Handbook of Intermediate Equipment
for
Road Works in Emerging Economies
(Selection and Costing)

Robert Petts - Intech Associates

Edition 1 – October 2012

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by

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Endorsed by

FOREWORD

A country's road network can be compared with our own arteries, in that they both ensure that the very life-blood, of the country or body, is able to flow freely and efficiently. Unfortunately, if either the arteries or the roads are not maintained satisfactorily, life and business slows down dramatically, or at worst stops altogether. All of you who travel widely will recognise, only too well, the effects of poor road maintenance, leading to delays, increased vehicle wear and damage, reduced access and services, and the inability of the country to enable the effective and safe transport of their people and goods to market.

The lack of available funds are often given as a major reason for the poor level of road maintenance in many countries, but this 'excuse' is often based on the incorrect assumption that the work always requires the use of large and expensive equipment and methods. Complex and advanced technology often also requires that the necessary expertise and management have to be sourced externally, resulting in the necessary skills not being developed within the country itself. For minor roads and tracks the use of purely labour based maintenance methods is often seen as the only affordable alternative solution, but the increase in both frequency and size of modern traffic, now dictates the need for a more viable and appropriate technology based approach.

Through their long experience and knowledge, the author and contributors of the **'Handbook of Intermediate Equipment'** have demonstrated that there is now a very viable and effective alternative to having to rely on the use of heavy/expensive equipment, or solely on labour based methods. Proven technology and methods designed principally around affordable agricultural tractors and intermediate equipment, ensure that local contractors, with the right support, can now not only compete for local road construction and maintenance contracts, but also diversify their operations into supporting agricultural and transport needs in their region. The 'win win' situation is that both the country and local people can benefit through increased employment and income generation, as well as improved roads and local agricultural efficiency.

This Handbook provides an essential reference for not only local contractors, and entrepreneurs, but also for governments and development agencies, in order to plan and introduce practical, affordable and sustainable, rehabilitation and maintenance programmes for their country's rural road systems.

Malcolm Cutler
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THE FUTURE

This Handbook has been planned as a dynamic knowledge source, to be available to practitioners free of charge in electronic form. Comments and contributions for future editions are welcomed by the Author. Extracts from the Handbook may be used freely, provided that the source is appropriately acknowledged by title and author. Suitable download web-sites are being investigated to make this Handbook available to as wide an audience as possible.

At the time of finalising the initial edition of this Manual, there are concerns and intense discussions on the issue of the carbon footprint of all economic and social activities. Available data is currently limited on construction equipment sourcing and application. However, the Author believes that this issue will become increasingly important in political and economic decision making. It is possible that Intermediate Equipment approaches will be shown to have the potential to provide more eco-friendly and sustainable solutions to rural development challenges as further research knowledge becomes available. These will be in addition to the undoubted social, local employment and affordability benefits.

This Handbook focuses on a number of key issues relating to equipment ownership and operation. Research for this document has highlighted significant knowledge gaps that could be beneficially investigated. Besides the carbon footprint issues, there is a need for more knowledge and better understanding of the potential, performance, limitations and factors affecting operation and costs of Intermediate Equipment in Emerging and Developing regions. It is planned to develop a companion guide on Intermediate Equipment operation.

The benefits of the Intermediate Equipment approaches will not be realised unless all of the sector stakeholders act in concert to disseminate, support and ensure the mainstreaming of the concepts and approaches embodied in this Handbook.

DISCLAIMER

Any person using the knowledge or recommendations of this Handbook should do so in accordance with local laws, regulations, standards and in respect of local customs and traditions. Any equipment can be dangerous to use if not operated properly and safely. The safety of operators, workers, road users and any bystanders is of upmost importance. Owners should ensure that all necessary training, supervision of operations and reasonable safety measures are arranged. The Author takes no responsibility for inappropriate or unsafe use of equipment in pursuance of the concepts and principles described in this Handbook.

CONTENTS

Page

THIS HANDBOOK

This Handbook sets out guidelines for the costing and procurement of intermediate equipment. These are two key management functions necessary to achieve successful and affordable road works in the limited resource environment typical of economically emerging and developing countries (EDCs). Some of the intermediate equipment items have useful applications or income earning potential in other sectors such as transport and agriculture.

The Handbook is aimed primarily at Contractors, Contractors Associations, Road Engineers, Planners, Investors, Equipment and other Managers involved with road works in emerging and developing economies. However, it is expected that Trainers and Educational Establishments will be able to incorporate material from the Handbook in their human resource development courses. Parts of this Handbook may be reproduced for this purpose provided that the source is clearly acknowledged by Title and Author.

This Handbook is not intended as a definitive document, as developments and improvements continue. Neither is the Handbook a comprehensive guide to equipment management. It is anticipated that this Handbook will be developed and updated from time to time to accommodate equipment management field experiences, and the development of individual intermediate equipment items.

The Handbook

- Introduces the concept and rationale for 'Intermediate Equipment'
- Provides guidelines on issues to consider and detailed costing of intermediate equipment for road works in emerging and developing countries.
- Includes a simple paper-based model for calculation of ALL components of the cost of ownership and operation of selected items of intermediate equipment, and example calculations.
- Provides guidelines on issues to consider regarding selection and procurement of intermediate equipment for road works in emerging and developing countries.
- Includes suggested specifications for procurement of selected items of intermediate equipment

Important pre-conditions for the successful application of Intermediate Equipment in road works and other sectors include appreciation of the opportunities for proven applications in prequalification and contract documentation, and works specifications, so that options for beneficial use of such equipment are not excluded.

All correspondence concerning the contents or suggested improvements regarding this manual should be directed to the Author.

ABBREVIATIONS

AFCAP	Africa Community Access Programme
Ah	Ampere hour
BPWA	British Public Works Association
CIDA	Canadian International Development Agency
CIF	Cost, Insurance, and Freight
CKD	Complete Knock Down (kit)
DANIDA	Danish International Development Authority
DFID	Department For International Development (formerly ODA)
DGIS	Directorate General for International Cooperation
dia	diameter
DIN	Deutsches Institut für Normung (German Standards institution)
EC	European Commission
EDCs	economically Emerging and Developing Countries
EU	European Union
FOREX	Foreign Exchange
GP	General Purpose
HD	Heavy Duty
hp	horsepower
ICE	Institution of Civil Engineers, UK
ILO	International Labour Organisation
ISO	International System of Units
ITE	Intermediate Technology Equipment
KDK	Knock Down Kit (sometimes referred to as CKD – Complete Knock Down or SKD – Semi Knocked Down Kit)
KfW	Kreditanstalt für Wiederaufbau
kg	kilogram
kW	kilowatt
LB	Labour Based
LCU	Local Currency Units
LVR	Low Volume Road
MART	Management of Appropriate Road Technology
N/A	Not Applicable
NGO	Non-Government Organisation
Nm	Newton metre
NORAD	Norwegian Agency for Development Cooperation
P.A.	Per Annum (per year)
PR	Ply Rating
PTO	Power Take Off
PTR	Pneumatic Tyre Roller
ROPS	Roll Over Protection Structure
Rpm	revolutions per minute
SAE	Society of Automotive Engineers
SAT	Single Axle Tractor
SDC	Swiss Development Cooperation and Humanitarian Aid
SIDA	Swedish International Development Authority
SKD	Semi Knock Down (kit)
SMEs	Small and Medium Enterprises
SRV	Small Rural Vehicle
t	tonne
TDR	Technology Development and Research
TRL	Transport Research Laboratory
USAID	United States Agency for International Development
V	volt
2WD	Two wheel drive
4WD	Four wheel drive

INTRODUCTION

This handbook has been developed to provide guidance on two specific areas of the ownership and use of intermediate equipment, namely costing and selection/procurement.

Experience in economically emerging and developing countries (EDCs) with both local contracting and road authority organisations and the investigations of a number of programme initiatives have demonstrated particular weaknesses in these key areas.

The consequences of this unsatisfactory situation are that both contractors and road authorities are often not aware of the true costs and implications of operation of the various types of (intermediate or heavy) equipment. Many managers are also not aware of available technology choices and lack the knowledge to make informed investment decisions. This often leads to considerable inefficiencies in the selection and operation of equipment, and poor profitability or performance of the enterprises/organisations. This is particularly alarming considering the current situation of scarce capital resources in these countries.

A further consequence is that the general public, and particularly rural communities, do not receive serviceable roads at a reasonable cost and in a sustainable way.

Using the Intermediate Equipment in this Handbook a contractor or road authority should be able to construct a wide range of road features, surfacing and paving options[1] and structures[2], and carry out efficient road maintenance operations.

After an **Introduction** to the concept and rationale of Intermediate Equipment, **Part 1** of this Handbook provides guidance on the costing of equipment, to include all aspects of ownership and operation. A simple cost model is introduced to assist owners and operators to realistically cost a piece of equipment.

Examples of the cost model application are provided in **Part 2**. Cost model examples for a motorgrader are also included for comparison purposes.

Part 3 of this Handbook provides guidance on the selection, specification and procurement of Intermediate Equipment.

Part 4 of this Handbook provides example procurement specifications for various items of Intermediate Equipment suitable for road works and other applications.

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1 Petts, Rationale for the Compilation of International Guidelines for Low-Cost Sustainable Road Surfacing (LCS) Working Paper No1, 2001.

2 Larcher, Petts & Spence, Small Structures for Rural Roads, 2010.

TECHNOLOGY

There are a number of Technology options open to CONTRACTORS AND ROAD AUTHORITIES for road works. The technologies can be broadly grouped into heavy equipment, intermediate equipment and labour (using hand tools). Many operations involve combinations of technology, however it is not widely appreciated that **there is a range of technology options for nearly every road sector construction or maintenance activity.** There are various definitions and interpretations of terminology used in the appropriate technology road works sector. The following definitions are suggested:-

LOCAL RESOURCES
These can include human resources, local government, private, NGO and community institutions, local entrepreneurs such as contractors, consultants, industrialists and artisans, local skills, locally made or intermediate equipment, local materials such as timber, stone, bricks, and marginal materials, locally raised finance or provision of materials or services in kind.

LABOUR BASED ROADWORKS
Operations carried out principally by manual methods, using hand tools. They may be supported by intermediate or sophisticated equipment for activities not ideally suited to labour methods, e.g. medium-long distance haulage, heavy compaction. Labourers usually walk or cycle to work each day from their homes.

INTERMEDIATE EQUIPMENT
Simple or intermediate equipment is 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. Modern wheeled agricultural tractors are a low cost mobile power source and with various attachments can be used to substitute for heavy equipment for a proven range of tasks in the road sector.

HEAVY PLANT
Sophisticated civil engineering equipment is typically designed for, and manufactured in, high-wage, low-investment-charge economies. It is expected to operate with close support and high annual utilisation; usually designed for a specific single function or task with high efficiency operation.

The choice of technology has important cost implications for the owner and operator of any equipment. These technology options should each be properly costed to ensure that the most technically compliant and cost-effective application of available resources is used.

Many problems encountered in the road sector in emerging and developing countries can be attributed to the application of inappropriate technology (see Box 1).

Box 1

PROBLEMS OFTEN ASSOCIATED WITH SOPHISTICATED IMPORTED HEAVY EQUIPMENT FOR ROADWORKS IN DEVELOPING COUNTRIES

Operational:

- Dedicated function (can only be used for one operation)
- Inter-dependence (e.g. dozer, loader, trucks, motorgrader, bowser, roller all required for gravelling – fleet idle when ONE link in the chain breaks down #)
- Lack of continuity of workload for plant items of dedicated function
- Usually based at locations remote from worksites – plant transporters required and long mobilization/demobilization distances involved

Technical:

- High pressure hydraulic systems
- Sophisticated mechanisms and hydraulics
- Disposable components; difficult to repair or refurbish

Local Support and Equipment Maintenance:

- Limited local market for equipment sales of each model
- Specialist repair and maintenance skills, tools and facilities required (often only available in the capital city or regional centre)
- Few dealers able to provide the necessary close support
- Long spares supply lines and delivery times
- Frequent model 'improvements' causing spares stocking and procurement problems and 'planned' obsolescence

Cost:

- All equipment and spares imported – consuming scarce foreign exchange
- High capital and finance costs
- High costs of stocking and provision of spares

RESULT - low availability & high overall costs!

