COLLABORATIVE RESEARCH INTO REDUCING ROAD COSTS IN DEVELOPING COUNTRIES: THE MART EXPERIENCE

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Abstract

Developing countries face a number of common access problems, which call for multi-disciplinary transport research. Access constraints are severe in both rural and urban areas, but funds are short for both road construction and maintenance. This case reviews experience in responding to a call for research on "reducing the costs of constructing, rehabilitating and maintaining road infrastructure, and vehicle operations", and describes how three non-Governmental organisations have worked together to promote and synthesise research on the topic through a project entitled Management of Appropriate Road Technology (MART). The research programme was pursued in four theme areas of hand tools, intermediate equipment, expanding private sector capacity and institution building. The paper reviews the information gathered through the collaborative approach adopted by the project team, leading to a discussion of the findings and an assessment of future priorities.

INTRODUCTION

Over the past fifty years numerous developing countries have gained independence, and among the many investment priorities for these newly independent nations the need for an effective road network was seen as paramount by governments, international financing agencies and bilateral/multilateral aid donors. Large sums of money were invested in many low income countries to establish a good quality basic road network. Unfortunately this investment frequently proved to be unsustainable when maintenance relied upon national budgetary allocations, while donors were reluctant to fund long term revenue expenditure of this kind. Thus projected financial rates of return that had been used to justify these road projects proved illusory, and many roads deteriorated into barely passable tracks.

In the mid 1970s governments and donor agencies began to appreciate that a large part of many countries' road networks had been lost due to neglect of maintenance. However, there was no large funding available to rehabilitate and maintain these networks. Access constraints in the rural areas of many countries were particularly severe, resulting in high transportation costs which adversely affected the potential profitability of local enterprises. Once it became clear that the problems were more complex than previously thought, with conflicting demands for various types of access, no obvious technical solutions and limited funds, there was a clear need for practical multi-disciplinary transport research to make effective use of the limited resources available to governments and their road departments.

A better resource mix was one avenue that could be explored. The one resource that is in abundant supply in the majority of low income countries is labour, with a large proportion of the population of working age either unemployed or under-employed. The cost of this labour was also potentially economically competitive with wage rates in the range of $1-$5 per day. Yet the potential for employment creation was rarely realised, largely because engineers and other construction professionals tended to propose conventional solutions which favoured the use of plant and equipment. Research on alternative road technologies led to a gradual realisation that there was scope for applying some form of labour-based or labour-intensive technology so as to maximise the use of local resources.

The terms labour-based and labour-intensive are generally regarded as synonymous, although in South Africa it has been argued that the term *labour-intensive* implies the use of as much labour as possible whereas *labour-based* aims also to change the technology employed to make it appropriate for manual construction methods (Watermeyer, 1993). For the purposes of this paper, which is not South Africa-specific, the terms will be used interchangeably, but bearing in mind Watermeyer's useful caveat that:

> *Labour-based* construction methods necessitate the complete reappraisal of design and construction techniques, in order to find solutions appropriate to manual methods. The design approach needs to question and challenge traditional procedures and methods.

The first concerted attempt to apply labour-based techniques to road rehabilitation and maintenance on a large scale in Africa was the Kenya Rural Access Roads Programme (RARP) which commenced in 1974 (de Veen 1980). The project not only created employment both directly and indirectly (by improving market access for local produce), but also demonstrated that these methods were economically feasible for road construction and maintenance. The RARP also showed that labour-based methods were not technically inferior, providing suitable tools and equipment and efficient management procedures were adopted. The success of the RARP project acted as the model for the development of labour based road programmes in many other countries in sub-Saharan Africa and elsewhere (Edmonds and de Veen 1992).

Although labour-based technologies proved their potential when introduced under project conditions with international technical assistance, the reliance on direct labour execution was a lurking weakness which lead to declining levels of operational performance. This resulted in a growing interest to stimulate private sector involvement, on the grounds that these small private enterprises would be more flexible and would be able to be able to achieve and maintain better levels of productivity than large direct labour organisations. In this context small scale contractors are considered as one person (usually one man) businesses which employ few (if any) permanent supervisory staff and may own a few simple items of equipment. They employ casual labour depending on the availability and size of the job(s) that they are undertaking. These small scale contractors, in order to survive, must be highly cost conscious and work as efficiently as possible. Their lack of capital often means that they have no choice but to adopt labour-based techniques and thereby provide local employment. The short chain of command allows decisions to be made quickly avoiding bureaucratic delays. Casual labourers are also more motivated by the competitive environment, and the more entrepreneurial minded are likely to seek out their own business opportunities.

