roadworks projects using the local private sector.

The second questionnaire; Handtools and Intermediate Equipment, focused on road authorities and small scale contractors using l-b methods with a view to establishing the requirement for the development of appropriate designs and specifications for standard and commonly used, or required, equipment items. It was also intended that problems associated with the procurement and use of these items of equipment would be highlighted. The questionnaire will assist the work undertaken by the MART programme in this field to review the possibility of improving existing designs, developing other items of equipment and addressing the current problems encountered with the use of intermediate equipment. The ultimate objective is the production of a set of guidelines on the use of intermediate equipment for roadworks that will include; trialed standard designs and specifications, advice on the owning and operating costs and capabilities of each item of equipment, and lists of possible suppliers. The current phase of the MART programme will produce an initial set of documents contributing to this objective.

This working paper discusses the results obtained from the responses to these two questionnaires. The data given in these questionnaires has not been fully cross checked and reconciled, however it is felt that the conclusions are broadly valid. The data also highlights areas for further work that will assist in the preparation of the guidelines discussed above and improve the future prospects for achieving sustainable road infrastructure through private, small scale, l-b contractors. The analysis of the Handtools component of the second questionnaire is presented in MART Working Paper No. 8. Tables 4 and 6 summarise the recommended initiatives arising from the questionnaires and workshops organised by MART and the ILO.

2. Training and Contracting Questionnaire

2. 1 Introduction

The main objectives of the ILO/MART questionnaire, "Labour and Tractor Based Roadworks: Training and Contracting" were to:

- obtain an indication of the current implementation of l-b construction and maintenance
- discover governments' policy towards l-b contracting
- obtain an indication of the level of domestic contracting experience
- discover the current level of education and training provision for l-b roadworks
- assess the level of international donor support for labour and tractor based roadworks

This information would be used to help identify the training needs and support that are required for the l-b roadworks sector. Most importantly it would be used to assess the training requirements of government and contractors' employees to implement construction and maintenance work by l-b techniques utilising the domestic private sector.

To facilitate completion, the questionnaire consisted of a series of questions which required yes/no or simple one word answers. It was hoped that this format would increase the response ratio of the questionnaires sent out. An example questionnaire is included in Appendix 2.1. The questions were compiled into a series of sections covering the issues of;

1. the size of the road network
2. level of l-b roadworks
3. government policy
4. government personnel
5. domestic contractors and consultants
6. education and training establishments
7. language
8. institutional and donor support

It was intended that the responses to these sections would allow a perspective to be obtained of the current and future prospects for labour based construction, coupled with the necessary support that would be required.

The questionnaires were distributed by Claes Andersson, of the ILO (POL/DEV) branch, to the ILO representatives in 20 African and Asian countries, during the later half of 1995. The questionnaires were either completed by the ILO representative or passed to an appropriate spokesperson in the country's highway authority. Appendix 2.2 lists the names of the people who responded to the questionnaire, with their title, to identify their perspective of l-b roadworks.

2. 2 Training and Contracting Survey Results

Completed questionnaires were received from highway authorities of the following countries:

Ghana	Malawi
Indonesia	Mozambique
Laos	Namibia
Lesotho	Nepal
Madagascar	Tanzania

This list represents a broad cross section of SE Asian and African countries. Appendix 2.3 summarises the full responses to the majority of the questionnaire but the main results are discussed below.

The smallest and largest highway authorities or projects responding to the questionnaire were responsible for road networks of 166 km (Nepal) and 200 000 km (Indonesia) respectively, however the average length of the remaining 8 countries was approximately 18 000 km. For all 10 countries responding an approximate average of 20-25% of the principal road authority/project network was bitumised.

All the highway authorities had either a policy and/or a programme of labour-based roadworks. It was noted that Indonesia and Tanzania had stated that they had no national programme, however, they did have a policy regarding l-b roadworks. An extract from the Tanzanian Government Policy Statement is included in Appendix 2.4. This was clarified by the additional statements by the respondents; Tanzania was drafting a programme and Indonesian policy was only towards labour employment but not necessarily labour-based works.

With the exceptions of Namibia and Laos which, according to the respondents, were just commencing l-b road programmes, all the countries had constructed a portion of their road network using these methods. They are also currently maintaining an even greater proportion using l-b techniques. Despite the length of roads being maintained by either lengthmen or l-b contractors, all countries indicated that it would be possible to maintain even greater lengths by l-b methods.

Regardless of the numbers of contractors registered with the road authority, the majority of road authorities had a policy towards the use of labour-based contractors for construction, rehabilitation and spot improvements. The two countries not committed to labour-based contractors were Indonesia and Laos which, at the time of the surveys, did not have a policy of using l-b contracting. Half of the countries responding have Contractors' Associations and, where they exist over 90% of contractors registered with the road authority are members. Although equipment hire companies exist in the majority of countries it is a very limited market with only one or two operating companies.

Road authorities can often implement or encourage special measures where there is a policy to support small l-b contractors. Table 1 shows which measures have been implemented by each country.

	Special Credit Facilities	Contractor Training Programme	Guaranteed Workload	Provision for Special Payments	Trained Contract Supervisors	Suitable Contract Documents	Other Measures
Ghana	✓	✓	✓	✓	✓	✓	✓
Indonesia							
Laos			✓	✓	✓	✓	
Lesotho		✓	✓	✓		✓	✓
Madagascar		✓				✓	✓
Malawi		✓					✓
Mozambique		✓	✓	✓	✓		
Namibia		✓	✓	✓			
Nepal				✓	✓		
Tanzania		✓	✓	✓	✓	✓	✓

Table 1 Measures implemented for the support of small labour-based contractors

There were 3 other measures adopted by the road authorities. Ghana and Malawi both had a mobilisation payment scheme to alleviate the financial constraints on the contractor. Tanzania, Lesotho and Ghana have hire purchase schemes designed to enable small scale contractors to acquire the equipment they need to undertake roadworks. Mozambique has an AGETIP (Agence d'execution des travaux d'interet public contre le sous emploi) which acts as a channel for funds from donors directly to the small construction enterprises[1].

All the countries questioned had limited education facilities for teaching highway engineering subjects. With the exception of Ghana and Tanzania, no country had the capability of teaching courses to MSc standard. The remaining countries, in general, each only had one establishment that could offer BSc and/or Diploma courses. Despite a government policy in the majority of the countries towards labour-based roadworks, only Tanzania offered l-b subjects on its courses.

At a vocational training level, Ghana is the most pro-active in providing training with courses covering l-b construction, rehabilitation and maintenance for engineers and supervisors. All other road authorities have a training school but only 5 of the remaining countries offered any form of l-b roadworks course. In all these cases training was solely directed towards supervisors with no courses suitable for engineers. The lack of courses suitable for engineers is likely to be due in many cases to the insufficient numbers to make a course economically justified. This situation may be compensated by the number of engineers that have been trained internationally, however, most universities running courses for international students are likely to ignore labour based construction topics. Kenya road training school at Kisii offers an

[1] In addition to the AGETIP, DFID is currently sponsoring a project in Mozambique to undertake rehabilitation work with small scale private contractors

international engineers course which caters for the engineers who are unable to attend courses in their own country. Despite the various training materials available through the ILO few countries have made use of these resources to develop new courses.

The language used for education and training courses depends on previous European influence and the grade of course participants. In general courses aimed at administration staff and small scale contractors are in the local or national language, however English is used in a number of cases. The language of the European country which had the most influence on a country's earlier development is normally used for training higher grade engineers and technicians.

Financial support for l-b road construction, rehabilitation and maintenance or training and organisational change has come from a range of donor and financing agencies summarised in Table 2 below.