 # Breakdowns are usually power unit or transmission related. By comparison, tractor power units can be reassigned between tasks if a breakdown occurs.

Source: Intech Associates

Preliminary investigations in many countries have identified the potential for considerable construction and maintenance works cost savings and beneficial flexibility from the introduction of wheeled tractor based technologies and Intermediate Equipment approaches. These approaches could be adopted by both own-force and the contracting sector to achieve the following key benefits:

- Substantially reduced capital investment and importation requirements
- Substantially reduced unit costs for a range of works items

All of this would be achieved with the essential outcome of the same, or improved[3], quality and durability of work for national, regional and local road authorities.

The potential benefits for the various stakeholders can be summarised as:

Road works – lower unit works costs, greater logistical flexibility, lower capital and operating costs

Market – provides complementary market opportunities between heavy equipment and labour technologies for improved market flexibility and efficiency. Opportunities for SMEs to enter market and provide sub-contracting and multi-sector services

Rural Communities – improved accessibility, lower transport costs, employment opportunities, better prices for crops, less crop wastage

National Economy – more serviceable roads at lower cost, SME development, local equipment manufacturing capacity development and export potential, imported equipment substitution, reduced importation of fuel and spares, rural and urban employment increases in related works and industry, increased tax base

Agricultural sector – improved roads, lower input and output costs, development of rural sector agricultural services based on tractor technology for increased tractor utilisation, farm income diversification, and lower cultivation processing and transport costs

Environmental – Lower carbon footprint of tractor technology.

EXAMPLES OF INTERMEDIATE EQUIPMENT

A wide range of intermediate equipment exists suitable for roadworks and rural services provision. Chart 1 sets out examples of Intermediate Equipment for road works identified by a workshop of sector practitioners[4].

Chart 2 shows how there can be a range of technology options for most road works activities[5]. The Chart highlights how agricultural tractors can be used as an alternative to heavy equipment or labour in just one example series of road rehabilitation operations. Similar technology choices are available for most road works operations. Chart 3 summarises the multi-sector applications and flexibility of the simple agricultural tractor as a low-cost, mobile rural power source.

[3] For example, due to the low cost and flexibility of wheeled tractor technology, it is possible to water and compact earth and gravel roads when reshaping in the dry season producing a more durable maintained surface and at lower cost.

[4] MART Working Paper No 5, Workshop Report, Intermediate Equipment for Labour-Based Roadworks, Accra, Ghana, 19 & 20 April 1996.

[5] MART Working Paper No 7, Agricultural Tractors in Roadworks, Edition 2, 2000, Robert Petts.

CHART 1 INTERMEDIATE EQUIPMENT CATEGORIES

EXCAVATION / LOADING	HAULAGE	SPREADING	COMPACTION #	SOIL STABILISATION	STRUCTURES	BITUMEN WORKS	ANCILLARY EQUIPMENT	SUPERVISION
(eg JCB)Tractor - excavator	Tractor 4WD - trailer	Tractor-towed grader	Tractor - towed vibro roller	Tractor - rotovator	Mobile crusher	Mobile Crusher	Compressor + air tools	4WD Pick-up
Tractor - backhoe	Tractor 2WD - trailer	Tractor - tipping trailer	Tractor - towed steel DW roller	Tractor - harrow	Concrete mixer	Towed bitumen heater	Tractor - brush cutter	2WD Pick-up
Tractor-scraper	Tractor-scraper	Tractor-scraper	Tractor - towed PTR	Tractor - bowser - sprayer	Concrete vibrator	Towed bitumen distributor	Tractor - grass cutter	Motor cycle
Tractor-dam scoop	Tractor-dam scoop	Tractor-dam scoop	Ride-on vibro roller	Tractor-towed grader	Simple crane	Concrete mixer	Water pump	Bicycle
Tractor-scarifier	Small tipper truck	Tractor-blade	Pedestrian vibro roller	Power tiller	Concrete dumper	Slurry box	Chain saw	Caravan
Tractor - disc plough	Small flatbed truck	Tractor-drag	Vibrating plate		Aerial ropeway	Tailgate chipping distributor	Towed fuel bowser	
Tractor-tine plough	SRV / ITEAN		Tractor - bowser + water pump		Hand operated crusher	Hand operated chip spreader	DCP	
Tractor - loader	Dumper				Culvert mould steel	Bitumen hand sprayer	MERLIN	
Rock drill	Power tiller - trailer				Culvert mould wooden		GPS	
	Animal cart				Re-usable culvert formwork		Levelling equipment	
	Hand cart				Concrete paver press			
	Wheelbarrow				Fired clay brick equipment			
					Water pump			

NOTES

Consolidation can also be achieved using loaded vehicle tyres, however not usually to compaction Specification requirements

DCP = Dynamic Cone Penetrometer

DW = Deadweight

GPS = Geographic Positioning System

ITEAN = Small locally made truck or SRV: Small Rural Vehicle

MERLIN = Roughness measurement equipment

PTR = Pneumatic Tyred Roller

vibro = vibrating

CHART 2 - CONSTRUCTION OF NEW ROAD BASE LAYER FROM EXISTING BASE AND BITUMINOUS SURFACING*

PAVED ROAD RECONSTRUCTION - TECHNOLOGY OPTIONS FOR EACH OPERATION - TRACTOR OPTIONS SHOWN EMBOLDENED

COLD PROCESS EMULSION TECHNOLOGY: Options shown generally in increasing complexity of technology down each column

1. BREAK UP EXISTING PAVEMENT	2. BREAK DOWN PAVEMENT MATERIAL TO ACCEPTABLE SIZE	3. APPLY BITUMEN EMULSION	4. MIX EMULSION AND RECYCLED PAVEMENT MATERIALS	5. SHAPE MIXED MATERIAL TO FORM NEW ROAD BASE LAYER	6. ROLL ROAD BASE LAYER	7. TEST ROAD BASE LAYER
Labour with picks, mattocks, sledgehammers, crowbars, shovels Labour with compressor and breaker tools **Wheeled tractor with ripper attachment** **Wheeled tractor with pulveriser/milling attachment** Tracked tractor with ripper attachment Self propelled milling equipment	Labour with sledgehammers, stone hammers and steel mesh **Wheeled tractor with adapted towed roller** **Wheeled tractor with pulveriser/milling attachment** Self propelled pulveriser/milling equipment	Labour using fixed volume containers per unit area Labour with one barrel hand lance **Wheeled tractor with towed/attached bitumen distributor** Truck mounted distributor	Labour with rakes and shovels **Wheeled tractor with heavy duty disc harrow** **Wheeled tractor with reciprocating harrow** **Wheeled tractor with heavy towed grader** Motor grader	Labour with rakes and shovels **Wheeled tractor with heavy towed grader** Motor grader	Labour with twin drum pedestrian vibrating roller **Wheeled tractor with towed deadweight roller**** **Wheeled tractor with towed vibrating roller** Self propelled deadweight roller** Self propelled vibrating roller	Level and thickness control Grading - sieve analysis Voids Bitumen content Benkelman Beam Falling weight Deflectometer

* The process can also be applied to the upgrading of an existing gravel surface of suitable material characteristics.

** Depending on deadweight per unit width of roll and layer thickness

*** Assumes that subgrade and/or sub base are of acceptable characteristics and any necessary repairs to the drainage system are carried out.

CHART 3 - Potential Agricultural Tractor Applications in the Rural Economy

SECTOR	OPERATIONS
AGRICULTURE	Ploughing, Harrowing, Rotovating, Sub-soiling, Haulage, Access Road Construction/Maintenance, Land clearance and levelling, Root removal, Planting, Seed Drilling, Fertiliser Application, Pesticide/Herbicide Application, Harvesting, Loading, Pond Construction, Dam Construction, Borehole Construction, Contour drains, Fencing (post hole boring)
FORESTRY	Winching, Loading, Hauling, Poling, Sawing, Access Roads
ROADS (paved and unpaved)	Gravel Haulage, Water Collection Haulage and Distribution, Personnel Transport, Bridge & Culvert Materials Haulage, Fuel Haulage, Plant Haulage (low loader trailer or semi-trailer), Towed Grading (heavy and light), Dragging, Towed Compaction (rubber tyred/steel roller), Earthworks Excavation & Haulage (towed scraper), Excavation (back hoe/ripper /scarifier/compressor & pneumatic tools), Loading (front shovel), Grass & Bush Control, Spreading Materials, Bitumen Sealing (towed bitumen/emulsion heater/sprayer), Stone crushing (towed crusher and screens), Chippings Transport, Recycling pavement (milling attachment), Brushing/Sweeping, Mixing (disc harrow), Slurry Sealing (mixer and spreader), Premix Patching Material Production, Temporary Accommodation (towed caravan/workshop)
AGRO-PROCESSORS	Threshing, Hulling, Milling, Haulage
MUNICIPAL (non-road)	Garbage Skips, Water Haulage, Night Soil Disposal
WATER SECTOR (non-road)	Pipeline Excavation, Pipe Laying, Cranage, Loading, Earth Dam Construction, Irrigation Channel Construction, Water Pumping, Water Haulage, Borehole Drilling
BUILDING CONTRACTORS	Materials Haulage, Excavation (back hoe/ripper/scarifier/compressor & pneumatic tools), Loading (front shovel),
MINING/ QUARRYING	Stone Crushing (from PTO), Loading, Access Roads, Materials Haulage
TRANSPORTERS	Loading, Short Haulage: Goods, Materials & Personnel
PLANT HIRE COMPANIES	Hire to Others for all the applications in this table
RESEARCH/ ACADEMIC/ TECHNICAL INSTITUTIONS	Demonstration Training
NGOs	Any of the above operations

Source: Reference 29

Two-axle agricultural tractors offer four important application features: tractive power, hydraulics, PTO and 3 point hitch. These provide the flexibility to power a range of attachments and towed items.

The following pages provide image examples of some of the Intermediate Equipment items.

IMAGES OF TRACTOR EQUIPMENT AND INTERMEDIATE POWER UNITS

Figure 1 – 75hp 2WD agricultural tractor

Figure 2 – 4WD Wheeled Belarus tractors assembled in Ethiopia

TRACTOR GRADING ATTACHMENTS

Figure 3 – Tractor and 5 tonne heavy towed grader (CMC), Kenya

Figure 4 – 5 tonne heavy towed grader (Landmech), South Africa

Figure 5 – Tractor and 2 tonne towed grader (Arthur Garden), Zimbabwe

OTHER ATTACHMENTS FOR TWO AXLE TRACTORS

Figure 6 – Front end loader and backhoe attachments

Figure 7 – Tractor towed ‘Rockbuster’ used to crush oversize material (Broons), Australia

Figure 8 – Mobile Stone Crusher (Parker)

Figure 9 – 8 tonne Tipping Trailer (Landmech), South Africa

SINGLE AXLE TRACTOR BASED EQUIPMENT

Figure 10 – General purpose trailer for Single Axle Tractor (Hebziba), Ethiopia

Figure 11 – Towed roller for Single Axle Tractor (Hebziba), Ethiopia

Figure 12 – Single axle tractor and trailer transporting people (Associated Press)

COMPACTION EQUIPMENT

Figure 13 – Towed vibrating Roller (Bomag)

Figure 14 – Towed Pneumatic Tyred Roller (PTR)

Figure 15 – Twin drum pedestrian vibrating roller

Figure 16 – Vibrating Plate Compactor

GENERAL PURPOSE

Figure 17 – Skid Steer tractor (wheeled or tracked), suitable for fitting a range of attachments, including cold milling attachments for bitumen pavement re-cycling

Figure 18 – Locally made 4WD Small Rural Vehicle (SRV) (Vietnam)

Figure 19 – Mixer for Cement, Concrete and Emulsion mix applications

Figure 20 – Mini digger, easily transportable using a general purpose light towing vehicle, and can be fitted with a range of attachments such as vibrating breakout hammer and patch compactor

PART 1
HOW TO COST A PIECE OF EQUIPMENT

1.1 INTRODUCTION

This Part of the Handbook has been prepared to assist contractors and road authority personnel to realistically and accurately price items of equipment and to help compare the costs of carrying out a work activity using different equipment types, or labour. This is an essential function, particularly when comparing the advantages and disadvantages of carrying out work using alternative technological approaches.