Over the last decade these considerations have led to moves towards the privatisation of road maintenance in many low income countries. While the principle of involving the private sector achieved broad acceptance, there was an inadequate understanding of the institutional changes that are required when road construction and maintenance are moved from force account to private sector operations. This paper reviews the work and findings of the initial 3-year phase of the MART (Management of Appropriate Road Technology) research project, which has initiated an integrated programme of research in order to advise on the optimum use of local resources and skills, the effective use of the private sector and the application of good management practices in both contracting and engineering organisations.

UK FUNDING OF OVERSEAS TRANSPORT RESEARCH

The Department for International Development (DFID - formerly ODA) is the source of UK official aid. Its current annual budget of £2.2 billion includes a component to finance engineering research in various infrastructure sectors. Within the transport area, the government has recently confirmed its commitment to improving infrastructure and transport links by *inter alia*:

- working with partners to develop rural feeder roads projects which train small local contractors and provides both local employment for villages and access to markets and other social services; and
- seeking appropriate ways to increase community participation in road maintenance and develop guidelines on improving the effectiveness of the involvement of communities in the maintenance and improvement of their local roads and tracks in order to protect community assets. (Department for International Development 1997)

Since 1994 DFID has issued an annual call for proposals to undertake practically-orientated research that will assist in the achievement of its objectives, one of which provides for research on "reducing the costs of constructing, rehabilitating and maintaining road infrastructure, and vehicle operations". DFID actively encourages collaborative research work among compatible organisations, which was a feature of the MART project proposal. The project was led by Loughborough University's Institute of Development Engineering, with broad experience in infrastructure and construction industry development, in collaboration with specialist consultants Intech Associates and IT Transport, who offer complementary experience in transport and road issues. The MART partners' intention to use the project as the basis for a continuing MART Initiative was seen as a further attraction, since DFID is keen to encourage wide dissemination of research findings.

THE MART PROJECT

In their research project proposal, the MART team identified two key problems.

1. Although donors and international agencies have invested heavily in labour-based road projects, published information on lessons learnt was scanty. Aid programmes tend to concentrate on specific projects rather than developing common procedures and systems, resulting in experience being fragmented and poorly documented. As the focus had been on individual country projects, it was necessary to draw together project experience and undertake general research on appropriate tools, equipment training materials, documents and routines.
2. The potential contribution of the private sector had been generally neglected. Technical co-operation projects had frequently been implemented through large cumbersome direct labour organisations with poor management structures. Their poor operational performance had damaged the reputation of labour-based road works. More recent projects executed through the private sector showed that higher productivity levels were attainable, making labour-based technologies more sustainable in the longer term.

Based on these two observations the project team divided the research programme into four theme areas, allowing the partners to focus on their specialist areas:

- Hand tools
- Intermediate equipment
- Expanding private sector capacity
- Institution building

The complementary range of skills and experience available to the project partners has ensured that both the technical and socio-economic issues of each theme have been properly addressed. Although different problems affected the work required in each of these theme areas, the project team initially undertook a similar work approach in each area, before diversifying on different work plans. The first stage was to collect and synthesise experience and reports from existing projects. Following the review of the data, areas requiring further investigations were highlighted, allowing the team to prioritise work activities in order to prepare the guidelines for each theme area. Fig. 1 below summarises the approach adopted to implementing project activities.