SIDA	NORAD	ILO
World Bank (IDA)	DFID (previously ODA)	KfW
DANIDA	USAID	EU
UNDP	ADB	

Table 2 Donors supporting labour-based contracting programmes

2. 3 Training and Contracting Survey Review and Analysis

As the countries surveyed have a widely varying size of road network, personnel and contracting capability, Table 3 overleaf indicates various values per km of road which have been produced to identify the relative capability of each country.

From Table 3 it can be seen that Malawi has constructed the vast majority of its tertiary road network by l-b methods and Lesotho and Nepal have constructed approximately a third of their network using labour. These countries have an equally high proportion of maintenance carried out by labour along with Madagascar, and Tanzania. Apart from the two countries who are setting up a labour-based programme, Namibia and Laos, the potential for maintenance using l-b techniques is assessed, by the respondents, to be between 50 and 100% of the total road network. Although it is unlikely that 100% of the road network may be maintained by labour-based methods, due to factors such as technical requirements for some activities and labour availability, there is the potential for a greater proportion of the network to be maintained by these methods

The staffing levels in the majority of road authorities surveyed appear to be adequate with engineers each responsible for between 150 and 700 km of road and technicians each covering up to 360 km. However, the road authorities with staffing levels similar to Mozambique and Namibia may be over-stretched, particularly when commencing a l-b programme, as engineers are each responsible for over 1500 km of road in these countries.

Although the respondents indicate that there may be sufficient contractors registered with their road authority to undertake roadworks there is no indication of the number of contractors who are available and capable of undertaking work at any time. The initial sections of the contracting questionnaire have shown that it would be possible to increase the work available for small contractors by expanding the amount of labour-based road maintenance that is currently carried out as;

- there is a greater percentage of roads which are maintainable by l-b methods
- there is usually sufficient staffing capacity within the road authorities

Unfortunately the questionnaire responses have also revealed a number of factors which will currently reduce the ability or success of expanding l-b programmes. Contractors often complain of 3 major factors preventing the development of their business;

1. Finance: A lack of working capital and long term loans to develop the business
2. Flow of Work: A lack of work continuity
3. Access to equipment: A labour-based contractor will usually require a small amount of equipment to undertake medium/long distance haulage and compaction tasks.

While the labour-based contracting programmes have implemented various measures to support small scale contractors, these 3 important factors appear to have been often overlooked. Firstly,
special credit facilities are only available through the Ghanaian programme, although Malawi does have a mobilisation scheme. Secondly, there appears to be a lack of planning within the road authorities to ensure a reasonably continuous work load is available for qualified contractors working in the roads sector. Finally, although plant hire companies appear to exist

Country	Total Road Network under Road Authority Control	Work carried out by l-b methods as a % of the total road network				Level of Road Authority Staffing No. of km of road per staff member			L-b contracting Capacity	
		Construction	Maintenance		Potential	Graduate	Foreign	Technical	Total number of registered	Potential length of
			lengthmen	contractor	L-B Main.	Engineers	Engineers	Staff	Contractors	L-B maint.
	km	%	%	%	%*	km	km	km	No.	km
Ghana	22170	6.8	0.0	7.5	52.7	568	11085	127	293	11680
Indonesia	200000	0.0	0.04	0.04	100	200	-	50	12650	200000
Laos	15000	Project commenced in 1994			33.3	300	1500	150	61	5000
Lesotho	2300	39.1	14.2	26.7	87.0	256	1150	40	21	2000
Madagascar	12000	8.3	50.0	50.0	70.0	150	2000	67	125	8400
Malawi	14594	87.7	48.0	100.0	100	663	4865	356	35	14594
Mozambique	26223	5.8	4.2		57.2	1457	-	1140	100	15000
Namibia	42501	L-B project in pilot phase			20.0	3542	4722	329	59	8500
Nepal	166	36.1	20.5	79.5		42	-	11	55	132
Tanzania	27835	3.4	10.7	85.4	100	107	1637	44	400	70000

Table 3 Comparison between 10 countries, based on the responses to the questionnaires, of the potential for labour-based contracting in the road sector

* It is unlikely that 100% of the road network could be maintained by labour based methods due to factors of labour availability or technical requirements for some activities.

in most countries, they are not widespread, with only one or two companies, and these likely to be located in the capital city. This is poses two problems for small contractors. Firstly, these few companies have a virtual monopoly and can therefore set high hire charges. Secondly, they are not easily accessible or cost effective for contractors working in rural areas.

In consideration of the advantages of this type of equipment on the one hand, and the present ownership problems of work continuity and therefore achieving high utilisation on the other, the encouragement of intermediate plant hire could bring considerable benefits. Intermediate Equipment hire organisations, and even hire between contractors would make this type of equipment more accessible (and low cost) to small local contractors. It could achieve high utilisation rates for individual items of plant with a better chance of repaying the investment and finance charges and achieving a profit. The economics and flexibility should make the hire of this type of equipment more attractive than purchase, and certainly far more attractive than purchase or hire of heavy civil engineering plant. The issue of plant hire of intermediate equipment requires further investigation to develop a pragmatic support strategy.

The respondents advised that local consultancies with a capability in the LB infrastructure sector do not generally exist in their countries. There is usually no system of registering this type of expertise. With fundamental civil service rationalisation occurring or planned in many countries there are certainly going to be opportunities for private sector consultancy services to take on some of the roles traditionally carried by the government organisations. However, as with local contracting, there are a range of issues which need to be tackled to develop an "enabling environment" for these enterprises. This topic requires further investigations to develop guidelines for the creation of this new capacity and the supporting "enabling environment."

The questionnaire responses have also highlighted that the training facilities are inadequate both at academic and vocational levels. The ILO has produced a number of sets of training materials which are used by some programmes. However, a number of programmes use very little of the ILO material. From the questionnaire responses it is not clear if this is due to its perceived unsuitability or lack of information about its availability. Although a large amount of training material has been produced, a number of areas have been identified where the questionnaire respondents are not aware of the availability of prepared training material. These include:

1. Training of contract supervisors
2. Training for engineers in l-b techniques
3. Training of trainers[2]

There is obviously insufficient awareness regarding the availability of the existing materials for the intended target audiences.

One of the respondents highlighted other institutional factors which may affect the success of a l-b programme which would otherwise be very successful;

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[2] This type of training material is catered for by the following ILO publications:

- International Course for Engineers and Managers of Labour-based Road Construction and Maintenance Programmes, Course notes by A Beusch and J deVeen, 1991
- Undergraduate and Postgraduate Courses on Labour Based Road Engineering, Course notes by J Howe and H. Muller, IHE Delft, 1995

"District road authorities are not interested in labour-based methods as "income" is earned through a system of awarding contracts to "friendly" contractors - they [Road Authority Personnel] see no advantages, in fact this [l-b] project is seen as a threat to the "income" base through the introduction of more efficient use of equipment and labour."

This problem can have a major constraining influence where road authority personnel remuneration for engineers and managers is well below that required for a professional standard of living or the incomes commanded by the private sector.

NOTE:
During peer review of this working paper doubts were raised about the validity of the road network lengths supplied by respondents to the questionnaires. The figures below, taken from the Statesman's Yearbook, indicate the length of road networks for the countries where responses to the questionnaire were obtained.

Country	Year of data	Total Road Length (km)	Length of Bitumen / Hard Surface Roads	Length of Earth or Gravel Roads
Ghana	1996	38700	15480	23220
Indonesia	1991		137060	
Laos	1996	16760	2350	
Lesotho	1992	5319	1005	4319
Madagascar	1989	49555	5401	
Malawi	1995	14070	2849	
Mozambique	1994		5000	23000
Namibia	1991	41815	4572	
Nepal	1994	9534	3404	
Tanzania	1994	55500	3660	

Source: Statesman's Year Book 1997/98 (134th edition), Macmillan 1997

The data above shows that the figures supplied by the questionnaire respondents were broadly correct. Where large discrepancies exist it is likely that respondents supplied information for the total length of the road network covered by their organisation/project rather than the whole country. Similar conclusions to those in sections 2.3 and 2.4 are drawn if the figures given in Table 3 are substituted by the above data.