Pricing equipment items is not an easy task. The process depends on a wide range of assumptions which need to be made regarding the costs of ownership and operation, and the performance of the equipment at the site.

It should be appreciated that accurate costing requires the collection and updating of a wide range of information on a regular basis. This is an essential fleet management function.

However, the effort made in setting up **and maintaining** a good (albeit simple) cost recording system should be rewarded many times over in improved management of the equipment fleet, and enhanced profit potential for a contractor. The costing system should be able to record all inputs, usage and overheads related to the individual item of equipment under the components of the costing system described in Section 1.4 of this Handbook. The records can be kept on a paper or computer based system. It is important that the record keepers are properly trained and motivated to ensure that the records are as accurate as possible. Regular checks and reconciliation (cross checks) should be carried out.

This Part of the Handbook will guide the user through the various factors to consider and introduces a simple cost model to help the owner/user. The cost model has been developed on a computer spread sheet, however in the form presented in Part 2 of this Handbook it can be used manually with the aid of a pocket calculator. Its simplicity means that only 3 sides of A4 paper are required to carry out a complete costing for a piece of equipment. Example calculations are also provided in Part 2 of this Handbook for some of the items of equipment. The system allows the costing to be repeated easily when any of the cost components vary due to changing circumstances.

It is important to remember that, for a contractor, if the costing is too low he/she will lose money. This may not be realised until eventually trying to replace a piece of aging plant. If a contractor's costing is too high he/she will risk not securing sufficient work. Although an appreciation of the market price for a piece of equipment is important, it is essential to also be aware of the actual, full equipment costs. Only in this way can potential sustainability, profit or loss be known. It is important for contractors to know when to decline a job opportunity.

A piece of plant can pay back its investment (and allow the contractor/owner to make a profit) if costed and managed properly. If not, it can be a costly liability,

capable of wreaking financial ruin. The potential economic life of heavy equipment is typically 10 - 20 years. It may be many years before the owner realises in which situation he/she is without a good costing system.

If a road authority operating a force account system does not realistically value its equipment, particularly the ownership costs, it may not be able to secure sufficient funding to replace its fleet on a sustainable basis. The result will be an aged or scrap fleet.

Due to the initial and ongoing work involved with accurately and effectively costing equipment, it is suggested that organisations such as contractor's associations, road administrations or their associations should develop costing databases and services on behalf of their members to provide 'benchmark' costs.

Finally, in an emerging or developing country, any equipment purchase involves considerable risk. Capital is relatively scarce and expensive, and the market for imported, sophisticated, heavy equipment and its use is limited or irregular. This equipment has been designed for high utilisation and relatively rapid 'payback' in a low-cost-finance, high-labour-cost environment. Cheaper intermediate equipment options are proven and available. Furthermore, careful consideration should be made before buying *any* equipment and the option of hiring should be evaluated if it is available. It should be noted that equipment hire services are used widely in developed economies as this is determined to be the most economic solution for many small and larger enterprises for non-continuous machine usage.

1.2 EQUIPMENT COST COMPONENTS

There are a number of components to equipment costing which must be fully appreciated and accommodated in any full and realistic costing of a piece of equipment.

The Cost Components to be considered:

OWNERSHIP

- **Finance/Opportunity cost of capital**
- **Depreciation/Replacement/Amortisation**

OPERATING

- **Spares and consumables**
- **Workshop costs**
- **Fuel and lubricants**
- **Operators' payments, allowances & other costs**

OTHER

- **Overheads**
- **Risk (e.g. late payment)**
- **Profit**

Some of these components are discussed in detail in the following sections.

1.3 EQUIPMENT COSTING ISSUES

Accurate equipment costing depends on a large range of factors as indicated in Figure 1.1. Many of these factors vary over time and a number of the influences can be outside the control of the equipment owner, e.g. finance costs, inflation, foreign exchange rate fluctuation, fuel costs, imported spares costs, etc..

Furthermore predictions have to be made up to 15 or more years ahead on issues such as expected equipment life, availability or cost of funding (interest rates), market for the equipment and probably most importantly; Utilisation.

An investment in equipment certainly carries considerable risk.

This section considers some of the factors which may have a significant effect on real equipment costs, losses or profits for a contractor, or performance of a road authority.

- Ownership costs
- Foreign currency components
- Exchange rate fluctuations & inflation
- Cost and availability of finance
- Economic life
- Utilisation
- Market considerations

Figure 1.1 - COSTING OF EQUIPMENT - FACTORS TO CONSIDER
These factors will affect the cost of ownership and operation of equipment, and its profitability.

Input Costs	Output / Productivity
• Economic Life • Depreciation: Capital Investment /Replacement • Obsolescence • Salvage value/demand for used equipment • Interest: Investment Costs • Spare Parts and Consumables • Workshop (inc. mechanics, equipment, tools, manuals, stores, etc.) • Mobile mechanical & logistical support • Workshop Management • Skill/motivation of mechanical support • Mobilisation (Low loader) • Manufacturer's local agent support • Insurances and taxes • Fuels, lubricants and greases (& their quality) • Operator and assistant(s) • Accommodation/transport/payroll costs • Training (initial & ongoing) • Environmental (e.g. dusty/poor air quality) • Standardisation (effects on spares/skills/training) • Forex premium • Theft, losses and security • Risks and cashflow on long term investment • Contractor cashflow: time lag between incurring costs and payment	• Standing time (breakdowns, workshop servicing, refurbishment) • Unproductive time (waiting for instructions, travel to/from/between work sites, waiting for spares/fuel, etc.) • Productive time per year • Type & size of machine (appropriate? flexible?) • Ground conditions • Climate • Nature of the work • Skill/motivation of Operator/assistant(s) • Condition of the Machine • Work Planning and Organisation • Adjustments from manufacturer's guidelines

1.3.1 Ownership Costs

There are two important, and potentially large, components in the ownership costs of a piece of equipment, these are:-

- **Depreciation/replacement/amortisation, and**
- **Finance or Opportunity Cost**

In the past, public authorities with force account operations have tended to ignore these important cost components (with very unfortunate consequences). Many contractors have also not evaluated these costs realistically.

Some reasons for this can be cited as:

- equipment being provided by international agencies with (low interest) loans or as gifts, (sometimes offered in the interests of the donor's national industries and NOT in the overall interests of the recipient's interests and sustainable operations),
- equipment inherited from other organisations,
- no capital or interest charges to the user,
- equipment procurement, management and user organisations being separate,
- very low inflation,
- equipment considered as 'written off' and therefore 'free of charge'.

Furthermore by ignoring these costs it has not been possible to make fair comparisons between force account (internal) and contractor operations options, and indeed between different technology options.

However in a future sustainable system, this approach will not be possible and commercial and responsible asset management practices will have to be adopted by contractors, public fleet owners and users alike, taking account of all costs.

There are different ways of viewing and treating these ownership costs. The author recommends the following approach.

Depreciation/replacement/amortisation

Depreciation/replacement/amortisation: these terms are used in different cultures or sectors to describe the same concept. Hereinafter the word 'depreciation' will be used for simplicity.

A piece of equipment is a substantial capital investment and should be viewed as an asset (although invariably declining in real value or depreciating).

Depreciation is the charge which should be made for using up the life of the equipment. For example when new, a piece of equipment may have an expected

economic life of 10,000 engine hours. The difference between the cost new and the residual/scrap value should be spread over the anticipated 10,000 hour working life and charged to the user for each hour used. The economic life or asset value of the piece of equipment is being **consumed** and should be paid for.

Naturally if the economic life is assessed to be only 5,000 hours for various reasons then the depreciation charges should be adjusted accordingly, i.e. double in this case. It is therefore very important that the owner is realistic in his/her assessment of the economic life. The factors indicated in Figure 1.1 are influential in the determination of this. Economic life can vary by a factor of more than 10 under the range of influences in practice.

Figure 1.2 Case Study - Effect of Equipment Life on Depreciation Charges

A piece of equipment costs 150,000 Local Currency Units (LCU). It is assumed that at the end of its life it has no residual or scrap value.

If it works for its total design life of 10,000 hours, the depreciation cost would be **15 LCU/hour**.

If it works only half its design life (5,000 hours) before being scrapped, the depreciation cost would be **30 LCU/hour**.

If it works only 1,000 hours before being scrapped, the depreciation cost would be **150 LCU/hour**.

It is important to appreciate that even with inflation the residual value is always tending towards zero or a very small value (unlike say, an investment in prime property).

If there is significant inflation, as is experienced in many developing countries, then it is important to regularly revise depreciation charge rates to reflect **current replacement costs** of the equipment. Otherwise the value of asset being used up will be undervalued and insufficient funds will be raised to replace the asset or repay the capital investment. Continuing with the example above, each hour of an expected 10,000 hour life should be charged at 1/10,000th of the **current** difference between cost new and scrap to avoid loss of asset value.

Figure 1.3 Case Study - Effect of Inflation

A piece of equipment cost 150,000 Local Currency Units (LCU) when purchased new 5 years ago. However, with inflation a replacement of the same model would now cost 250,000 LCU. The current scrap value for a similar machine is 25,000 LCU.

Assuming the machine will have a working life of 10,000 hours, the current depreciation charge should be:-

(250,000 - 25,000) / 10,000 = **22.5 LCU/hour**

IF THE OWNER MAKES INSUFFICIENT CHARGES FOR DEPRECIATION/ REPLACEMENT THEN HE/SHE IS EFFECTIVELY WASTING THE ASSET.

A contractor risks bankruptcy and a public fleet manager risks ending up with a fleet of scrap with insufficient funds to replace it. Unfortunately it can take many years for this to become apparent when equipment life cycles are typically 10 - 20 years.

For normal accounting purposes a writing-down or depreciation allowance is usually made for equipment investments. This is for accounting or taxation purposes and should not be confused with the economic management of the equipment asset and charge rates to be recovered from the user or client.

Finance or Opportunity Cost

This is a more difficult concept to explain. This is the *cost of the capital* tied up in the piece of equipment. There are two ways of looking at this cost.

Firstly, if an individual, contractor or organisation procures a piece of equipment and needs to borrow the money to buy it, he/she will be charged interest on the capital amount (as well as having to repay the total capital amount borrowed - the principal). The cost of this interest should be recovered from the use of the equipment. Sometimes this charge is actually included in the overall operational overhead, however it is likely to be a substantial component and should certainly be part of the charge rate.

Alternatively, if the owner already has the financial resources to buy the equipment for cash, he/she could choose to invest it elsewhere, e.g. deposit at a bank, purchase government securities bearing interest, loan it to another business or friend. In every case the owner could expect a *return* or *interest* on the capital deployed, as well as getting the capital back after a period of time.
Whichever view is taken there is a cost or value on the availability of the capital or *opportunity cost* - the interest charged for or foregone by investing in the equipment.
The problem is to determine what value should be used for costing this

component. For a piece of equipment procured on a loan, it is fairly straightforward. The cost should be the actual cost of the finance, i.e. the interest charges plus any other (non-capital repayment) charges that the financing institution includes in the loan arrangement.