PHASE	*1 PREPARATION*	*2 REVIEW*	*3 INVESTIGATIONS AND COMPILATIONS*	*4 PRESENTATION AND DISSEMINATION*	*5 FOLLOW UP*
MAIN ACTIVITIES	*Programme planning. Establishment of institutional linkages. Inception Report Initiate prize competition for papers reviewing experiences and needs(sponsored by the British Public Works Association).*	*Review Workshop on Local Contractor Development (Zimbabwe) Review Workshop on Intermediate Equipment (Ghana). Judge competition papers and prepare for publication.*	*Finalise planning of MART activities. Publish Workshop proceedings. Carry out, monitor and evaluate investigations and development work Produce draft guidelines, peer review and prepare Final Guidelines*	*UK Seminar to present MART theme Guidelines Discuss and plan dissemination, R&D support and further required initiatives.*	*Publish and disseminate Guidelines and supporting documentation to research and academic institutions, and practitioners Collate comments and experiences, for future editions of the guidelines*
CONTINUOUS	*Institution building to promote centres of excellence in selected countries/regional centres*				

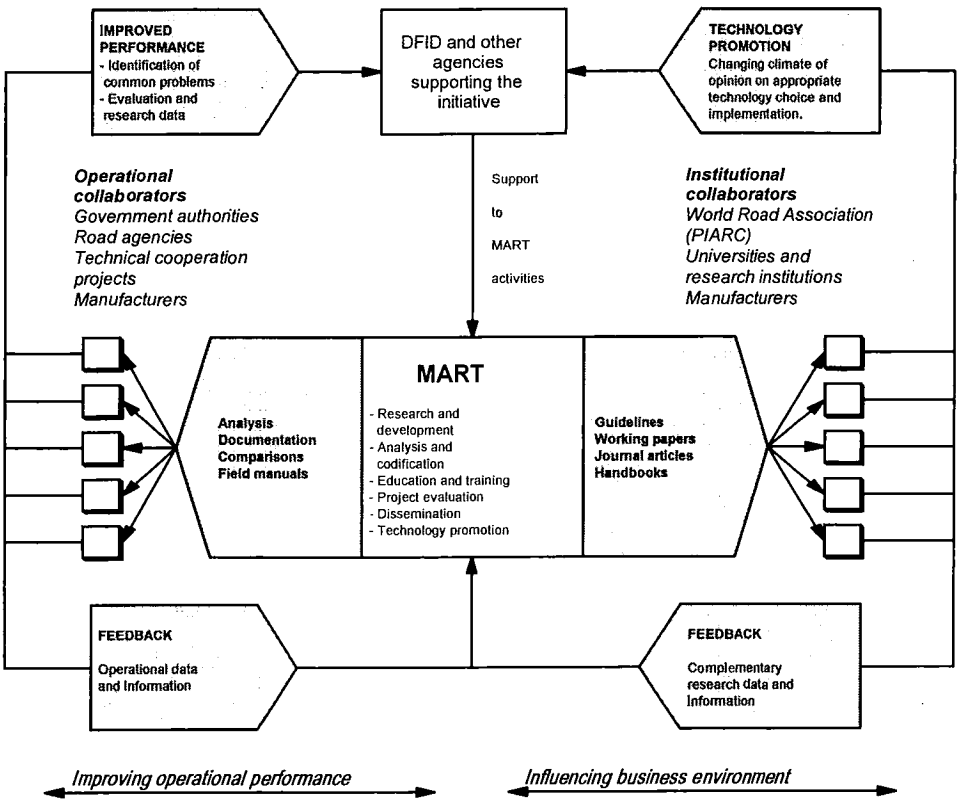
Source: Miles and Petts, 1997.

Fig.1 MART project activities

The MART team has initiated collaborative links with other relevant local and international organisations including:

- the World Road Association (PIARC)
- the Institution of Civil Engineers Appropriate Development Panel
- International Forum for Rural Transport and Development (IFRTD)
- ASIST (International Labour Office project)
- UK consultants
- Non Governmental Organisation (NGOs)

Collaborating organisations are interested in improving the implementation of road improvement or contractor development projects and/or the overall business environment in which these developments take place. This dichotomy not only results in a variety of types and format of information but also a requirement for a variety of outputs from the MART project if its clients' needs are to be satisfied. Fig. 2 shows how the team attempts to meet the needs of these two institutional groups. It shows that in order to meet the needs of either institutional collaborators or operational collaborators it is essential that feedback and information is obtained from both groups.



Source: Miles and Petts, 1997.