2. 4 Further work

The questionnaire responses have highlighted the unanimous view that there is a greater potential for the use of l-b roadworks than is currently implemented. Further investigations are required to determine the reasons why labour-based methods are not more widely used, to their full potential, in countries that already have a l-b programme. Issues of resistance to change, vested interests and motivation of stakeholders need to be addressed.

Although many of the road authorities have positive policies towards the use of l-b roadworks and contractors, there appear to be insufficient follow-up initiatives or strategies to ensure that a sustainable, cost-effective and profitable domestic contracting sector is developed on these principles. MART Working Paper No. 1 lists the considerable range of factors which will influence this development and which should be accommodated in any implementation strategy.

It appears from the questionnaire responses that there would be insufficient roadworks based work available for the potential number of small scale contractors. Careful consideration must therefore be given when planning or expanding a l-b roadworks programme to ensure that sufficient other work is available to keep the contractors employed at viable levels of utilisation in the roadworks sector. Training programmes should also address the other roles and profitable work a contractor may be able to undertake. This may involve a small additional amount of further training to ensure contractors have skills in other related fields, thus ensuring work continuity and profitable return on capital deployed. Potential exists in the building, agricultural and water sectors.

It is clear that improved credit facilities are required for small contractors. A higher profile contractors association would also benefit contractors; facilitating a channel of information and opinion between contractors and the road authorities or government. Both these approaches could be promoted through the donor agencies. They would not necessarily be required to increase their financial input, but would be able to influence the important factors to be considered during the planning or expansion of a l-b programme. Clear information therefore needs to be made available to donor agencies which will highlight the various factors that need to be addressed in the development of a labour-based contracting programme. The current MART project aims to achieve this objective through the production of guidelines on contractor development under the tentative title; “Constructive relationships: Towards a sustainable market for labour-based road contracting”.

Training usually forms a large component of a contractor development or l-b roadworks programme. There is a substantial amount of existing training material already available for use on these programmes. However, it appears that many project implementers are unaware of the wide range of material which is available. It would appear further publicity is required to inform potential users of the material which is available. This could be achieved, for example, by providing a pull out centre spread for the ASIST Bulletin listing the important training manuals and reference titles, and where copies may be obtained. It would also be useful to obtain the opinions of those implementers who are aware of the material to discover their views on its limitations. This work would be especially important in projects which are aware but have not

made any use of the available material. This follow up investigation may also be undertaken through donor agencies or ILO-ASIST initiatives.

There are some training aspects which require material to be prepared or methods to be addressed:

1. The awareness creation and planning for road authorities for their changing role to contract supervising agencies and appropriate technology roadworks.
2. The training of engineers in contract supervision work
3. The training of trainers in l-b infrastructure works
4. The issues of how to achieve decentralised training programmes.

It is clear that l-b technology for infrastructure works has not been "mainstreamed" in the education and training systems of most of the countries where these techniques have been introduced; despite the many attractions and benefits of this approach. The reasons for this need to be established and initiatives taken to overcome this deficiency.

Finally, labour-based programmes have been undertaken in a number of different countries. As new programmes are developed in other countries it may be useful to facilitate study visits to allow road authorities to learn from each other. This approach has been carried out for example between Laos and Cambodia, with representatives from the Laos road authorities visiting Cambodian l-b roadworks programmes.

Table 4 summarises the initiatives proposed from the analysis of the contracting and training questionnaire responses and the MART-ILO Zimbabwe workshop.

ISSUE	**SUGGESTED INITIATIVES**
4.1 - INSUFFICIENT **ADOPTION** OF APPROPRIATE TECHNOLOGY APPROACHES IN ROADWORKS	- Investigate reasons - Consider the attitudes and benefits/losses to all stakeholders - Identify and support potential "Champions" in the adopting road authority - Ensure positive motivation of stakeholders
4.2 - LABOUR BASED ROADWORKS **POLICY** NOT **FOLLOWED UP** TO CREATE AN "ENABLING ENVIRONMENT"	- Investigate "enabling environment" needs (after MART Working Paper No 1) - take measures to create an enabling environment
4.3 - **MARKET** - POOR MATCH OF CONTRACTING CAPACITY TO WORK AVAILABLE	- Encourage stable market for small scale contractors and reasonable matching contracting capacity, to achieve competition yet profitability for efficient contractors. - Encourage flexibility and diversity of contractor capability in complementary sectors
4.4 - POOR AVAILABILITY OF **CREDIT** FOR CONTRACTORS	- Encourage initiatives to improve availability of finance to small scale contractors
4.5 - POOR **REPRESENTATION** OF CONTRACTOR'S INTERESTS	- Encourage small scale contractors associations and articulation of small scale contractor's interests

4.6 - FEW PRIVATE **HIRE COMPANIES** OFFERING INTERMEDIATE EQUIPMENT	- Encourage establishment of intermediate equipment plant hire companies - Promote projects to support establishment of local, intermediate-equipment plant hire companies, instead of equipping all contractors - Encourage contractors to hire out intermediate plant if they do not themselves have work
4.7 - FEW **DOMESTIC CONSULTANTS** WITH LABOUR BASED CAPABILITY/WORK	- Encourage registration of local consultants with l-b expertise - Encourage local private sector planning and management of L-B infrastructure works
4.8 - INSUFFICIENT USE OF EXISTING **TRAINING MATERIAL**	- Investigate reasons - Publicise available training documentation and reference material
4.9 - FURTHER **TRAINING AND AWARENESS CREATION** MATERIAL REQUIRED ON SPECIFIC SUBJECTS	- Identify and provide for gaps in training and awareness creation material, including: # rationale for l-b technology + contracting for senior decision makers # institutional change to contracting # contract supervision work # training of trainers and decentralising training
4.10 - L-B EDUCATION AND **TRAINING NOT "MAINSTREAMED"**	- Investigate reasons - Support incorporation of l-b infrastructure works as a principal and mainstream option in all technical education and training establishments
4.11 - INSUFFICIENT **EXCHANGE OF EXPERIENCES**	- Facilitate study tours *and ensure follow-up application of lessons learned*

Table 4 Proposed Initiatives regarding Contracting Development and Training

3. Intermediate Equipment Questionnaire

3. 1 Introduction

The main objectives of the intermediate equipment component of the ILO/MART questionnaire, "Labour and Tractor Based Roadworks: Handtools and Intermediate Equipment" were to:

- obtain an indication of commonly used items of equipment and their availability
- investigate countries' equipment manufacturing capacity
- obtain any available standard equipment designs and specifications
- discover the problems associated with the procurement or use of this equipment

The information obtained from these questionnaires would then be used to highlight areas for further work and investigation by the MART programme team, in order to fulfil the project objectives. One of these objectives is to produce standard designs and specifications for commonly required items of equipment from which prototype versions of these designs can be constructed, trialed and evaluated.

The questionnaire consisted of two parts: intermediate equipment, and handtools, with the intermediate equipment part broken down into two sections. The analysis of the returns to the Handtools section is described in MART Working Paper No. 8. An example questionnaire is included in Appendix 3.1. The first section investigated the use and availability of 30 items of intermediate roadwork equipment and the second section investigated the problems encountered when using intermediate equipment.

The first section consisted of a matrix with the list of 30 equipment items and the following four questions.

1. Is a standard design or specification available in the country ?
2. Is the item of equipment available to purchase locally ?
3. Is the piece of equipment built in country ?
4. Is the item of equipment considered important for roadworks by the respondent's organisation ?