Extreme care should be taken regarding the evaluation of finance arrangements, as lending institutions have different ways of calculating interest charges. The same quoted interest rate can result in widely varying interest charges due to different calculation methods. It is important to obtain detailed information on the actual interest charges, whether they are fixed or will vary throughout the period of the loan.

If the equipment is purchased with cash, more flexibility can be used to assess the value of the capital. This is one cost component where a contractor can adjust his/her price to gain competitive advantage after considering the prevailing market rates. Consideration of current and likely future interest rates, the risks associated with alternative investments, and inflation rate should also come into the decision making process.

Figure 1.4 Case Study - Finance Cost

A contractor buys a piece of equipment which costs 150,000 Local Currency Units (LCU) new. The purchase is financed completely by a bank loan with security provided by some property that he owns. The fixed interest rate and other charges relating to the loan (excluding capital repayment) are equivalent to an interest rate of 20% per annum. The contractor expects to work the machine for 10,000 hours over a 5 year period (i.e. 2,000 hours/year) over which time he will repay the loan.

The costs of finance per hour can be calculated as follows:-

$$\textit{Finance cost} = \frac{\textit{((N + 1) / 2N) x Purchase Price x interest rate expressed as a decimal}}{\textit{Hours per year}}$$

Where N = number of years of the loan

In this case the finance charge should be **9 LCU/hour**

Lower utilisation or extended repayment periods would increase this figure significantly. For example, an 8 year equipment life and loan repayment period, and 1,200 hours per year, utilisation would raise the finance charge to **14 LCU/hour**.

1.3.2 Foreign currency components

Equipment ownership and operation can have a very high foreign exchange component. Heavy plant is usually all manufactured outside of a developing country so that a major portion of the capital cost is sourced from outside the country. Spares for these items of equipment are also usually imported.

All road sector operations can be carried out by Intermediate equipment and/or labour as an alternative to heavy plant. Intermediate equipment may also be imported, however it can often be fabricated in-country. Its relative simplicity usually means that it can be more easily repaired with local resources or spares.

In order to attract sales, some suppliers can provide access to finance in foreign currency, usually US$. The interest charges on these loans are a foreign currency cost.

In countries where the private sector uses heavy or imported equipment and produces products for the external market (e.g. mining and export crops), they can cope reasonably with foreign exchange rate variations as their earnings are also tied to foreign currency. Unfortunately all road works are a local ‘product’ for

a local market, paid for in local currency revenues. Any organisation reliant on imported equipment will be more susceptible to exchange rate depreciation and the associated cost inflation.

1.3.3 Exchange rate fluctuations and inflation

The exchange rate of the local currency can be very volatile against the 'harder' currencies of the heavy equipment manufacturing countries.

In many countries the local currency has weakened considerably against these 'hard' currencies in recent years. The costs of imported equipment items have necessarily risen accordingly in local currency terms. The depreciation of a local currency feeds a substantial amount of inflation into the local economy. The prices of items such as imported equipment and spares are particularly related to these currency movements.

This has an effect on road sector budgets and operations, particularly for replacement of heavy plant fleets, procurement of spares for the existing heavy equipment fleets, securing adequate finance for heavy equipment operations, and keeping equipment charge rates up-to-date.

Any organisation which took out a foreign currency loan to finance equipment purchase before such a currency depreciation, would have experienced their interest payments rise correspondingly.

Even if heavy equipment was procured and paid for prior to the exchange rate deterioration, the owner would be facing corresponding increases in costs of imported spares for heavy equipment.

The currency risks and effect on equipment costing are substantial.

Figure 1.5 Case Study

A Zimbabwean contractor bought a piece of imported equipment costing Z$1,000,000 in August 1998 when the exchange rate was US$1 = Z$ 22. The supplier arranged a 3 year US$ loan to cover 80% of the purchase cost at 9% interest rate. The 20% deposit was paid cash by the contractor. Interest payments started immediately and amounted to **Z$6,000** per month plus repayment of principal of about **Z$23,000** per month.

Unfortunately 2 months later the exchange rate had changed to US$1 = Z$35. The outstanding capital to be repaid had actually risen in local currency terms from Z$800,000 to Z$1,200,000. The interest payments rose to **Z$ 9,000** per month and the monthly capital repayments had risen to **Z$35,300.**

1.3.4 Cost and availability of Finance

The availability and cost of finance are related to the economic climate in the country. In times of economic uncertainty the availability of finance for relatively risky equipment procurement can be difficult to obtain. Furthermore the interest rates tend to increase in actual and real terms to reflect the greater risks to the borrower and lender.

The current commercial finance rates in the UK (2012) are about 7 - 10% per annum. Rates of below 10% are fairly typical of the developed economies. However, in recent years, the availability of finance has become an issue even in developed economies. Finance rates are usually much higher in developing countries[4] and this raises equipment ownership costs considerably.

It can also be very difficult for local contractors to be able to secure finance for equipment purchase as lending institutions will often require very onerous terms or collateral. Some will not even loan to local contractors.

Where there are quotas or availability restrictions of finance to the sector, that means that there is a ‘premium’ or elevated ‘market’ rate for finance.

1.3.5 Economic Life

Heavy plant manufacturers usually quote initial economic life for their machines as approximately 10,000 - 12,000 hours. Agricultural tractors are usually expected to have an initial economic life of 6,000 hours to 10,000 hours or more, depending on engine type, configuration and power. These figures assume that

[4] MART Working Paper No 2 (1997) reported bank interest rates of 15 - 48% per annum in the developing countries surveyed.

planned (preventive) maintenance is carried out according to manufacturers' recommendations.

Major overhauls can extend these initial life periods, however the cost of a complete overhaul can approach the costs of a replacement model for heavy equipment, without the benefit of the new machine warranties.

It is of particular interest that for some popular makes and models of agricultural tractor there is a thriving 'remanufacturing' industry. The costs are usually substantially below the price of current new models. These companies usually offer warranties on their rebuilt models. Details of some suppliers are contained in Appendix 1.

Working life also depends crucially on the quality of operators, and timeliness and quality of maintenance and mechanical support. This can be a crucial factor for a remote, ill equipped, workshop facility. Some contractors and authorities do not have properly equipped workshop facilities, or trained and motivated operators and mechanics. This will certainly substantially reduce the economic lives of their equipment. Some repairs and certain maintenance of modern equipment require expensive instruments with workshops operating under 'laboratory' standards.

Poor operator skills or behaviour and accidents can seriously reduce equipment economic life. Operator training, appropriate motivation and close supervision can be justified considering the equipment investment value and consequences of misuse.

The preventive maintenance of all equipment is essential for longevity. However, it should be noted that any vibrating equipment used in compaction requires particular attention. Basic physics dictates that anything vibrating involves unbalanced forces which are working to the detriment of the equipment. It is essential that the manufacturer's preventive maintenance regime is properly followed.

The factors influencing economic life are listed in Figure 1.1. Economic life figures quoted by equipment agents can be derived from those provided by manufacturers, based on ideal conditions; **they can be very different from the reality of remote site conditions in a developing country environment**.

Obsolescence is also an important factor. Spares become increasingly difficult to obtain once a model is no longer in production. For models with a low population in-country this can rapidly become a serious matter as agents will have little interest in stocking spares items (every spare on the shelf is capital tied up). Although a piece of equipment may have been little used it may need to be scrapped or disposed of due to lack of some important spares. It only takes ONE essential part to be non-functioning and the whole machine is immobilised.

1.3.6 Utilisation

This is probably the most important issue to consider in owning and costing equipment. The cost models described in Section 1.4 demonstrate how the cost of equipment varies with equipment life in years, but more particularly with annual utilisation. Figure 1.6 illustrates this relationship[5] (the actual figures may not be applicable to a particular developing country situation as local cost factor vary significantly, however the relative values are indicative).

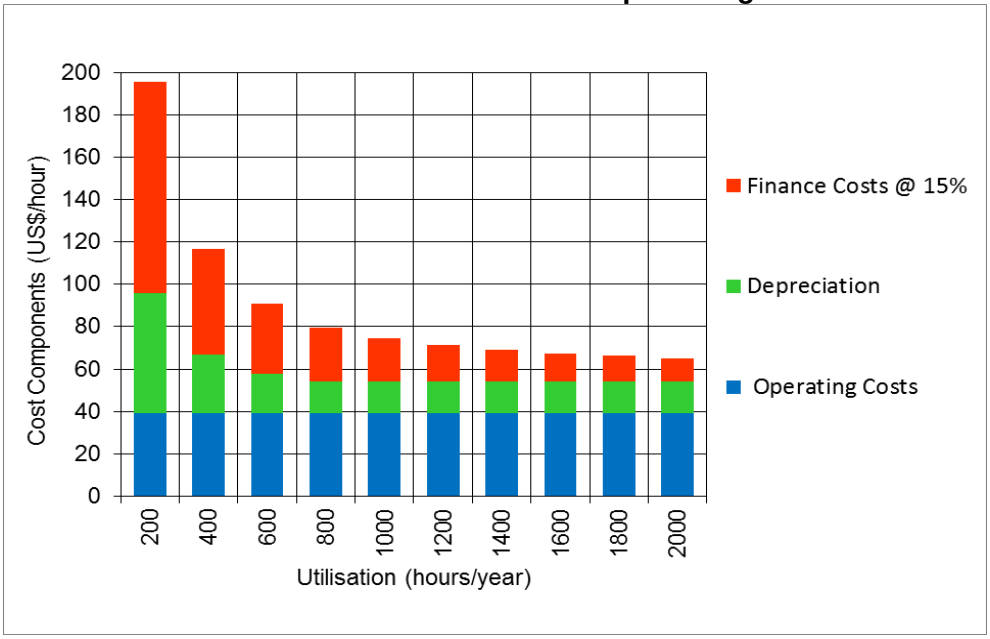
Basically, at high utilisation the equipment investment is being paid back more quickly with work or charges, thus lowering finance costs per hour, spreading the investment costs over a greater number of working hours (within the parameters of economic life) and preventing obsolescence from prematurely devaluing the asset.

[5] Derived from MART Working Paper No 7 - Agricultural Tractors in Roadworks, and the Handbook Cost Model

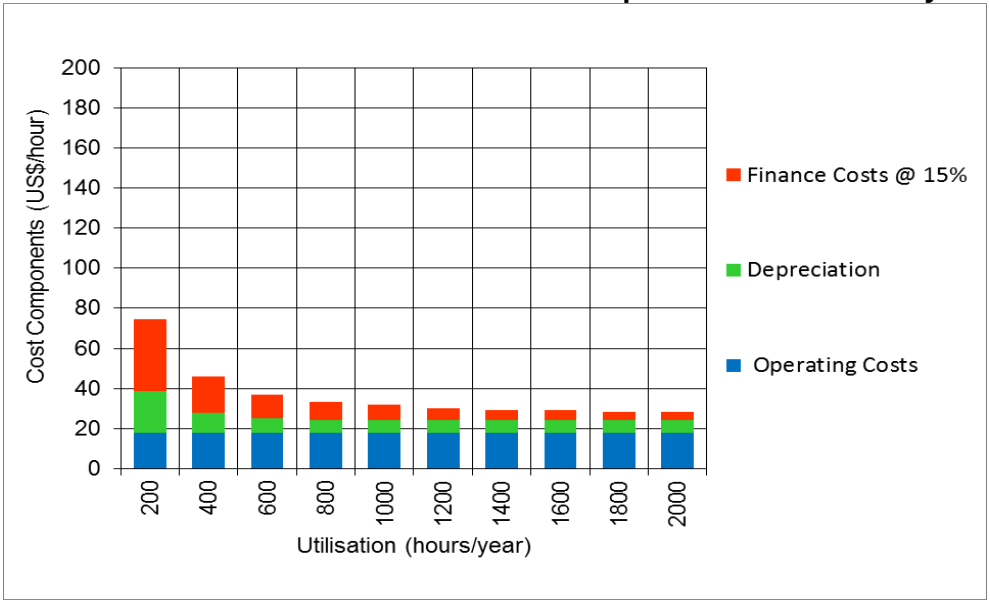
Figure 1.6 EQUIPMENT UTILISATION - COST RELATIONSHIPS

The figure illustrates how finance and depreciation costs increase substantially at annual utilisation of less than 1,000 hours.