Fig. 2 MART information flow and dissemination plan

The programme primarily aimed to provide advice in a form that would reduce wasteful duplication of lessons that had been learned elsewhere, by collating and analysing field experience in labour based road works and the use of the private sector. The output would include working papers and articles in technical journals, leading to the formulation of guidelines that can be used by policy makers and practitioners working in the field. The guidelines produced by the project cover the three core topics:

- Hand tools for construction
- A guide to the use of intermediate equipment
- A book on institutional and organisational issues with the provisional title *Rules for Roads: Towards a sustainable market for labour based road contracting.*

The MART programme has highlighted the need to promote continuous learning from diverse field experience in order to gradually improve the way in which these initiatives are designed and implemented. Most infrastructure projects are subjected to the internal disciplines of planning, implementation, monitoring and evaluation (Fig. 3). However, to obtain the maximum benefit from a continuing programme of development, it is necessary for component projects to be successively assessed to organise feedback, ideas and experiences and disseminate them to those responsible for the design and implementation of future projects. This iterative learning process is what the MART Initiative aims to promote (Fig. 4).

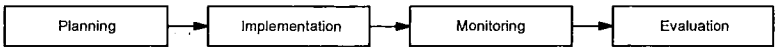


Fig. 3 Project management disciplines

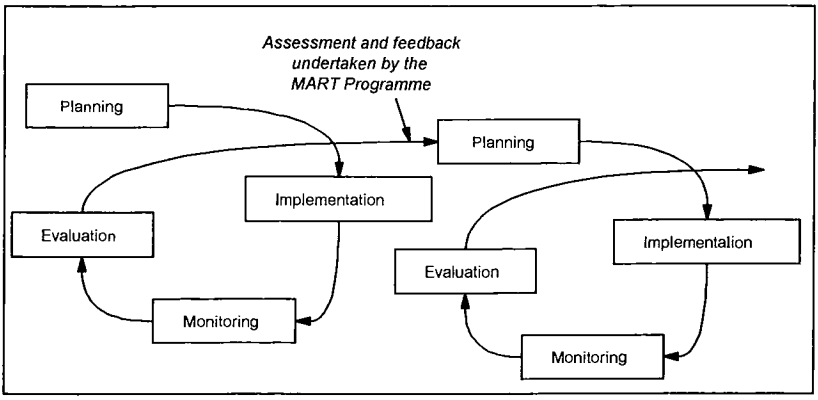


Fig. 4 Iterative learning process

The MART Initiative aims to continue with the dissemination of existing information by identifying and strengthening opportunities for international networking and collaborative work on outstanding issues. However, to be effective these links must offer an efficient dissemination route to project planners including seminars, a database of resources and Internet-based resource information, drawing on knowledge and information from a wide variety of collaborating organisations.

Hand tools

The share of wages in the cost of labour based road construction and maintenance is generally in the range of 30-50% (IT Transport 1997a) The competitiveness of these methods is therefore heavily dependent on the productivity of the labour force. Although it is logical to suppose that tool quality affects the productivity of labour based works, there was very little evidence to quantify the difference in productivity achieved by using tools of different quality. Agreed standards and specifications were available (ILO 1981), but poor quality hand tools are still being used in many road projects. The results of a survey undertaken by MART (IT Transport 1997b) showed that the main criteria for procuring hand tools are relative availability and immediate cost. Within sub-Saharan Africa this favours poorer quality tools imported from Asia. If a choice of brands is available, good quality tools are only chosen if experienced technical staff manage the procurement process. However, if the tools are obtained by a non-technical procurement officer or tender board the lowest cost tools are generally chosen, irrespective of quality. The survey also showed that new tools are rarely tested for conformity to specification, other than a brief visual inspection.