The respondents were asked to tick the boxes of the grid that corresponded to the items of equipment and answers to the 4 questions which were applicable to their country. The second section investigating the problems associated with the use of intermediate equipment, consisted of statements of 11 problems that may be encountered. The respondents were requested to tick the statements that were applicable to their country. In both sections of the questionnaire there was additional space for respondents to include either additional important equipment used on site or problems that they encountered which were not included in the lists.

The questionnaires were distributed by Claes Andersson, of the ILO (POL/DEV) branch, to the ILO representatives in 20 African and Asian countries. The questionnaires were either completed by the ILO representative or passed on to an appropriate spokesperson in the country's highway authority. Additional questionnaires were distributed by the MART project team to practitioners working in the field following the initial responses received by the ILO. Appendix 3.2 lists the names of the people who responded to the questionnaire, with their title, to identify their perspective of labour-based roadworks.

3. 2 Intermediate Equipment Survey Results

Questionnaires were distributed to ILO representatives in December '95 and responses received during the first half of 1996. Information was received for the following countries:

Cambodia	Lesotho
Ghana	Madagascar
Indonesia	Mozambique
Kenya	Nepal
Laos	Tanzania

This list represents a broad cross section of S. E. Asian and African countries. Appendix 3.3 tables the responses of the questionnaire but the main results are discussed below.

All the items of equipment in the questionnaire were considered important for roadworks by at least one country. The 30 equipment items have therefore been classified into 3 bands of importance titled; essential, world-wide and country specific importance, according to the responses (Table 5).

Table 5 Summary of responses regarding perceived importance of intermediate equipment items

Intermediate equipment items essential for roadworks

- Agricultural tractor <70hp
- $3m^3$ gravel trailer
- Tractor drawn dead-weight roller(s)
- Pedestrian controlled vibrating roller (twin drum)
- Supervision vehicle - motorcycle
- Culvert mould 60cm dia
- Culvert mould 100cm dia
- Towed bowser - water
- Towed bowser - fuel
- Supervision vehicle - 4wd

Intermediate equipment items with world-wide importance for roadworks

- Agricultural tractor >70hp
- Automatic tractor pick up hitch
- Pedestrian controlled vibrating roller (single drum)
- Heavy duty fixed tractor hitch
- Small manually operated bitumen heater
- Heavy towed grader (>3 tonnes)
- Light towed grader (<3 tonnes)
- Supervision vehicle - 2wd pickup
- Heavy duty bicycle
- Accommodation / workshop caravan

Intermediate equipment items with country specific importance for roadworks	
• Towing eyes and fixings	• Towed drag
• Stand or skid for towed items	• Animal drawn gravel cart
• Manually operated concrete paver press	• Hand drawn dead-weight roller
• Manually operated concrete paver testing apparatus	• Animal drawn dead-weight roller
• Lime stabilisation harrow/mixer tractor attachment	• Towed bitumen slurry box for slurry sealing

Cambodia and Nepal were the only countries that indicated that they used any another items of intermediate equipment which were not included on the list. Cambodia uses vibrating plate compactors and tractors with a blade mounted on the front. These tractors are presumably used for spreading, profiling and camber formation although this is not made clear on the return. Both countries use locally made trucks; Nepal uses 'TATA' trucks which have been made in India and are based on older Mercedes models and Cambodia uses 'Etean' trucks. Eteans are light trucks of 2 - 5 tonnes carry capacity, locally manufactured from recycled scrap medium size trucks. They are usually fitted with a new agricultural tiller engine.

The respondents indicated that standard designs and specifications were available, in their country, for many of the items of equipment included on the list. Although the questionnaires requested that any available specifications should be attached to the returned questionnaire, only the Cambodian respondent sent copies of their specifications.

The only items of equipment which appear to be manufactured locally in the majority of countries are $3m^3$ gravel trailers, culvert moulds and towed water or fuel bowsers. Kenya is the one exception of all the countries surveyed which manufactures a number of other items of intermediate equipment, through its Minor Roads Programme. Indonesia manufactures tractors and 2wd/4wd vehicles, however it may be considered a newly industrialised country unlike the remaining countries surveyed.

With the exception of Mozambique, all the items of equipment which were considered important for roadworks were available to buy in country. Mozambique manufactures $3m^3$ gravel trailers and towed water and fuel bowsers in country and they are therefore available to purchase locally, however all other items of equipment are neither manufactured nor available to purchase in-country.

The 2nd section of the questionnaire, addressing the problems associated with using equipment, revealed that intermediate equipment was acceptable to all the road authorities with the exception of Nepal. All the other nine possible problems listed on the questionnaire were encountered by at least two countries. The most common problems, which were almost globally encountered by all countries are:

- the poor quality of locally manufactured equipment
- lack of training for equipment operation and mechanical support

- non-availability of good quality equipment for hire
- difficulty in obtaining finance to purchase equipment

Coupled with the difficulty in obtaining finance, the interest charges on equipment loans are high ranging from 20% in Nepal to 48% in Ghana and Mozambique. The availability of good quality equipment for purchase is only encountered in a third of the countries surveyed. However, a further third commented that bureaucratic procedures and taxes resulted in delays and difficulties in purchasing equipment.

Under the contractor development programme in Ghana contractors are supplied with a 'set' of roadworks equipment. The cost of this equipment loan is paid back through winning and undertaking roadworks contracts. The contractors commented that they would prefer a cash loan to make their own choice on the type and particular model of equipment that they wish to buy rather than being forced to accept the equipment offered through the programme in terms of types, numbers, manufacturers and models.

A number of countries also indicated that the supply of spare parts, especially in rural areas, and after sales support in general from equipment suppliers was poor. The Cambodian questionnaire suggested that spare parts should be interchangeable as far as possible between different items of equipment. This would allow a more efficient supply of spare parts and the 'borrowing' of parts from under-utilised equipment to keep essential equipment running. The age of equipment in use in many countries, particularly Madagascar (15+ years), results in frequent breakdowns and high maintenance costs in operating the equipment.

3. 3 Discussions with Labour-based Roadworks Contractors

The survey results from Ghana were obtained during a discussion with four contractors from the Ashanti and Southern Regions of Ghana. This discussion, which centred around the questions posed by the questionnaire, was held during the MART intermediate equipment workshop, which took place at Accra in April 1996. Many of the issues raised by these contractors are specific to Ghana, however, a number of issues were raised which may apply to small scale l-b contractors world-wide.

The MART team commented that the trailers being used on roadwork sites viewed during their visit to Ghana were all agricultural trailers which did not seem to be sufficiently robust for roadworks. The contractors explained that agricultural equipment brought into the country does not incur any import duties, however construction equipment incurs a substantial import tax of approximately 15%. Although the trailers require frequent repair they are cheaper to purchase than more substantial trailers which would be more suited to gravel haulage. The contractors also explained that the tipping mechanisms frequently broke on the trailers which has resulted in them discarding the mechanism and welding the trailer bucket to the chassis. Hand unloading had therefore been adopted.

The standard wheels which are supplied with the trailers are too narrow for use on roadworks sites. The gravel loads carried by the trailers results in the wheels sinking in soft ground. The contractors have solved this problem by fitting wheels with balloon tyres, but these tyres suffer frequent punctures increasing the equipment's downtime. However if suitable designs were available it is probable that these could be locally made

Trailers on site were seen propped up with the use of large rocks and logs and towing eyes were invariably badly worn. The lack of heavy duty towing eyes and suitable stands for the trailers was again attributed to the import duties on suitable equipment being defined as construction rather than agricultural equipment.

The Ghanaian specification for l-b roadworks states that a compaction of 98% should be achieved for all road material. While there could be many discussions on the setting of the level of compaction, the contractors explained that they had no means of testing their work to ensure compliance with the specification. The Department of Feeder Roads use a dynamic cone pentrometer (DCP) to check the CBR after work is completed. The contractors felt that there was a need for a cheap and simple item of equipment which could be used to give a reasonably accurate indication of the level of compaction achieved.