COST VARIATION WITH UTILISATION – 120hp Motor grader



COST VARIATION WITH UTILISATION – 100hp 4WD Tractor + Heavy Towed Grader



The above charts illustrate how the costs of a 120hp motor grader, and a 100hp 4WD tractor and Towed Grader unit vary with annual utilisation, based on the costing model described in Section 1.4 and in Part 2 of this Handbook. The data is illustrative only and is based on assumptions of equipment lives of 15,000 hours and finance/opportunity costs of 15%p.a.. The costs exclude consideration of Overhead and Profit components.

At low utilisation of the equipment, the finance and depreciation costs can overshadow operating costs as overall unit costs rise substantially.

In the UK it is expected that heavy plant will be used between 1,500 and 2,000 hours a year to be economic for the owner (Figures 1.7 and 1.8).

Figure 1.7 ECONOMICAL OWNERSHIP PERIODS FOR HEAVY PLANT - UK

PLANT ITEM	ECONOMIC LIFE - YEARS	USAGE - HOURS/YEAR
LARGE HYDRAULIC EXCAVATORS	9	1,575
DOZERS/SCRAPERS/ (GRADERS?)	10	1,680
LOADERS/SHOVELS	9	1,680
TIPPER TRUCKS	6	1,890
ROLLERS/ COMPACTION	6	1,680
DIESEL ROAD VEHICLES	6 - 7	1,890
PETROL ROAD VEHICLES	5 - 6	1,890

Source: Spon's Civil Engineering & Highway Works Price Book, 1997.

Contractors and road authorities in developing countries can find it difficult to approach these levels of utilisation for their road construction and maintenance activities for various reasons. These factors include limited workloads for individual specialist equipment items, seasonal factors, shortage of funds to support the operations or cash flow discontinuities, low availability of equipment (age, support problems), lack of performance incentives, the road network logistics.

Where records exist, utilisation rates of well below 1,000 hours per year can be experienced. This seriously affects unit operating costs.

In view of these figures it would be sensible for contractors, road authorities and investors to consider commercially operated equipment hire companies to ensure that any equipment investment is being utilised by somebody. Intermediate equipment with flexible applications across a number of sectors will offer greater chances of achieving high utilisation and thus profitability.

Figure 1.8

QUOTATION:

'It is not usually economical for Contractors to own plant unless they can ensure at least 75 - 80% utilisation factor based on the Contractor's normal working hours'

Note:
1. Source: Spon's Civil Engineering & Highway Works Price Book.
2. UK experience based on 2,100 hours working year.

1.3.7 Market Considerations

In developing countries, the local market for road making and maintenance equipment can be relatively small. This will tend to support the use of simpler, flexible equipment which can be deployed to a range of profitable activities both in and outside the road sector.

It is essential that at all times the private sector is aware of the market prices for equipment. However they should also be aware of their own real costs, and the extent and consequences of any under-pricing.

Short term situations should not overly influence strategy on owning or hiring. Investment in any equipment should normally be seen as a 10 - 20 year commitment.

The equipment owner should regularly review the equipment investments, to assess whether it is the best use of assets. Options of disposal, replacement, or hiring-in should be considered. Retaining the item and putting it to work should only be considered if it is assessed to be the best option for the business/operation.

Contractors and their associations should engage in regular dialogue with the road authorities and clients to ensure that pre-selection and contract documentation permit the use of intermediate equipment as an acceptable option for cost-effective road works and fair market access for all categories of contractors.

1.4 THE EQUIPMENT COST MODEL

How to Cost a Piece of Equipment using the models in PART 2 of this Handbook.

Investigations for the MART programme have shown that there are widespread difficulties with equipment costing. These are due to a range of problems which include:

- lack of awareness/consideration of all cost components,
- lack of recorded data on actual costs, use and performance,
- uncertainties regarding future market, costs, economic life, and utilisation, and
- insufficient commercial pressures on decision making.

With the trend towards contractor implementation of road works (and possibly intermediate equipment hire) it becomes essential that contractors, client's representatives and other users become aware of the true costs of equipment ownership and operation. Where different cost components are managed in separate departments/accounts (e.g. investment, replacement, workshop support and operation) it is particularly important to appreciate the cost implications for each component.

When costing the equipment component of a piece of work there are two stages to the process:

Stage 1. Determine the Cost of Provision of the equipment (to make it AVAILABLE)

Stage 2. Determine the Output or Productivity of the piece of equipment (the UTILISATION)

The guidelines in this Handbook focus on Stage 1 of the process and should be of particular interest to plant owners or hirers, whether they are contractors, road agencies or specialist equipment hirers etc..

A further range of assumptions has to be made regarding the UTILISATION of the equipment and prediction of how much work it will actually produce. This second stage of the costing calculation is comparatively simple, however this also requires local data to be collected on actual field experiences as productivity will vary depending on factors such as local traditions, operator skill and motivation, site characteristics, logistics, material and weather conditions, seasonal factors etc. Detailed guidance on this part of the costing process is **NOT** provided by this Handbook.

PART 2 of this Handbook contains the cost model sheets necessary to calculate the various cost components and the overall costs of PROVISION of a piece of equipment (Stage 1). The costing method is designed to include all cost components relating to the ownership, operation and overheads components. The approach may be used for any type of intermediate or heavy equipment. Three sheets (1, 2 & 3) are all that are required to carry out the Stage 1 costing of a piece of equipment. For some equipment types an example of the calculations on sheet 3 are provided (these are shown on **Example Sheet 3**).

The system allows the owner/user to make assumptions regarding the many variables affecting the cost of a piece of equipment. It must be appreciated that the ACTUAL overall costs will not be known until the day the piece of equipment is actually sold or scrapped (*IF* adequate records have been kept throughout the equipment ownership). Costing therefore depends on good record keeping and a realistic appreciation and assessment of a range of important historical, current and future factors.

The system intends to highlight the real costs of financing and ownership which are neglected in many equipment management systems, and which can dwarf operating costs in a high-cost-finance environment; thus possibly adversely affecting management decisions on choice of technology or equipment. Whereas finance may be obtainable at about 10% (or less) per annum in economically developed countries, they may be many times higher in developing economies[6].

Failure to take sufficient account of and provision for financing and ownership costs will ultimately lead to severe problems when it becomes necessary to replace the equipment.

Costs are particularly sensitive to annual utilisation as Tables A & B show in the Cost Models in PART 2. Whereas many equipment items are designed to achieve annual utilisation of 1,000 to 2,000 hours of work for economic ownership, significantly lower utilisation can be extremely expensive and un-economic. The costing system demonstrates that for most road works in developing countries the operating environment is particularly unfavourable to the use of sophisticated plant.

The costing system should allow contractors to quickly assess the effects of various assumptions or scenarios and how this will affect their income, outgoings and profits.

For small or unpowered items of equipment a daily, rather than hourly, cost rate is appropriate throughout the calculations. All cost sheets end up with a calculated daily rate. The following instructions are detailed for calculations based initially on an hourly cost rate.

To carry out the costing exercise, the following input data is required:

- Equipment Item procurement cost (New or second hand)
- Expected duration of ownership in years (economic life)
- Expected value on disposal after ownership, or scrap value
- Expected annual productive utilisation (in hours or days)
- Assumed number of productive hours utilisation per day (except small items)
- Finance or Opportunity Cost of capital deployed (as an annual interest rate)
- Estimate or record of value of spares consumed per year for the equipment item compared to cost new and reduced to a daily charge

6 MART Working Paper No 2 (1997) reports bank interest rates of 15 - 48 % per annum in the developing countries surveyed.

- Estimate or record of value cost of servicing and repair workshop costs per year for the equipment item and reduced to a daily charge
- Estimate or record of fuel and lubricants consumption and costs per hour/day of utilisation
- Costs of operator's and assistant's wages, allowances or other costs, reduced to a daily charge
- All cost components relating to overheads to be assigned to the equipment item over the course of the operating year and reduced to a charge per operating day.

This information is input into the costing process as described in the following pages, and using the example forms in Part 2 of the Handbook.

In Summary, the steps involved in the costing process are:

1. Determine a baseline Depreciation cost
2. Determine the baseline Finance/Opportunity cost
3. Adjust for Actual new or second hand cost
4. Adjust for expected Residual/disposal/scrap value
5. Adjust for expected Economic life
6. Adjust for expected Annual Utilisation
7. Estimate Spares and consumables costs
8. Estimate Servicing and Repair workshop and labour costs
9. Estimate Fuel and Lubricants costs
10. Estimate Operators costs
11. Estimate Overheads, including contingency, and any other costs not included above
12. Assess a suitable Profit margin

STEP BY STEP instructions for using the cost model

Select the 3 sheets (1, 2 & 3) appropriate for the piece of equipment to be costed.

The initial stages of the costing (sheets 1 & 2) are carried out in US$. The calculations on part of the 3rd sheet can be carried out in either US$ or continued in the local currency. For some small or unpowered items of equipment a simplified daily, rather than hourly, cost rate is used throughout.

SHEET 1 & 2

For the selected item of equipment determine the hourly cost of depreciation/replacement (Sheet 1) and finance (from Sheet 2). These cost figures are to be inserted on Sheet 3 in the boxes *C1* and *C2* respectively using the following method.

1. *Predict the average utilisation of the piece of equipment in hours/year.*

2. *Predict the economic life in years of the equipment in ownership between initial purchase and expected date of disposal.* The system allows for purchase new or second hand and disposal before or at the end of its useful life.

3. *From Table A1 read off the depreciation/replacement charge in US$ per hour according to the selected utilisation and economic life.* This is the cost of using up the investment or life in the equipment. *Circle or note the selected figure for future reference. Insert this figure in the Box C1 on Sheet 3.*

4. *Select the interest rate (Table B1, B2* ***or*** *B3) that most closely matches the expected cost of finance (or opportunity cost) through the ownership of the equipment.* For other interest rates it is possible to interpolate between the tables. Extreme caution should be used as prediction of future interest rates is extremely problematic. Interest rates should include allowance for arrangement fees and any other special charges added to the cost of arranging or servicing a loan.

5. *From Table B1, B2* ***or*** *B3 read off the finance charge in US$ per hour according to the selected utilisation and economic life. Circle or note the selected figure for future reference. Insert this figure in the Box C2 on Sheet 3.* This is the cost of obtaining the funds to invest in the equipment. Alternatively if you already own the equipment or have the funds to purchase it, this is the *opportunity cost* of the capital; if you invested that money elsewhere it could represent the interest or return you should obtain by investing the capital.

   Particular care should be taken in selecting the interest rate. If finance is used, the actual rate, whether in local or foreign currency should be used, as this is what the financing institution will charge. However, where currency exchange rates are expected to fluctuate an allowance should be made for this risk.

Where an opportunity cost is used, this should represent the assessed *REAL* value of the capital deployed. This should be determined with reference to the market interest rates for capital and local inflation.

Equipment may be provided to a road authority free of charge or at a subsidised loan rate, however this is not a realistic or sustainable method of costing, particularly for a national equipment fleet. Contractors MUST take account of this component to realistically cost their equipment.

Steps 1 to 5 are the most difficult in the costing process to assess as assumptions are made dependent on a prediction of future conditions and equipment performance throughout its life. Over-assessment could lead to non-competitive bids by a contractor. Under-assessment will provide inadequate funding for loans and/or replacement of equipment.

SHEET 3

6. Insert the selected interest rate assumed for reference purposes in the box provided.

7. Insert in the Box C1 the depreciation/replacement charge selected as described in Step 3.

8. Insert in the Box C2 the finance charge selected as described in Step 5.

9. Insert the actual cost of procurement or replacement of the piece of equipment in the Box C3. This will almost certainly be different from the 'COST NEW' shown on Sheet 1; an adjustment for this will be made in the following steps. The cost inserted should be the actual current **cost new** of purchasing the equipment including all taxes, duties and charges involved. Even if you purchased the equipment new some time ago, insert the current cost new, otherwise you will undervalue the life being used up by each hour of use.