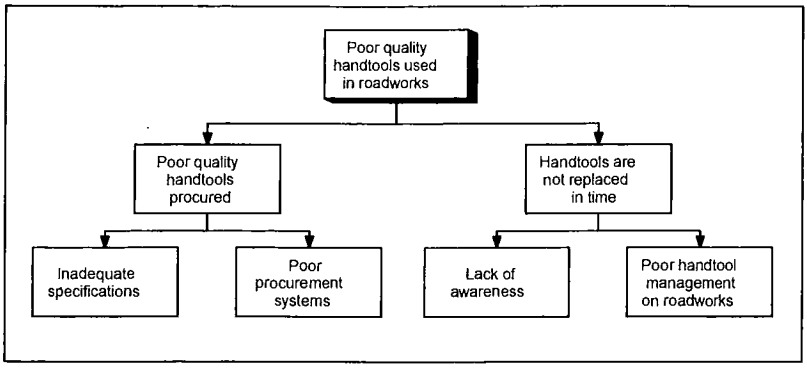
The move from direct labour-executed road works to private sector contracting might have been expected to lead to a more rational choice, but there is evidence that road construction and maintenance projects which seek to promote the use of private contractors still frequently utilise poor quality tools. Interviews with contractors suggest two reasons for this:

1. Many government-initiated contracting projects procure tools centrally on the criterion of least immediate cost, and then sell these on to contractors.
2. Contractors frequently do not appreciate that significantly higher levels of productivity could be achieved with better tools.

Fig. 5 summarises the causes of continuing use of poor quality tools. The issues on the left of this diagram are well known and a large amount of work has been carried out in an attempt to improve the initial quality of tools. The guidelines produced by MART, with the provisional title *Hand tools for Construction*, attempt to build on previous work undertaken in this area by:

- raising awareness, especially among contractors, of the cost advantage when workers are supplied with good quality hand tools
- making standards more readily available and accessible to personnel involved in procurement
- advocating simple, on site, acceptance tests
- promoting the sources of good quality tools

The MART programme has also highlighted the neglected problems on the right of the diagram. In some areas of Africa there is little demand for higher quality tools which are suitable for road works. The uneconomical distribution of these higher quality tools in small numbers through scattered retailers results in high unit prices and encourages the purchase of poorer, but cheaper, tools. Productivity research has shown that the immediate difference in output between new tools of different quality is very small. However, the productivity of the poor quality tool drops off more quickly. For example the use of a poor quality, worn shovel for ditching work reduces long term productivity be 22%. The research has also shown that few contractors are aware of the decline in productivity, and hence profit, when badly worn hand tools are employed. The MART Guidelines also highlight the need to replace tools before they become too worn, regardless of the initial quality, and also offer advice on hand tool management, including site maintenance procedures.



Source: Taylor 1997

Fig. 5 Poor quality hand tools: the causes

Intermediate Equipment

The theme area of intermediate equipment draws on the extensive field experience of Intech Associates, with attention directed to socio-economic as well as technical factors. As labour-based techniques gained favour, it became clear that there was a need to support the labour force with basic equipment for certain tasks which are less suited to the labour-based approach. These include material haulage for distances greater than 200 metres, compaction of the road surface and maintenance grading of unsealed roads. The conventional solution might be to bring in heavy construction plant to excavate, move and regrade material. However, intermediate equipment, based on the agricultural tractor, can often prove both more effective and more economic. Furthermore it can often be locally manufactured, or at least locally repaired and maintained, and is sufficiently versatile to be put to other remunerative uses when not required for construction or maintenance. The object of promoting intermediate equipment is not to displace labour but to complement it. MART aims to show that an optimal mix of labour and intermediate equipment can provide a socially, economically and technically superior solution to a heavy equipment-based approach (see Table 1).

Table 1 Definition of the two equipment approaches

Heavy Construction Plant	Intermediate Equipment
Sophisticated civil engineering equipment designed for, and manufactured in, high-wage, low-investment-charge economies. Expected to operate with close support and high annual utilisation. Usually designed for a single function with high efficiency operation.	Simple 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.

Source: Petts, 1997

The definition of heavy construction plant highlights some of the problems which are commonly encountered when conventional plant is used in developing countries. Each item of equipment has a dedicated function which results in an interdependence. If one item of equipment breaks down then the whole fleet becomes idle as 'a link in the chain' has been broken. In addition the equipment often relies upon sophisticated mechanics, hydraulics and electronics to be fully operational. The specialist spare parts as well as the maintenance and repair skills for these items of equipment are

only available, at best, in capital cities. All equipment and spares have to be imported which consumes scarce foreign exchange and in the case of spare parts may take weeks or even months to obtain. Plant manufacturers also produce model improvements and cease stocking spares for old and 'obsolete' equipment.