The four contractors present disagreed on the type of small roller which gave the highest compaction with a 50% split for the single and twin drum vibrating pedestrian roller. Within their experience it was not possible to achieve the required level of compaction using dead-weight rollers. On the other hand they were not aware of the existence or use of a sheep's foot roller to obtain high concentrated compaction loading. All the contractors agreed that vibrating plate compactors did not achieve good compaction and were 'overworked' on site which resulted in frequent breakdowns.

There were a number of equipment items on the list which the contractors were unaware of or had never seen. These included ribbed rollers, mentioned above, block paving press and bitumen slurry box. Once these items of equipment had been described to the contractors, they

indicated that they may be useful to their business and were keen to explore the equipment's potential.

All the contractors only used 4wd vehicles for supervision. When asked why they always used 4wd vehicles it was explained that they did not believe that 2wd drive vehicles were suitable for any of the work that they carried out. While this statement may be true for some of the work they undertook it is unlikely that 2wd vehicles would be unsuitable for all their work.

Two of the contractors had tried providing their supervisors with motorbikes but their use had been abused by the employees. They therefore considered motorbikes as an unfeasible option as they could not guarantee that they would be respected and maintained. Another contractor pointed out that the DFR supervisors used motorbikes to visit roadworks sites. This system worked because the DFR employees owned the motorbike and were paid a mileage allowance by the DFR. One contractor was considering offering loans to selected supervisors to allow them to buy motorbikes for their work.

The contractors agreed that the lack of a workshop on site or in local villages often posed a problem to efficient operations. As most of their contracts were over relatively short lengths of road (up to 5 km) they did not feel that a workshop caravan would be a useful asset. They would prefer a "segmental tin hut" which could quickly and easily be erected on site to provide a secure store and small workshop. One contractor had investigated the availability of these huts in Ghana but had been unable to find a supplier.

3. 4 Review and Analysis

Equipment importance and availability

Almost all items of equipment considered important by road authorities for roadworks are available for purchase in country. This may be a simple case of suppliers importing equipment which is required by the authorities and contractors for roadworks. However the question which must be raised is: Are these items of equipment considered important because they are the only ones available? (i.e. which came first, the importance or the availability). This conundrum may be partly addressed by the results from the Madagascan questionnaire, which indicate that there are a number of pieces of equipment which are available locally but are not considered important by their road authority for roadworks. However, it is likely that the intermediate equipment market in each country has reached different stages of development depending on the awareness and demands of the clients, and the knowledge, resourcefulness, marketing or manufacturing skills of the local suppliers. These various factors will tend towards a crude match of supply and demand.

Depending on the type of roadworks being undertaken (construction/maintenance of feeder/ bitumised/urban roads) different equipment will be considered important. However the number of items of equipment that each respondent considered to be important was smaller than expected. This may be attributed to one or more of the following reasons:

1. The respondent is unaware of the existence of the other items
2. Other items of equipment are used on roadworks but are not considered important
3. The respondents are unaware of the problems solved or capabilities of other items of equipment
4. Other items of equipment are not important because they are unavailable and hence not used. (see above)

The discussions held with the Ghanaian Contractors reinforces the view that highway officials and other contractors may be unaware of the existence and / or capabilities of certain items of equipment.

There is also an almost universal lack of knowledge regarding the actual overall costs of owning and operating intermediate equipment which is a major constraint to rational selection of equipment type and model. This problem is compounded by the similar lack of cost-awareness about heavy civil engineering plant.

The questionnaire responses have indicated that all types of supervision vehicles are important for use on roadworks. Further investigations may be carried out in order to determine the efficiency and frequency of using 4wd in preference to motorbikes or 2wd vehicles which may be cheaper to buy and operate. Factors such as economic life, repairability, reliability, strength and resale value may counteract lower fuel and other running cost considerations.

Human and animal drawn compaction equipment is only considered important in some Asian countries. This may be due to the unavailability of suitable equipment in Africa or that the use of labour or animals for haulage/towing work would be viewed as culturally unacceptable by

decision makers. Again, the lack of cost-awareness and benefits may have an influence on views..

Designs and Specifications

The questionnaire requested that copies of standard designs or specifications should be sent with the reply. Although countries indicated that there was a standard design or specification available for virtually all items of important equipment, only Cambodia attached copies with their reply. The equipment specifications appeared to be a description of the equipment available rather than a procurement specification. It is possible that designs or specifications are perceived to exist; equipment is being used, hence a design or specification must exist. This theory may be confirmed by the fact that questionnaire responses indicated that the specifications existed but they were unavailable. The problem may arise from the situation that the procurement personnel of a road authority are often far removed (geographically or institutionally) from the users. The question of availability is raised again; are the items of equipment supplied to meet the specifications or have the specifications been adapted/relaxed to agree with the equipment available? As specifications have not been returned with the questionnaires the latter situation may be judged to be the most prevalent.

Problems Encountered with Equipment

The questionnaire listed 11 possible problems which could be encountered in the use of intermediate equipment requesting that the relevant problems were ticked. This allowed the respondents to include as many problems as they considered applicable. The number of boxes ticked ranged from 2 (Lesotho) to 10 (Nepal). It may be argued that countries which have ticked only a few boxes experience few problems with the use of equipment. However, the occurrence of these problems must be looked at individually. For example one possible problem is the difficulty of getting prototype equipment manufactured in-country. If a country's road authority has not attempted to get prototype equipment manufactured, they will not consider this issue a problem. This does not mean that the problem does not exist in their country, rather that it has not currently been encountered. Problems which are likely to have been encountered by all countries are those which have the highest number of occurrences. Care must therefore be taken when concluding from the results that certain problems do not exist in the majority of the countries questioned. From anecdotal evidence it is more likely that a majority of the problems exist in most or all of the countries.

Problems which are definitely prevalent in most countries and should therefore be addressed as a high priority are:

- the poor quality of locally manufactured equipment
- lack of training for equipment operation and mechanical support
- non-availability of good quality equipment for hire
- difficulty in obtaining finance and interest charges incurred in the procurement of equipment

MART Intermediate equipment workshop

This workshop was held in Ghana in April 1996 and was attended by over 30 equipment specialists from government, advisory and contracting backgrounds.[3] The workshop

[3] The report from the workshop is available as MART Working Paper No. 5

participants produced a list of 70 items of intermediate equipment and 28 equipment issues that should be addressed by the MART Guidelines. For the 35 items considered the most important, by the workshop, 3 further tasks were carried out.

- Identification of available information on each item of equipment
- Identification of further R & D needs
- Agreement of actions required.

The list of items discussed in detail by the workshop included all those that have been categorised as essential or of world-wide importance as a result of this survey. (Supervision vehicles were excluded from this list as they were considered an 'off the shelf' item which would not benefit from further R&D and l-b roadworks consisted of an insignificant market for manufacturers to adapt their products.) A significant proportion of equipment items in the country specific important category were also discussed at the workshop.

3. 5 Further Work

The responses to the questionnaire and the discussions at the Accra workshop confirm the serious underdevelopment of the intermediate equipment sub-sector. This significantly constrains the ability of road authorities and contractors to invest in and utilise this type of equipment in the support of labour based roadworks. The situation is such that many decision makers do not have the knowledge or the supporting environment to make rational and cost-efficient decisions regarding whether to use labour, intermediate equipment, or heavy civil engineering plant for each particular activity in the local road sector. Manufacturers and suppliers are also not aware of the exact needs and potential for intermediate equipment to provide optimal solutions for their road authority and contractor clients. The result is that the most cost-effective approach is often not achieved.

Furthermore the natural development progression of a contractor from pure-labour to intermediate equipment to heavy plant, in terms of capital required, management capability, work competence, cash flow and (possibly) profitability is severely constrained.