Alternatively, if the equipment will be, or was, purchased **second hand**, that price can be inserted, however there should also be an adjustment for the reduced economic life at time of purchase and possibly lower annual utilisation compared to a new equipment model. Again it is important to adjust purchase costs with inflation. This can be done by relating the price paid for the second-hand piece of equipment compared to the price new at that time (as a percentage) and apply the same percentage to the current price new.

10. Insert the assumed number of operating hours each day in the Box C4.

*11. Calculate the DAILY OWNERSHIP COST based on the formula shown and insert the figure in the Box **C**.*

This DAILY OWNERSHIP COST should be adjusted for the expected value of the equipment on ultimate sale, disposal or scrap. Second hand and scrap

values of plant are difficult to predict. The residual scrap value of an obsolete item of plant can be less than the cost of cranage and transport for disposal. It is suggested that you insert an assessment of the CURRENT value of scrap machines for this model.

If you intend to dispose of the equipment item before it reaches scrap condition, make an assessment of the disposal value which would reflect any residual life remaining. An adjustment to the economic life would be necessary in *Steps 2 - 5* in this case.

12. *Insert the assumed residual/scrap value in the Box D1.*

13. *Insert the economic life in years selected in Step 2 in the Box D2.*

14. *Insert the utilisation in hours/year selected in Step 1 in the Box D3.*

15. *Calculate the ADJUSTMENT FOR SCRAP (or disposal) VALUE based on the formula shown and insert the figure in the Box D.*

16. *Calculate the* ***SUB-TOTAL FOR OWNERSHIP COSTS (W = C - D).*** The figure is an adjusted daily rate.

17. *Insert in the Box E1 a percentage value for the cost of spares and consumables each year compared to the machine cost new (Box C3).* This value should ideally be obtained from actual working records. Alternatively the equipment agent should be able to offer advice on this figure. As with any advice it should be checked with alternative sources such as other users. Spares have a ready resale market and good control and record keeping are essential.

18. *Calculate the DAILY COST OF SPARES based on the formula shown and insert the figure in the Box E.*

    From this point the calculations may be continued in US$ or converted into the local currency at the prevailing exchange rate.

19. *Insert in the Box F1 a percentage value of the cost of spares and consumables each year to cover the servicing and repair workshop labour costs.*

20. *Calculate the DAILY WORKSHOP LABOUR COSTS based on the formula shown and insert the figure in the Box F.*

21. *Insert in the Box G1 the cost of fuel per litre (delivered), adding an allowance for the cost of lubricants and greases used between servicing.*

22. *Insert in the Box G2 the assumed fuel consumption in litres per hour from records, manufacturer's data or reference documents based on the engine size and workload.* Fuel consumption will vary considerably depending on workload, equipment age and condition, and operator. Benchmark guidance based on

tractor tests on new equipment in the USA suggest average figures of 0.243 litres/hour/pto kW (Reference 11). Fuel theft and losses can be considerable and difficult to control. It is important to keep good control of its security, issue and use, assisted by good record keeping.

23. *Calculate the DAILY FUEL COST based on the formula shown and insert the figure in the Box G.*

24. *Insert wages, allowances and other associated costs (such as overnight allowances, housing allowances, pensions or insurances) in the spaces provided for each category of personnel necessary for the operation of the equipment. Insert the total OPERATORS DAILY COSTS in the Box H.*

    It is important to take account of any personnel costs for days that the equipment is idle, for whatever reason, and the operators and assistants are still drawing wages and allowances etc. The suggested approach is to calculate the annual payroll costs for the operator, assistant, etc., and divide them by the number of expected working days (equivalent working days = *D3/C4)*.

25. *Calculate the* ***SUB-TOTAL FOR OPERATING COSTS (X = E + F + G + H).***

26. *From records and estimates calculate appropriate daily allowances for the various overheads including risks.* These should include yard, security and garaging costs, as well as mobilisation/demobilisation (transporter) costs if these are not included elsewhere or separately charged. It is suggested to base overheads costs on the business' annual accounts figures or budgets; total the figures for the complete fleet being managed and assign a proportion to each piece of equipment. It is wise to add a 'contingency' component for unforeseen costs or eventualities. Only local experience will allow a reasonable assessment to be made for this. *Divide the annual figures by the number of days that the specific equipment item will be used (D3/C4). Enter the sum of the individual overheads in the Box* ***Y****.*

27. *Decide the Profit Margin to be applied and enter this in the Box* ***Z***

And Finally …….

28. *Calculate the* ***TOTAL COST TO BE CHARGED (= W + X + Y + Z).***

PART 2
EXAMPLE EQUIPMENT COST SHEETS

2.1 INTRODUCTION

This section of the Handbook contains selected blank and worked examples of the individual intermediate equipment cost sheets. The work sheets for a 120HP motorgrader are also included for comparison purposes. The instructions for completing the cost calculation are contained in Part 1 of this document. Three Sheets (1, 2 & 3) corresponding to the selected equipment item are required for the costing. An example calculation for Sheet 3 is provided for each equipment item.

2.2 CONTENTS

- Twin Drum Pedestrian **ROLLER**
- **Small Rural Vehicle (SRV)**
- **100hp** (75kW) Agricultural **Tractor** (4WD)
- 5 tonne **Heavy Towed Grader**
- **60hp** (45kW) Agricultural **Tractor** (2WD)
- 2 Tonne **Towed Grader**
- 120hp (90kW) **Motorgrader**

COST CALCULATION

Twin Drum Pedestrian ROLLER

TOTAL HOURLY CHARGE COMPRISES OWNERSHIP + OPERATING + OVERHEAD COSTS (+PROFIT).

OWNERSHIP COSTS COMPRISE:-
DEPRECIATION/REPLACEMENT (TABLE A1) PLUS FINANCE CHARGE (TABLE B1, B2 OR B3)

ALL TABLE A & B COSTS IN US$/HOUR

COST NEW- US$ 20,000 (INCLUDING ALL TAXES, DUTIES, CIF & DELIVERY CHARGES)
Note: This is the benchmark cost which is adjusted on Sheet 3 for the ACTUAL cost of purchase New or Second Hand

A1 - DEPRECIATION/REPLACEMENT CHARGE IN US$/HOUR

ECONOMIC LIFE	UTILISATION IN HOURS/YEAR									
YEARS	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
1	**100.0**	**50.0**	**33.3**	**25.0**	**20.0**	**16.7**	**14.3**	**12.5**	**11.1**	**10.0**
2	**50.0**	**25.0**	**16.7**	**12.5**	**10.0**	**8.3**	**7.1**	**6.3**	**5.6**	**5.0**
3	**33.3**	**16.7**	**11.1**	**8.3**	**6.7**	**5.6**	**4.8**	**4.2**	**3.7**	**3.3**
4	**25.0**	**12.5**	**8.3**	**6.3**	**5.0**	**4.2**	**3.6**	**3.1**	**2.8**	**2.5**
5	**20.0**	**10.0**	**6.7**	**5.0**	**4.0**	**3.3**	**2.9**	**2.5**	**2.2**	**2.0**
6	**16.7**	**8.3**	**5.6**	**4.2**	**3.3**	**2.8**	**2.4**	**2.1**	**1.9**	**1.7**
7	**14.3**	**7.1**	**4.8**	**3.6**	**2.9**	**2.4**	**2.0**	**1.8**	*1.6*	*1.4*
8	**12.5**	**6.3**	**4.2**	**3.1**	**2.5**	**2.1**	**1.8**	*1.6*	*1.4*	*1.3*
9	**11.1**	**5.6**	**3.7**	**2.8**	**2.2**	**1.9**	*1.6*	*1.4*	*1.2*	*1.1*
10	**10.0**	**5.0**	**3.3**	**2.5**	**2.0**	**1.7**	*1.4*	*1.3*	*1.1*	*1.0*
11	**9.1**	**4.5**	**3.0**	**2.3**	**1.8**	*1.5*	*1.3*	*1.1*	*1.0*	
12	**8.3**	**4.2**	**2.8**	**2.1**	**1.7**	*1.4*	*1.2*	*1.0*		
13	**7.7**	**3.8**	**2.6**	**1.9**	*1.5*	*1.3*	*1.1*			
14	**7.1**	**3.6**	**2.4**	**1.8**	*1.4*	*1.2*	*1.0*			
15	**6.7**	**3.3**	**2.2**	**1.7**	*1.3*	*1.1*				
16	**6.3**	**3.1**	**2.1**	*1.6*	*1.3*	*1.0*				
17	**5.9**	**2.9**	**2.0**	*1.5*	*1.2*					
18	**5.6**	**2.8**	**1.9**	*1.4*	*1.1*					
19	**5.3**	**2.6**	**1.8**	*1.3*	*1.1*					
20	**5.0**	**2.5**	**1.7**	*1.3*	*1.0*					

Ref: ped-roller-a.xls *Intech Associates*

NOTES March 2012

It is extremely unusual for the management, operational & support skills and resources to exist to achieve intermediate equipment life of 12,000 hours or more.
Equipment lives of 12,000 hours or more should only be assumed in exceptional circumstances (figures in italics).

Circle or note the figure selected and insert the value in Box C1 on Sheet 3.

COST CALCULATION **Twin Drum Pedestrian ROLLER**

Continued **SHEET 2 OF 3**

TOTAL HOURLY CHARGE COMPRISES OWNERSHIP + OPERATING + OVERHEAD COSTS (+PROFIT).

OWNERSHIP COSTS COMPRISE:-
DEPRECIATION/REPLACEMENT (TABLE A1) PLUS FINANCE CHARGE (TABLE B1, B2 OR B3)

ALL TABLE A & B COSTS IN US$/HOUR

COST NEW- US$ 20,000 (INCLUDING ALL TAXES, DUTIES, CIF & DELIVERY CHARGES)
Note: This is the benchmark cost which is adjusted on Sheet 3 for the ACTUAL cost of purchase New or Second Hand

TABLE B: FINANCE OR OPPORTUNITY COST OF CAPITAL

SELECT APPROPRIATE TABLE (B1, B2 OR B3) OR INTERPOLATE FOR AN INTERMEDIATE INTEREST RATE

B1 - FINANCE @ **10 % p.a.** **FINANCE CHARGE IN US$/HOUR**

ECONOMIC LIFE	UTILISATION IN HOURS/YEAR									
YEARS	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
1	**10.0**	**5.0**	**3.3**	**2.5**	**2.0**	**1.7**	**1.4**	**1.3**	**1.1**	**1.0**
2	**7.5**	**3.8**	**2.5**	**1.9**	**1.5**	**1.3**	**1.1**	**0.9**	**0.8**	**0.8**
3	**6.7**	**3.3**	**2.2**	**1.7**	**1.3**	**1.1**	**1.0**	**0.8**	**0.7**	**0.7**
4	**6.3**	**3.1**	**2.1**	**1.6**	**1.3**	**1.0**	**0.9**	**0.8**	**0.7**	**0.6**
5	**6.0**	**3.0**	**2.0**	**1.5**	**1.2**	**1.0**	**0.9**	**0.8**	**0.7**	**0.6**
6	**5.8**	**2.9**	**1.9**	**1.5**	**1.2**	**1.0**	**0.8**	**0.7**	**0.6**	**0.6**
7	**5.7**	**2.9**	**1.9**	**1.4**	**1.1**	**1.0**	**0.8**	**0.7**	*0.6*	*0.6*
8	**5.6**	**2.8**	**1.9**	**1.4**	**1.1**	**0.9**	**0.8**	*0.7*	*0.6*	*0.6*
9	**5.6**	**2.8**	**1.9**	**1.4**	**1.1**	**0.9**	*0.8*	*0.7*	*0.6*	*0.6*
10	**5.5**	**2.8**	**1.8**	**1.4**	**1.1**	**0.9**	*0.8*	*0.7*	*0.6*	*0.6*
11	**5.5**	**2.7**	**1.8**	**1.4**	**1.1**	*0.9*	*0.8*	*0.7*	*0.6*	
12	**5.4**	**2.7**	**1.8**	**1.4**	**1.1**	*0.9*	*0.8*	*0.7*		
13	**5.4**	**2.7**	**1.8**	**1.3**	*1.1*	*0.9*	*0.8*			
14	**5.4**	**2.7**	**1.8**	**1.3**	*1.1*	*0.9*	*0.8*			
15	**5.3**	**2.7**	**1.8**	**1.3**	*1.1*	*0.9*				