Heavy plant is particularly unaffordable and unsuitable where small scale contractors are to carry out road works. They require equipment which is not only cheap to purchase but also robust and easily maintainable in a modest rural workshop. By developing designs that could be manufactured locally, further employment opportunities can be created and the lack of support services overcome. There are also economic arguments for the development of intermediate equipment. Many developing countries are subject to high interest rates, especially for the purchase of construction equipment which may not earn a reliable return. These high interest charges coupled with the high capital cost of heavy plant makes their use on all but the largest project economically unjustifiable. The argument is based on the utilisation requirement in terms of number of hours per year which the equipment is required to operate in order to cover its fixed and variable costs. While the operating costs may be virtually constant regardless of the number of utilisation hours, the finance costs and depreciation increase dramatically as the number of utilisation hours decreases. The graphs in Fig.6 below compare costs of using a motor grader and a tractor with a towed grader based on a 12-year economic life and an interest rate of 20%. (Petts 1997)

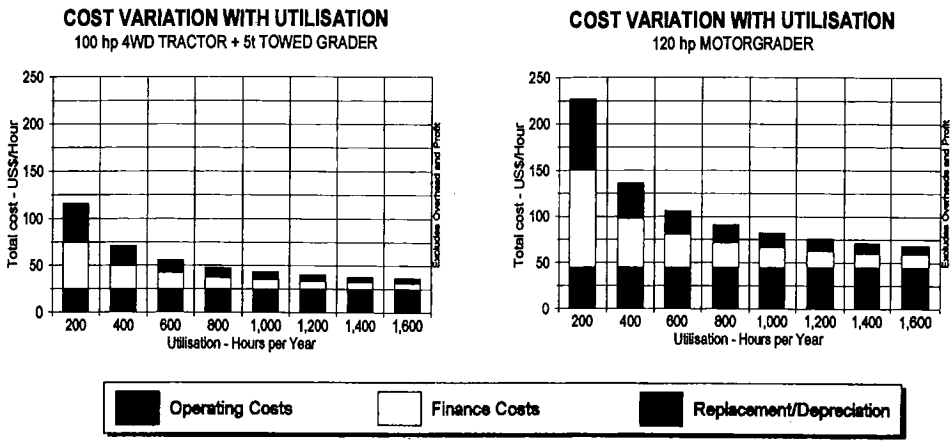


Fig. 6 Cost variation for motor grader and tractor-towed grader

A contractor operating in a typical industrialised country would expect to achieve a utilisation of about 1000 hours per year. At this point on both graphs the cost variation against utilisation is small due to the high proportion of the operating cost in the total price. However, a contractor in a developing economy would be lucky to achieve a utilisation of 400 hours due to cyclical demand and unpredictable delays. At this level of utilisation the cost of the motor grader is significantly higher than the tractor and towed grader. The total cost per hour also changes significantly for changes in the level of utilisation. These graphs highlight the problems contractors working in low income countries face when they attempt to utilise sophisticated plant.

A MART survey of the problems associated with intermediate equipment (Larcher and Petts 1997) confirmed these concerns but also highlighted a general lack of awareness by road authorities and

contractors on the availability, capabilities, flexibility, capital and operating costs, and procurement sources for intermediate equipment. This was exacerbated by the poor awareness among client and contracting organisations of the real cost of owning and operating items of equipment. Many organisations seemed unaware that the cost of owning equipment should include loan interest and depreciation in addition to direct running costs such as operator wages or fuel. The survey also highlighted the lack of proven designs for items of intermediate equipment and inadequate training material in the procurement, management and operation of equipment. Contractors were generally unable to hire equipment and experienced great difficulties in obtaining loans to purchase equipment. The critical issues are:

- the lack of awareness of the total cost of using different equipment; and
- poor general awareness of the use, ability and arguments for intermediate equipment.