There is considerable potential for a healthy local industry in the manufacture, fabrication and support of intermediate equipment in many countries (with its related skilled, high-value employment generation) which is currently suppressed by the present situation.

Probably the most serious problem is the lack of cost-awareness regarding the real owning and operating costs of all equipment, and particularly intermediate equipment. Combined with a typical lack of genuine management pressures for cost-effective solutions and performance on road authority personnel, there is often little inclination to change to a more rational approach regarding equipment selection and use.

It is apparent that considerable further research, development and promotion of intermediate equipment is required. The principal issues to be addressed from the evaluation of Accra workshop and the equipment questionnaire responses are summarised in Table 6.

Table 6 Proposed Initiatives regarding Intermediate Equipment

ISSUE	**SUGGESTED INITIATIVES**
6.1 - LACK OF **AWARENESS** REGARDING INTERMEDIATE EQUIPMENT	- Develop documentation on the availability, capabilities, flexibility, capital and operating costs, and sourcing of intermediate equipment for clients and contractors - Promote awareness of potential market and requirements with equipment manufacturers and suppliers
6.2 - POOR **COST-AWARENESS** REGARDING ALL EQUIPMENT (& PARTICULARLY INTERMEDIATE EQUIPMENT)	- Develop owning and operating cost tables for all common items of intermediate equipment and selected comparable heavy items, incorporating factors/assumptions regarding economic life, annual utilisation and capital interest rates.
6.3 - NON-AVAILABILITY OF **DESIGNS AND SPECIFICATIONS** FOR PROCUREMENT OF INTERMEDIATE EQUIPMENT	- Develop procurement specifications - Develop designs and prototypes and carry out performance trials for important items of non off-the-shelf items - Promote development of intermediate equipment with manufacturers and suppliers

6.4 - WEAK **PROCUREMENT** ARRANGEMENTS FOR INTERMEDIATE EQUIPMENT	- Develop guidelines on the selection, specification, supplier appointment, quality control, delivery approval, warranty, spares provision and operational support of intermediate equipment
6.5 - POOR **MANAGEMENT AND SUPPORT** OF INTERMEDIATE EQUIPMENT	- Develop guidelines on the mechanical support and management of intermediate equipment
6.6 - INADEQUATE **TRAINING** FOR INTERMEDIATE EQUIPMENT	- Develop training material regarding all aspects of intermediate equipment - Encourage "Mainstreaming" of intermediate equipment training
6.7 - POOR AVAILABILITY OF **FINANCE** FOR INTERMEDIATE EQUIPMENT	- Encourage donors and programme sponsors to provide suitable credit or financing arrangements (interest rates and terms) for the acquisition and use of intermediate equipment
6.8 - POOR AVAILABILITY OF INTERMEDIATE EQUIPMENT FOR **HIRE**	- Encourage establishment of intermediate equipment plant hire companies - Promote projects to support establishment of local, intermediate-equipment plant hire companies, instead of equipping all contractors - Encourage contractors to hire out intermediate plant if they do not themselves have work
6.9 - POOR **DISSEMINATION** OF INFORMATION ABOUT INTERMEDIATE EQUIPMENT	- Document and disseminate information of intermediate equipment to road authorities, practitioners, consultants and contractors through ILO-ASIST, MART, PIARC and professional institutions.

A number of the proposed initiatives are coincident with those of Table 4.

Some of the proposed initiatives are discussed in more detail on the following pages.

The range of issues to be addressed and the scale of the task means that the initial MART programme will only be able to take the initial steps towards producing the comprehensive documentation and guidelines required concerning intermediate equipment. Priority will be given to documenting the existing knowledge and experiences, and developing preliminary guidelines and cost information on the common and priority items of intermediate equipment. Proposals will be developed to improve the knowledge base and dissemination of issues relating to intermediate equipment and the promotion of its cost-effective use through owning or hiring.

To tackle the crucial issue of increasing **cost-awareness** and increase general **awareness** regarding intermediate equipment, a reference document (Intermediate Equipment Handbook) will be developed in the basic format of one double sided A4 sheet for each item of equipment. On the front side of the page will be descriptive details (including illustration/photograph) and recommended procurement specifications for the item including advice on capabilities/limitations and sourcing. On the reverse side will be guidelines on costing. These will be divided into owing costs and operating costs. The owning costs will be set out in a matrix format so that planners, owners or users may select appropriate values of assumed economic life, annual utilisation and finance interest rate to select a corresponding ownership cost per hour or day of use. The operating costs will be calculated separately.

The sheet-per-item format should assist **dissemination, training** and everyday use of the

information, and will ease updating. Contractors, manufacturers or suppliers could request the provision of only the sheet or sheets of immediate interest to them. It should be possible to mail, fax or e-mail this information at very low cost. There is potential to have this information downloadable from the Internet.

It is envisaged that the initial document will be a basic "core" issue. Interested parties will be encouraged to contribute to, expand and refine the data in subsequent issues. The document should help promote the awareness of the potential market with equipment manufacturers. Further funding will be sought to develop the document from the core initial issue.

There are few proven designs available for non off-the-shelf items of intermediate equipment. MART will separately document the available existing designs. Initiatives will be taken to promote the development of standard **designs and specifications** where these do not already exist, including the trialing of prototypes. The involvement of manufacturers (which has hitherto been minimal) will be encouraged.

For off-the-shelf items the recommended specifications of commonly available items will be summarised.

MART will develop guidelines on the **procurement** process to be included in the Intermediate Equipment Handbook.

The cost information on the important items of intermediate equipment should assist in justifying and mobilising **finance** for purchase of the equipment and show the potential income from efficient **plant hire** operations.

MART will approach agricultural tractor manufacturers to discuss the potential market for their products in the roadworks sector and other sectors in which contractors could profitably operate. The results and findings of MART work on trailer hitches and tractor specifications will be offered. The manufacturers will be encouraged to assist and work with the MART programme team in carrying out additional work to develop any suitable modifications or adaptations to their tractors and produce suitable hitches in order to supply and develop this market sector.

MART will address the issues of supervision vehicles; from bicycles to 4wd vehicles, resulting in the drafting of guidelines on their use. These guidelines should include cost/benefit analysis of each vehicle for different supervision tasks. The road construction market will not produce a large enough market share for vehicle manufacturers to supply modified or adapted vehicles to meet the industry's specific needs. The use of the guidelines would assist contractors or project planners in choosing the most effective vehicle or vehicle fleet for their predicted projects.

Appendix 2.1

Labour and Tractor Based Roadworks Contracting and Training Questionnaire

Appendix 2.2

Training and Contracting
Questionnaire respondents

Country	Name of Responder	Title of Responder
Ghana	C D Antwi	Director, Department of Feeder Roads
Indonesia	M Knowles	CTA
Laos	T Jones	Consultant
Lesotho	D Sahale	Snr Operations Engineer, Labour Construction Unit
Madagascar	R Andriamampionona	Directeur, National Routes
Malawi	B Kapoteza	Chief Civil Engineer
Mozambique	C Fortes	Counterpart to CTA
Namibia	J Runji	National Co-ordinator, Labour-based roadworks
Nepal	Y Rai	Department of Roads
Tanzania	H Urio	Director of Roads