B2 - FINANCE @ **20 % p.a.** **FINANCE CHARGE IN US$/HOUR**

ECONOMIC LIFE	UTILISATION IN HOURS/YEAR									
YEARS	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
1	**20.0**	**10.0**	**6.7**	**5.0**	**4.0**	**3.3**	**2.9**	**2.5**	**2.2**	**2.0**
2	**15.0**	**7.5**	**5.0**	**3.8**	**3.0**	**2.5**	**2.1**	**1.9**	**1.7**	**1.5**
3	**13.3**	**6.7**	**4.4**	**3.3**	**2.7**	**2.2**	**1.9**	**1.7**	**1.5**	**1.3**
4	**12.5**	**6.3**	**4.2**	**3.1**	**2.5**	**2.1**	**1.8**	**1.6**	**1.4**	**1.3**
5	**12.0**	**6.0**	**4.0**	**3.0**	**2.4**	**2.0**	**1.7**	**1.5**	**1.3**	**1.2**
6	**11.7**	**5.8**	**3.9**	**2.9**	**2.3**	**1.9**	**1.7**	**1.5**	**1.3**	**1.2**
7	**11.4**	**5.7**	**3.8**	**2.9**	**2.3**	**1.9**	**1.6**	**1.4**	*1.3*	*1.1*
8	**11.3**	**5.6**	**3.8**	**2.8**	**2.3**	**1.9**	**1.6**	*1.4*	*1.3*	*1.1*
9	**11.1**	**5.6**	**3.7**	**2.8**	**2.2**	**1.9**	*1.6*	*1.4*	*1.2*	*1.1*
10	**11.0**	**5.5**	**3.7**	**2.8**	**2.2**	**1.8**	*1.6*	*1.4*	*1.2*	*1.1*
11	**10.9**	**5.5**	**3.6**	**2.7**	**2.2**	*1.8*	*1.6*	*1.4*	*1.2*	
12	**10.8**	**5.4**	**3.6**	**2.7**	**2.2**	*1.8*	*1.5*	*1.4*		
13	**10.8**	**5.4**	**3.6**	**2.7**	*2.2*	*1.8*	*1.5*			
14	**10.7**	**5.4**	**3.6**	**2.7**	*2.1*	*1.8*	*1.5*			
15	**10.7**	**5.3**	**3.6**	**2.7**	*2.1*	*1.8*				

B3 - FINANCE @ **30 % p.a.** **FINANCE CHARGE IN US$/HOUR**

ECONOMIC LIFE	UTILISATION IN HOURS/YEAR									
YEARS	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
1	**30.0**	**15.0**	**10.0**	**7.5**	**6.0**	**5.0**	**4.3**	**3.8**	**3.3**	**3.0**
2	**22.5**	**11.3**	**7.5**	**5.6**	**4.5**	**3.8**	**3.2**	**2.8**	**2.5**	**2.3**
3	**20.0**	**10.0**	**6.7**	**5.0**	**4.0**	**3.3**	**2.9**	**2.5**	**2.2**	**2.0**
4	**18.8**	**9.4**	**6.3**	**4.7**	**3.8**	**3.1**	**2.7**	**2.3**	**2.1**	**1.9**
5	**18.0**	**9.0**	**6.0**	**4.5**	**3.6**	**3.0**	**2.6**	**2.3**	**2.0**	**1.8**
6	**17.5**	**8.8**	**5.8**	**4.4**	**3.5**	**2.9**	**2.5**	**2.2**	**1.9**	**1.8**
7	**17.1**	**8.6**	**5.7**	**4.3**	**3.4**	**2.9**	**2.4**	**2.1**	*1.9*	*1.7*
8	**16.9**	**8.4**	**5.6**	**4.2**	**3.4**	**2.8**	**2.4**	*2.1*	*1.9*	*1.7*
9	**16.7**	**8.3**	**5.6**	**4.2**	**3.3**	**2.8**	*2.4*	*2.1*	*1.9*	*1.7*
10	**16.5**	**8.3**	**5.5**	**4.1**	**3.3**	**2.8**	*2.4*	*2.1*	*1.8*	*1.7*
11	**16.4**	**8.2**	**5.5**	**4.1**	**3.3**	*2.7*	*2.3*	*2.0*	*1.8*	
12	**16.3**	**8.1**	**5.4**	**4.1**	**3.3**	*2.7*	*2.3*	*2.0*		
13	**16.2**	**8.1**	**5.4**	**4.0**	*3.2*	*2.7*	*2.3*			
14	**16.1**	**8.0**	**5.4**	**4.0**	*3.2*	*2.7*	*2.3*			
15	**16.0**	**8.0**	**5.3**	**4.0**	*3.2*	*2.7*				

For periods over 15 years it is suggested that the figure for 15 years is used.

March 2012
Ref: ped-roller-b.xls
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Circle or note the figure selected and insert the value in Box C2 on Sheet 3.

COST CALCULATION — Twin Drum Pedestrian ROLLER

Continued

SHEET 3 OF 3
WORKING SHEET

CONVERSION TO DAILY CHARGE RATE

INTEREST RATE ASSUMED (Sheet 2) ____ %

OWNERSHIP COSTS

C ADJUSTMENT FOR ACTUAL COST OF PURCHASE

Selected Depreciation/replacement charge (US$/hr) from Table A1	*(C1)*		
Selected Finance charge (US$/hr) from Table B1, B2 or B3 (or interpolation)	*(C2)*		
Actual purchase/replacement cost in US$	*(C3)*		
Assumed number of operating hours per day	*(C4)*	**Local currency**	
DAILY OWNERSHIP COST = (C1 + C2) x C4 x C3 / 20,000 =	**US$/day**		**(C)**

D ADJUSTMENT FOR EXPECTED RESIDUAL/SCRAP VALUE (IF ANY)

Assumed Residual/Scrap Value in US$	*(D1)*		
Assumed Economic Life in years	*(D2)*		
Assumed Utilisation in Hours / Year	*(D3)*	**Local currency**	
ADJUSTMENT FOR RESIDUAL/SCRAP VALUE = (D1 x C4) / (D2 x D3)	**US$/day**		**(D)**
SUB-TOTAL FOR OWNERSHIP COSTS = (C) - (D)			**(W)**

OPERATING COSTS

E SPARES & CONSUMABLES

Either predict daily costs from past records or select from the following:-

Select percentage of spares and consumables per year compared to machine current cost new, Suggested value between 2 and 10% of cost new (usually increases with age)	*% (E1)*	**Local currency**	
DAILY COST OF SPARES = 0.01 x C3 x C4 x E1 / D3	**US$/day**		**(E)**

F SERVICING AND REPAIR (WORKSHOP LABOUR COSTS)

Either predict daily costs from past records or select from the following:-

Suggested value between 20% and 100% of (E)	*% (F1)*	**Local currency**	
DAILY WORKSHOP LABOUR COSTS = 0.01 x E x F1	**US$/day**		**(F)**

G FUEL & LUBRICANTS

Cost of fuel per litre (add between 2 and 5% to cover lubricant costs)	*(G1)*		
Assumed fuel consumption in litres per hour	*(G2)*	**Local currency**	
DAILY FUEL COST = C4 x G1 x G2	**US$/day**		**(G)**

H OPERATORS (DAILY COSTS)

	Wages	Allowances	Other
Operator			
Assistant			
Other			
Sub-totals			

Local currency

US$/day ____ ____ **(H)**

SUB-TOTAL FOR OPERATING COSTS = (E) + (F) + (G) + (H) ____ ____ **(X)**

OVERHEADS

Predict from past records to include:-

I	Offices, Workshops, Tools & other Facilities	
J	Supervisory, management and clerical personnel	
K	Supervision and support vehicles	
L	Stores and other stock	
M	Insurances	
N	Banking and other finance charges not relating to the equipment item	
O	Administration, training, safety or other overhead costs	
P	Risk, late payment and other contingency items	
Q	Taxes, levies etc.	

US$/day **Local currency**

SUB-TOTAL FOR OVERHEADS = Daily allowance for items (I) to (Q) ____ ____ **(Y)**

US$/day **Local currency**

PROFIT **SUB-TOTAL PROFIT** ____ ____ **(Z)**

US$/day **Local currency**

TOTAL COST TO BE CHARGED = (W) + (X) + (Y) + (Z) = **US$/day** ____ ____

NOTES

1 Finance charge (Sheet 2) calculated by the formula:-

$$C2 = \frac{((N + 1) / 2N) \times \text{Purchase Price} \times \text{interest rate expressed as a decimal}}{\text{Hours per year}}$$

Where N = number of years (economic life)

2 To convert the US$ values to Local Currency multiply by the current exchange rate

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COST CALCULATION — Twin Drum Pedestrian ROLLER

Continued

SHEET 3 OF 3

WORKING SHEET

EXAMPLE

CONVERSION TO DAILY CHARGE RATE

INTEREST RATE ASSUMED (Sheet 2) *10* %

OWNERSHIP COSTS

C ADJUSTMENT FOR ACTUAL COST OF PURCHASE

Selected Depreciation/replacement charge (US$/hr) from Table A1	*2.9* (C1)			
Selected Finance charge (US$/hr) from Table B1, B2 or B3 (or interpolation)	*1.6* (C2)			
Actual purchase/replacement cost in US$	*19,000* (C3)			
Assumed number of operating hours per day	*6* (C4)		Local currency	
DAILY OWNERSHIP COST = (C1 + C2) x C4 x C3 / 20,000 =	**US$/day**	*25.65*		**(C)**

D ADJUSTMENT FOR EXPECTED RESIDUAL/SCRAP VALUE (IF ANY)

Assumed Residual/Scrap Value in US$	*800* (D1)			
Assumed Economic Life in years	*10* (D2)			
Assumed Utilisation in Hours / Year	*700* (D3)		Local currency	
ADJUSTMENT FOR RESIDUAL/SCRAP VALUE = (D1 x C4) / (D2 x D3)	**US$/day**	*0.69*		**(D)**
SUB-TOTAL FOR OWNERSHIP COSTS = (C) - (D)		*24.96*		**(W)**

OPERATING COSTS

E SPARES & CONSUMABLES

Either predict daily costs from past records or select from the following:-

Select percentage of spares and consumables per year compared to machine current cost new,

Suggested value between 2 and 10% of cost new (usually increases with age)	*6* % (E1)		Local currency	
DAILY COST OF SPARES = 0.01 x C3 x C4 x E1 / D3	**US$/day**	*9.77*		**(E)**

F SERVICING AND REPAIR (WORKSHOP LABOUR COSTS)

Either predict daily costs from past records or select from the following:-

Suggested value between 20% and 100% of (E)	*70* % (F1)		Local currency	
DAILY WORKSHOP LABOUR COSTS = 0.01 x E x F1	**US$/day**	*6.84*		**(F)**

G FUEL & LUBRICANTS

Cost of fuel per litre (add between 2 and 5% to cover lubricant costs)	*$0.4* (G1)			
Assumed fuel consumption in litres per hour	*2.5* (G2)		Local currency	
DAILY FUEL COST = C4 x G1 x G2	**US$/day**	*6.00*		**(G)**