The intermediate equipment handbook produced by the MART project aims to address these issues by providing a reference document on items of intermediate equipment. For each item the handbook includes a description of the equipment item and details of its capabilities. The handbook also provides information and proforma to build up and calculate the cost of operating the piece of equipment. It is anticipated that this equipment handbook will form a useful training manual and show the potential for intermediate equipment plant hire companies. Heavy construction plant will still continue to be justifiable on many large, paved main road, reconstruction and rehabilitation projects where the factors of heavy traffic, sophisticated technical specifications, high guaranteed plant utilisation, economies of scale, intensive management, rapid implementation and relatively simple logistics favour a large-contractor, capital-intensive approach. However for most other road works in developing countries the use of intermediate equipment and labour is often cheaper and more appropriate. There are also strong political and social arguments for adopting a more local-resource orientated approach.

Local contractor development

Research undertaken by the MART project on the use of appropriate technology road works has revealed a poor adoption of the technology and low contracting capacity for the potential work available (Larcher and Petts 1997). Work carried out by the ILO over the past few years in Ghana, Madagascar and the Philippines 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, and being paid on time and operating within very demanding contractual regulations; these problems remain the same whatever the technology (Miles 1995a). There is also often a poor representation of contractors' interests, due to an absence of a contractors' association or other representative body.

Interest in local contractor development has grown gradually over the past two decades, as countries appreciated the scope for improved operational performance and the creation of relatively secure employment opportunities by mobilising their local private sectors. The first step for the project team was to review existing information, with a preliminary identification of problem areas to be tackled under the MART project and associated initiatives, which enabled analysis of recent project experience in Africa and Asia (Miles 1995b, 1996a and 1997). In order to benefit from current experience of practitioners, an international workshop was sponsored jointly with the ILO/ASIST project, at Mazvikadei, Zimbabwe. As a result, MART has published a framework document entitled *Towards Guidelines for Labour-Based Contracting* (Miles 1996b). The framework document addressed both institutional issues (of primary interest to MART) and operational issues (of immediate interest to the ILO in view of their large technical co-operation programme). Key issues identified by workshop participants in the two broad issue areas are listed in Table 2.

Table 2 Labour-based contracting development: Key issues

Institutional issues	Operational issues
1. Focus: objectives and benefits	1. Introduction
2. Investment and market profiles	2. Delivery systems
3. Enabling environment	3. Technologies
4. Contracting development policies	4. Contractor identification
5. Funding mechanisms	5. Contract procedures
6. Capacity building for delivery systems	6. Access to resources
	7. Equipment maintenance management systems
	8. Control and monitoring capacity
	9. Labour issues
	10. Training programmes

The MART project is focusing on developing guidelines on the institutional aspects of contractor development, which will be published in 1999 as a book with the provisional title of *Rules for Roads: Towards a Sustainable Market for Labour-based Road Contracting*. This book will provide policy makers with a framework and discussion of the issues to be addressed. It cannot offer all the answers to the problems of developing small scale private contractors and initiating the necessary institutional changes required to promote a privatised construction industry but highlights options available on key issues which need to be addressed.

Institutional strengthening

This theme requires the application of knowledge on organisational development and change management issues as well as an understanding of the characteristics of construction as an economic sector. With an increasing interest in the commercialisation of road provision, the first step was to gain a better understanding of the features of this market and the role that is available for local small scale contractors as service providers. This work included analysis of the economics of road provision, business management, procurement procedures and government policies. The public sector is, and is likely to remain, the predominant client for infrastructure in most developing countries. Government not only controls the process by which infrastructure is financed but also influences attitudes, policies, institutions and working practices. The overriding factor in initiating change is therefore the commitment of government at all levels to create a favourable enabling environment, coupled with a commitment to honest and open government. The rule of law and the absence of corruption are crucial in attracting external financing as well as ensuring a properly functioning market for road construction and maintenance.

Institutions are commonly regarded as organisations, but a more useful definition is *the rules which govern the relations among individuals and groups and which are commonly known and used by those involved* (Schroeder 1997). A key aim of institutional strengthening in the context of the MART Initiative is to find ways of ensuring that engineers and other professionals concerned with road construction and maintenance take proper account of the socio-economic dimension in choosing and implementing technological solutions in low- and middle-income countries. The task of institutional strengthening is undoubtedly the most testing of the four priority topics faced by the MART team, bearing in mind the need to help participating organisations to meet the following range of demanding criteria (Miles and Neale 1991):

- strong and knowledgeable leadership;
- a pronounced practical orientation;
- closest possible links with the client base;
- an interdisciplinary and problem-oriented approach;

- a coherent and balanced portfolio of intervention methods (training, consultancy, research, information services);
- flexibility in reacting to new situations, needs and challenges;
- competent and motivated staff;
- operational autonomy; and
- impact judged according to actual results achieved by clients served.