*CTA = ILO Chief Technical Advisor

Appendix 2.3

Training and Contracting
Questionnaire survey results in tabular form

Country	3. Road Network			4. Technology				5. Policy		6. Road Authority Personnel		
	Total Length km	Bitum.d km	Other auth. km	LB const. km	LB Maintenance lengthmen km	LB Maintenance contractor km	Pos. LB maint. km	committed to LB	Action plan	No. Grad Engineers No.	No. Foreign Engineers No.	No. Tech Staff No.
Ghana	22170	220	16770	1500	-	1657	11680	yes	yes	39	2	175
Indonesia	200000	30000	65000	45	85	85	200000	yes	no	1000	0	4000
Laos	15000	3000		none, project started in 1994			5000	no	yes	50	10	100
Lesotho	2300	0	3000	900	327	613	2000	yes	yes	9	2	58
Madagascar	12000	4750	unknown	1000	6000	6000	(2)	yes	yes	80	6	179
Malawi	14594	2849	517	12795	7000	14594	14594	no	yes	22	3	41
Mozambique	26223	5328	-	1522	1097	-	15000	yes	yes	18		23
Namibia	42501	5021	23302	0(1)	9	0(1)	8500	no	yes	12	9	129
Nepal	166	165	116	60	34	132				4	0	15
Tanzania	27835	3961	50640	956	2987	23783	70000	yes	no	261	17	631

Country	7. Domestic Contractors															
	Policy for using LB		Registered contractors			Contractors Assoc.		Hire companies		Measures for SSC support						
	contr/rehab	spot improv	labour only	inc equip	other	Exists	No. regtd	exist	No.	credit facilities	training provided	workload guaranteed	payment system	trained supervsn	suitable contract	other
Ghana	yes	yes	93	200		yes	81	yes	limited	yes	yes	yes	yes	yes	yes	mobtn pay
Indonesia	no	no	10000	2500	150			yes		no	no	no	no	no	no	
Laos	no	no	0	61	0	no		not available yet		no	no	yes	not yet	not yet	not yet	
Lesotho	yes	yes		21		yes	21	yes	privately	no	yes	yes	yes	no	yes	
Madagascar	yes	yes		125		yes	unknown	large contractors		no	yes	no	no	no	yes	Agetip
Malawi	yes	yes	20	6	9	no		yes	1-2	no	yes	no	no	no	no	mobtn pay
Mozambique	yes	yes	100	-	-	yes		no		no	yes	yes	yes	yes	no	
Namibia	yes	yes	5	54		no		yes	?	no	yes	yes	yes	no	no	
Nepal	yes	yes	50	5	-	yes	55	yes	1	no	no	no	yes	yes	no	
Tanzania	yes	yes	0	400	0	no		yes	2	no	yes	yes	yes	yes	yes	hire purch.

Country	8. Domestic Consultants			9. Education Establishments			10. Training			
	Policy for using consultants		No.	BSc	MSc	Diploma	Road Auth	LB constr	LB rehab	LB Main
	constr/rehab	spot improve	Registered	(inc. LB)	(inc. LB)	(inc. LB)	Centre	Eng./sup	Eng./sup	Eng./sup
Ghana	yes	yes	0	5/0	3/1	10/0	yes	yes/yes	yes/yes	yes/yes
Indonesia	no	no	0	3/0	0	0	yes	no	no	no
Laos	no	yes	~0	1/0	0/0	0/0	yes	no	no	no
Lesotho	no	no	0	0/0	0/0	1/0	yes	no/yes	no/yes	no/yes
Madagascar	yes	no	20	1/0	0	1/0	yes	yes	yes	yes
Malawi	yes	no	0	1/0	0	1/0	yes	no/yes	no/yes	no/yes
Mozambique	no	no	0	1/0	0	4/0	yes	no	no/yes	no/yes
Namibia	yes		1	1/0	0	0	yes	no	no	no
Nepal	no	no		3		3	no			
Tanzania	yes	yes	in progress	1/1	1/1	1/1	yes	no/yes	no/yes	no/yes

Appendix 2.4

Extract from Tanzanian Government Labour-based Roadworks Policy Statement

POLICY STATEMENT ON THE USE OF LABOUR-BASED METHODS IN THE ROADS SECTOR

It is the policy of the Government to;

"encourage the development and use of labour-based methods in order to create local employment and reduce the (roads) sub-sector's foreign currency requirements."
(Extract from "Letter of Transport Sector Policy" March 1994).

Accordingly, the planning and design of road construction and maintenance works, shall consider the use of labour-based methods. In general, only where such methods are clearly either not cost-effective or can not produce the required quality should alternative equipment-based methods be used. This will require that the designs and packaging (size of individual contracts) of the roadworks are carried out in such a way as to be conducive to the use of labour-based methods.

Since the capacity in terms of trained staff and contractors is limited in some regions and districts, enhanced efforts shall be made to build capacity through appropriate awareness and training programmes. This shall be followed up by the provision of practical experience on the use of labour-based methods for roadworks by the trained staff.

Arrangements shall be made to register labour-based trained contractors. Adequate opportunities will be provided for registered labour-based contractors to participate in road construction and maintenance works.

Where consultants are used in the preparation of roadworks schemes, they shall be instructed, where appropriate, to adopt the policy as laid down here.

The Ministries responsible for roads will monitor the implementation of this policy.

Appendix 3.1

Labour and Tractor Based Roadworks
Handtools and Intermediate Equipment Questionnaire

Appendix 3.2
Intermediate Equipment
Questionnaire Respondents

Country	Name of Responder	Title of Responder
Cambodia	David Salter	Snr Engineer, L-B Infrastructure Rehabilitation Project
Ghana	N/A	local contractors
Indonesia	M Knowles	CTA*
Kenya	J Hamper	Mech Eng., MOPWH
Laos	T Jones	Consultant
Madagascar	R Andriamampionona	DNP project
Mozambique	Carlos Fortes	Counterpart to CTA* MOZ/91/07
Nepal	Werner Meyer	CTA
Tanzania	E Lima	Contracts Eng., L-B Contractor Training Project

*CTA = ILO Chief Technical Advisor

Appendix 3.3
Intermediate Equipment
Questionnaire survey results in tabular form

Table 1. Equipment considered important for roadworks

Item	1				2				3				4				5				6				7				8				9				10	11			12				13				14				15			
Avail/use	S	P	B	I	S	P	B	I	S	P	B	I	S	P	B	I	S	P	B	I	S	P	B	I	S	P	B	I	S	P	B	I	S	P	B	I	S P B I	S	P	B	I	S	P	B	I	S	P	B	I	S	P	B	I
Cambodia	✓	✓		✓																						✓	✓	✓									sm'th steel			✓	✓			✓				✓				✓			✓
Ghana	✓	✓		✓	✓	✓							✓	✓		✓	✓	✓		✓				✓	✓	✓		✓									sm'th steel	✓		✓	✓	✓			✓	✓	✓		✓				✓
Indonesia	✓	✓	✓						✓	✓	✓										✓	✓	✓		✓	✓	✓																✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Kenya		✓		✓		✓		✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓		✓		sm'th / rib	✓	✓	✓	✓		✓				✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Laos	✓	✓		✓	✓	✓		✓	✓				✓				✓				✓								✓	✓	✓	✓					sm'th steel	✓		✓	✓			✓				✓	✓	✓	✓	✓	✓	✓	✓
Lesotho																																											✓		✓									
Madagasgar		✓		✓		✓		✓		✓		✓		✓		✓										✓		✓									rubber tyred		✓			✓		✓		✓		✓			✓		✓			✓	✓
Mozambique	✓			✓	✓			✓	✓			✓	✓			✓									✓	✓	✓	✓																✓			✓							
Nepal	✓	✓		✓	✓	✓				✓		✓						✓				✓				✓	✓	✓			✓					✓	sm'th/rib	✓	✓		✓	✓	✓		✓	✓	✓		✓		✓	✓	✓		✓	✓	✓
Tanzania		✓		✓		✓		✓				✓														✓	✓	✓		✓	✓						sm'th steel			✓		✓		✓		✓		✓			✓		✓	✓	✓	✓

Item	16				17				18				19				20				21				22				23				24				25				26				27				28				29				30			
Avail/use	S	P	B	I	S	P	B	I	S	P	B	I	S	P	B	I	S	P	B	I	S	P	B	I	S	P	B	I	S	P	B	I	S	P	B	I	S	P	B	I	S	P	B	I	S	P	B	I	S	P	B	I	S	P	B	I
Cambodia																													✓	✓	✓										✓	✓		✓	✓			✓	✓			✓	✓			✓			
Ghana				✓				✓	✓			✓	✓			✓	✓	✓	✓	✓								✓	✓	✓	✓	✓				✓				✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓			✓
Indonesia																													✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Kenya									✓	✓	✓	✓																	✓	✓	✓	✓	✓	✓	✓	✓					✓			✓		✓			✓			✓				✓		
Laos	✓	✓	✓	✓					✓	✓	✓												✓		✓			✓	✓		✓	✓	✓		✓	✓				✓			✓	✓	✓		✓	✓	✓		✓	✓	✓			✓
Lesotho																													✓	✓	✓		✓		✓									✓			✓			✓				✓		
Madagasgar		✓	✓			✓	✓																			✓	✓		✓	✓		✓	✓			✓	✓				✓				✓			✓				✓			
Mozambique													✓		✓														✓	✓	✓	✓	✓	✓	✓	✓							✓				✓				✓						
Nepal				✓						✓		✓			✓				✓	✓									✓	✓	✓			✓	✓		✓	✓	✓			✓	✓			✓	✓			✓	✓					
Tanzania										✓		✓		✓		✓													✓	✓	✓		✓	✓	✓							✓			✓		✓			✓			✓			✓

Key:

S Standard design or specification available in country
P equipment available for Purchase in country
B equipment is Built in country
I equipment is considered Important for roadworks

Equipment item numbers:

1. Agricultural tractor <70hp
2. Agricultural tractor >70hp
3. Heavy duty fixed tractor hitch
4. Automatic tractor pick up hitch
5. Towing eyes and fixings
6. Stand or skid for towed items
7. $3m^3$ gravel trailer
8. Animal drawn gravel cart
9. Hand drawn dead-weight roller
10. Animal drawn dead-weight roller
11. Tractor drawn dead-weight roller(s)
12. Pedestrian controlled vibrating roller (single drum)
13. Pedestrian controlled vibrating roller (twin drum)
14. Culvert mould 60cm dia
15. Culvert mould 100cm dia
16. Manually operated concrete paver press
17. Manually operated concrete paver testing apparatus
18. Light towed grader (<3 tonnes)
19. Heavy towed grader (>3 tonnes)
20. Towed drag
21. Lime stabilisation harrow/mixer tractor attachment
22. Towed bitumen slurry box for slurry sealing
23. Towed bowser - water
24. Towed bowser - fuel
25. Small manually operated bitumen heater
26. Heavy duty bicycle
27. Supervision vehicle - motorcycle
28. Supervision vehicle - 2wd pickup
29. Supervision vehicle - 4wd pickup
30. Accommodation/workshop caravan

Table 2: Problems encountered with the use of intermediate equipment

	Int eqp not acceptable	lack of informatn.	good quality not av. Hire	purchase	No workshop	Inadeqte. materials	prototypes built/test	Poor local quality	lack of res for repair	lack of eq training	lack of sp suppliers	finance for equip	Interest charges	OTHER
Cambodia			✓	✓	✓	✓	✓	✓	✓	✓		✓		lack/delay in obtaining spare parts
Ghana			✓		✓	✓	✓	✓	✓	✓	✓	✓	48%	acquisition of contractors plant by gov'ment
Indonesia		✓	✓					✓		✓		✓	20%	Backup support by local suppliers is very poor
Kenya			✓				✓	✓		✓	✓			procurement guidelines required
Laos					✓		✓	✓	✓	✓	✓	✓	22%	bureaucratic purchasing procedures
Lesotho			✓										22%	
Madagascar								✓	✓			✓	40%	Maintenance cost of old equipment is very high
Mozambique			✓	✓		✓	✓	✓		✓			48%	
Nepal	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	15-20%	Difficult for contractors to procure IT tools
Tanzania		✓	✓		✓	✓	✓					✓	high	Lack of availability of spare parts in rural areas
TOTALS	1	3	8	3	4	5	7	8	4	7	4	7		

A list of working papers, journal articles and books prepared under the MART Initiative, including forthcoming publications.

MART Working Papers

1. Towards Guidelines for Labour-Based Contracting, 1996
2. Selective Experience of Training, Contracting and the Use of Intermediate Equipment for Labour-based Roadworks, 1997
3. *(Working papers 3 and 4 will be published as a book: "Labour based roadworks: A*
4. *state of the Art Review)*
5. Workshop on Intermediate Equipment for Labour-Based Roadworks, 1996
6. Private Sector Development and Institution Building: A Select Bibliography and Literature Review, 1997
7. Tractors in Roadworks, 1997
8. Handtools for Labour Based Roadworks: Questionnaire Survey Results *(Draft)*
9. Handtool Productivity *(Draft)*
10. Handtool Literature Review *(Draft)*
11. Towed Graders for Roadworks *(Proposed)*
12. Compaction Equipment for Roadworks *(Proposed)*
13. Haulage Equipment for Roadworks *(Proposed)*

Conference and Journal Papers

- Training across boundaries: promoting international small enterprise development, Miles D, Cross Cultural Management Vol. 2 No. 3, pp 39-46, 1995
- International experience in developing private sector infrastructure capacity, Miles D., ACSP-Detroit Conference, 1995
- The Client/Contractor Relationship in Labour-based Construction and Maintenance, Miles D., 5th ASIST Regional Seminar, Accra, Apr-96
- Force Account or Contractors?: A comparison of Kenya and Ghana, Taylor G., 5th ASIST Regional Seminar, Accra, Apr-96
- Effective Technical Co-operation for Construction Industry Development, Miles D., CIB Beijing International Conference, 1996
- Tractors in roadworks and the MART Initiative, Petts R, Landwards, IAgrE, July 1997
- Promoting Small Contractors in Lesotho: Privatisation in practice, Miles D, Proceedings of the Institution of Civil Engineers: Civil Engineering, Vol. 114 Issue 3 pp 124-129, August 1996
- A Decade of Small Contractor Development In Asia: Lessons from project experience, Miles D., Public Works Management and Policy (USA), Vol. 1 No. 3 pp245-257, 1997

- The Development of Labour-Based contracting for Roadworks: Lessons from Ghana, Mozambique and Lesotho, Miles D**,** deVeen J, & Clifton J, International Workshop on Rural Infrastructure, World Bank / EDI, May-97
- Management of Appropriate Road Technology (MART), Miles D & Petts R, Routes / Roads No. 295, World Road Association (PIARC), Jul-97
- International Initiatives to Promote Contractor-based Road Construction and Maintenance, Miles and Larcher, submitted for the 4th International Conference on Managing Pavements, Durban 1998

Books

- Labour Based Roadworks: A state of the art review, Larcher P, IT Publications, London
- Improve Your Construction Business: Pricing and Bidding (Handbook & Workbook), Andersson C, Miles D, Neale R and Ward J, ILO Geneva
- Improve Your Construction Business: Site Management (Handbook & Workbook), Andersson C, Miles D, Neale R and Ward J, ILO Geneva
- Improve Your Construction Business: Business Management (Handbook & Workbook.), Andersson C, Miles D, and Ward J, ILO Geneva
- Road Maintenance and Regravelling (ROMAR) Using Labour-based Methods (Handbook and Workbook), Andersson C, Beusch A & Miles D., IT Publications, London

IT Publications' books are available from: 103-105 Southampton Row, London, WC1B 4HH
ILO publications are available from: ILO, Millbank Tower, 21-24 Millbank, London, SW1P 4QP

Forthcoming Publications

- Rules for Roads: Towards a sustainable market for labour-based road contracting
- Intermediate Equipment Handbook (Vols. 1 & 2)
- Guidelines on Handtools for Construction

Note: In the case of co-authored publications, the name of the MART author is underlined