There is a need to promote existing training documentation and support the incorporation of labour-based infrastructure works as a mainstream option in education and training institutions. MART has prepared an outline modular plan for teaching/training to support private sector implementation of labour-based construction programmes, by devising and testing a 3-week module on *Contractor Development* at Loughborough's Water, Engineering and Development Centre (WEDC). This module is available either as a short stand-alone course, or as an integral part of a development-oriented MSc programme. When the module has been fully tested, it may be offered with local collaborating institutions through some form of twinning arrangement.

In relation to the institutional aspects of private sector implementation, the ILO has made a major contribution by publishing three sets of *Improve Your Construction Business* (IYCB) handbooks/workbooks (Andersson et al 1994-6), together with a *Routine Maintenance and Regravelling* (ROMAR) handbook and workbook (Andersson et al 1996) (all with contributions by MART personnel as co-authors). These books are an important training and self-study resource, but more work is required on systems to consolidate their use in effective integrated contractor development programmes which will enable participants to achieve self-sufficiency.

Each country is different. While they may share common features, there are no standardised 'policy packages', and each country or district will need to develop their own policy mix depending on the current economic, social and political environment. While certain areas of activity may be targeted for support careful consideration must be given to the effect on parties who do benefit from what may be support to a minority group. The parallel issue of enabling client institutions to cope with their changing role as commissioners and supervisors of work executed by contractors also merits attention. As a first step, investigations are being made to determine the need for in-country support for road supervisor training programmes, based on existing documentation such as *The International Road Maintenance Handbook* (Petts 1994), funded by DFID and issued under PIARC, as well as a number of ILO documents specifically designed for supervisor training. In some countries such courses are readily available but may not stress sufficiently the need to apply appropriate technologies, while in others there is a serious dearth of sources of training to meet the needs of the sector, both to ensure effective quality procedures and to permit the trainees to acquire appropriate accreditation.

FUTURE PRIORITIES

The MART project has highlighted the need to document experiences and feedback information, even on topics where the principles are readily comprehensible and the technologies are relatively unsophisticated. This is particularly true in the field of applying appropriate road technologies and management practices, where social and cultural differences can profoundly influence the practicability of alternative approaches. For a small additional financial investment in projects which allow project personnel the time and resources to document their experience, the learning curve may be reduced for future projects.

The resources available to the MART partners are small in relation to the scale of the problems faced by the road sector in low- and middle-income countries, so there is a continuing need for global co-

ordination of the various initiatives that are currently under way. To this end, collaboration with the World Road Association (PIARC) is vital in view of its global membership as well as the scope for complementary research. PIARC has a series of Committees and Working Groups, which draw together international experts who interpret the results of ongoing research and offer suggestions on ways of putting them into practice. It is recognised as an authoritative and neutral forum for the dissemination of research results in French and Spanish as well as English. MART personnel are participating in the current work programmes of its Committees C3 (Technological Exchanges and Development) and C6 (Road Management), all of which are relevant to the objectives of the MART programme (see Table 3) .

Table 3 PIARC work programmes 1996/99 for Committees C3 and C6

C3 Technological Exchanges and Development	C6 Road Management
1. Technology of technology transfer	1. Customer-defined levels of service
2. Financing maintenance under severe budget constraints	2. Quality management systems
3. Facilitate stronger links with regional/national organisations	3. Contract maintenance
4. Better use of local resources	4. Planning and budgeting maintenance
5. Road transport investment and development	5. Training for maintenance
	6. Presenting budgets to decision-makers*
	7. Performance measures

** Subsequently merged with work area 4.*

MART is essentially an enabling initiative, and can only achieve success by working with and through other organisations. To follow up and carry forward our current activities, we would welcome the opportunity to initiate a network to encourage collaboration with donors, consultants, organisations, research and academic institutions with a mutual interest in supporting and promoting appropriate construction technologies and management techniques.

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