H OPERATORS (DAILY COSTS)

	Wages	Allowances	Other
Operator	*$9.0*	*$2.0*	*$1.0*
Assistant			
Other			
Sub-totals	*$9.00*	*$2.00*	*$1.00*

			Local currency	
	US$/day	*12.00*		**(H)**
SUB-TOTAL FOR OPERATING COSTS = (E) + (F) + (G) + (H)		*34.61*		**(X)**

OVERHEADS

Predict from past records to include:-

I	Offices, Workshops, Tools & other Facilities			
J	Supervisory, management and clerical personnel			
K	Supervision and support vehicles			
L	Stores and other stock			
M	Insurances			
N	Banking and other finance charges not relating to the equipment item			
O	Administration, training, safety or other overhead costs			
P	Risk, late payment and other contingency items			
Q	Taxes, levies etc.		US$/day	Local currency
SUB-TOTAL FOR OVERHEADS = Daily allowance for items (I) to (Q)		*8.94*		**(Y)**
(assuming 15% in this example)		US$/day	Local currency	
PROFIT **SUB-TOTAL PROFIT**		*8.94*		**(Z)**
(assuming 15% in this example)		US$/day	Local currency	
TOTAL COST TO BE CHARGED = (W) + (X) + (Y) + (Z) =	**US$/day**	***77.45***		

NOTES

1 Finance charge (Sheet 2) calculated by the formula:-

$$C2 = \frac{((N + 1) / 2N) \times \text{Purchase Price} \times \text{interest rate expressed as a decimal}}{\text{Hours per year}}$$

Where N = number of years (economic life)

2 To convert the US$ values to Local Currency multiply by the current exchange rate

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March 2012 *Ref: ped-roller-d.xls*

COST CALCULATION

Small Rural Vehicle (SRV)

SHEET 1 OF 3

TOTAL **DAILY** CHARGE COMPRISES OWNERSHIP + OPERATING + OVERHEAD COSTS (+PROFIT).

OWNERSHIP COSTS COMPRISE:-
DEPRECIATION/REPLACEMENT (TABLE A1) PLUS FINANCE CHARGE (TABLE B1, B2 OR B3)

ALL TABLE A & B COSTS IN US$/DAY

COST NEW- US$ 4,000 (INCLUDING ALL TAXES, DUTIES, CIF & DELIVERY CHARGES)
Note: This is the benchmark cost which is adjusted on Sheet 3 for the ACTUAL cost of purchase New or Second Hand

A1 - DEPRECIATION/REPLACEMENT CHARGE IN US$/DAY

ECONOMIC LIFE	UTILISATION IN DAYS/YEAR										
YEARS	30	60	90	120	150	180	210	240	270	300	330
1	133.33	66.67	44.44	33.33	26.67	22.22	19.05	16.67	14.81	13.33	12.12
2	66.67	33.33	22.22	16.67	13.33	11.11	9.52	8.33	7.41	6.67	6.06
3	44.44	22.22	14.81	11.11	8.89	7.41	6.35	5.56	4.94	4.44	4.04
4	33.33	16.67	11.11	8.33	6.67	5.56	4.76	4.17	3.70	3.33	3.03
5	26.67	13.33	8.89	6.67	5.33	4.44	3.81	3.33	2.96	2.67	2.42
6	22.22	11.11	7.41	5.56	4.44	3.70	3.17	2.78	2.47	2.22	2.02
7	19.05	9.52	6.35	4.76	3.81	3.17	2.72	2.38	2.12	1.90	1.73
8	16.67	8.33	5.56	4.17	3.33	2.78	2.38	2.08	1.85	1.67	1.52
9	14.81	7.41	4.94	3.70	2.96	2.47	2.12	1.85	1.65	1.48	1.35
10	13.33	6.67	4.44	3.33	2.67	2.22	1.90	1.67	1.48	1.33	
11	12.12	6.06	4.04	3.03	2.42	2.02	1.73	1.52	1.35		
12	11.11	5.56	3.70	2.78	2.22	1.85	1.59	1.39			
13	10.26	5.13	3.42	2.56	2.05	1.71	1.47				
14	9.52	4.76	3.17	2.38	1.90	1.59	1.36				
15	8.89	4.44	2.96	2.22	1.78	1.48					

Ref: SRV-a.xls *Intech Associates*

Circle or note the figure selected and insert the value in Box C1 on Sheet 3.

March 2012

COST CALCULATION

Small Rural Vehicle (SRV)

Continued

SHEET 2 OF 3

TOTAL DAILY CHARGE COMPRISES OWNERSHIP + OPERATING + OVERHEAD COSTS (+PROFIT).

OWNERSHIP COSTS COMPRISE:-
DEPRECIATION/REPLACEMENT (TABLE A1) PLUS FINANCE CHARGE (TABLE B1, B2 OR B3)

ALL TABLE A & B COSTS IN US$/DAY

COST NEW- US$ 4,000 (INCLUDING ALL TAXES, DUTIES, CIF & DELIVERY CHARGES)
Note: This is the benchmark cost which is adjusted on Sheet 3 for the ACTUAL cost of purchase New or Second Hand

TABLE B: FINANCE OR OPPORTUNITY COST OF CAPITAL

SELECT APPROPRIATE TABLE (B1, B2 OR B3) OR INTERPOLATE FOR AN INTERMEDIATE INTEREST RATE

B1 - FINANCE @ **10 % p.a.** **FINANCE CHARGE IN US$/DAY**

ECONOMIC LIFE	UTILISATION IN DAYS/YEAR										
YEARS	30	60	90	120	150	180	210	240	270	300	330
1	13.33	6.67	4.44	3.33	2.67	2.22	1.90	1.67	1.48	1.33	1.21
2	10.00	5.00	3.33	2.50	2.00	1.67	1.43	1.25	1.11	1.00	0.91
3	8.89	4.44	2.96	2.22	1.78	1.48	1.27	1.11	0.99	0.89	0.81
4	8.33	4.17	2.78	2.08	1.67	1.39	1.19	1.04	0.93	0.83	0.76
5	8.00	4.00	2.67	2.00	1.60	1.33	1.14	1.00	0.89	0.80	0.73
6	7.78	3.89	2.59	1.94	1.56	1.30	1.11	0.97	0.86	0.78	0.71
7	7.62	3.81	2.54	1.90	1.52	1.27	1.09	0.95	0.85	0.76	0.69
8	7.50	3.75	2.50	1.88	1.50	1.25	1.07	0.94	0.83	0.75	0.68
9	7.41	3.70	2.47	1.85	1.48	1.23	1.06	0.93	0.82	0.74	0.67
10	7.33	3.67	2.44	1.83	1.47	1.22	1.05	0.92	0.81	0.73	
11	7.27	3.64	2.42	1.82	1.45	1.21	1.04	0.91	0.81		
12	7.22	3.61	2.41	1.81	1.44	1.20	1.03	0.90			
13	7.18	3.59	2.39	1.79	1.44	1.20	1.03				
14	7.14	3.57	2.38	1.79	1.43	1.19	1.02				
15	7.11	3.56	2.37	1.78	1.42	1.19					

B2 - FINANCE @ **20 % p.a.** **FINANCE CHARGE IN US$/DAY**

ECONOMIC LIFE	UTILISATION IN DAYS/YEAR										
YEARS	30	60	90	120	150	180	210	240	270	300	330
1	26.67	13.33	8.89	6.67	5.33	4.44	3.81	3.33	2.96	2.67	2.42
2	20.00	10.00	6.67	5.00	4.00	3.33	2.86	2.50	2.22	2.00	1.82
3	17.78	8.89	5.93	4.44	3.56	2.96	2.54	2.22	1.98	1.78	1.62
4	16.67	8.33	5.56	4.17	3.33	2.78	2.38	2.08	1.85	1.67	1.52
5	16.00	8.00	5.33	4.00	3.20	2.67	2.29	2.00	1.78	1.60	1.45
6	15.56	7.78	5.19	3.89	3.11	2.59	2.22	1.94	1.73	1.56	1.41
7	15.24	7.62	5.08	3.81	3.05	2.54	2.18	1.90	1.69	1.52	1.39
8	15.00	7.50	5.00	3.75	3.00	2.50	2.14	1.88	1.67	1.50	1.36
9	14.81	7.41	4.94	3.70	2.96	2.47	2.12	1.85	1.65	1.48	1.35
10	14.67	7.33	4.89	3.67	2.93	2.44	2.10	1.83	1.63	1.47	
11	14.55	7.27	4.85	3.64	2.91	2.42	2.08	1.82	1.62		
12	14.44	7.22	4.81	3.61	2.89	2.41	2.06	1.81			
13	14.36	7.18	4.79	3.59	2.87	2.39	2.05				
14	14.29	7.14	4.76	3.57	2.86	2.38	2.04				
15	14.22	7.11	4.74	3.56	2.84	2.37					

B3 - FINANCE @ **30 % p.a.** **FINANCE CHARGE IN US$/DAY**

ECONOMIC LIFE	UTILISATION IN DAYS/YEAR										
YEARS	30	60	90	120	150	180	210	240	270	300	330
1	40.00	20.00	13.33	10.00	8.00	6.67	5.71	5.00	4.44	4.00	3.64
2	30.00	15.00	10.00	7.50	6.00	5.00	4.29	3.75	3.33	3.00	2.73
3	26.67	13.33	8.89	6.67	5.33	4.44	3.81	3.33	2.96	2.67	2.42
4	25.00	12.50	8.33	6.25	5.00	4.17	3.57	3.13	2.78	2.50	2.27
5	24.00	12.00	8.00	6.00	4.80	4.00	3.43	3.00	2.67	2.40	2.18
6	23.33	11.67	7.78	5.83	4.67	3.89	3.33	2.92	2.59	2.33	2.12
7	22.86	11.43	7.62	5.71	4.57	3.81	3.27	2.86	2.54	2.29	2.08
8	22.50	11.25	7.50	5.63	4.50	3.75	3.21	2.81	2.50	2.25	2.05
9	22.22	11.11	7.41	5.56	4.44	3.70	3.17	2.78	2.47	2.22	2.02
10	22.00	11.00	7.33	5.50	4.40	3.67	3.14	2.75	2.44	2.20	
11	21.82	10.91	7.27	5.45	4.36	3.64	3.12	2.73	2.42		
12	21.67	10.83	7.22	5.42	4.33	3.61	3.10	2.71			
13	21.54	10.77	7.18	5.38	4.31	3.59	3.08				
14	21.43	10.71	7.14	5.36	4.29	3.57	3.06				
15	21.33	10.67	7.11	5.33	4.27	3.56					

For periods over 15 years it is suggested that the figure for 15 years is used.

Circle or note the figure selected and insert the value in Box C2 on Sheet 3.

March 2012
Ref: ped-roller-b.xls
Intech Associates

COST CALCULATION — Small Rural Vehicle (SRV)

Continued

SHEET 3 OF 3
WORKING SHEET

CONVERSION TO ADJUSTED DAILY CHARGE RATE

INTEREST RATE ASSUMED (Sheet 2) ____ %

OWNERSHIP COSTS

C ADJUSTMENT FOR ACTUAL COST OF PURCHASE

Selected Depreciation/replacement charge (US$/day) from Table A1	*(C1)*		
Selected Finance charge (US$/day) from Table B1, B2 or B3 (or interpolation)	*(C2)*		
Actual purchase/replacement cost in US$	*(C3)*		**Local currency**
DAILY OWNERSHIP COST = (C1 + C2) x C3 / 4,000 =	**US$/day**		**(C)**

D ADJUSTMENT FOR EXPECTED RESIDUAL/SCRAP VALUE (IF ANY)

Assumed Residual/Scrap Value in US$	*(D1)*		
Assumed Economic Life in years	*(D2)*		
Assumed Utilisation in Days / Year	*(D3)*		**Local currency**
ADJUSTMENT FOR RESIDUAL/SCRAP VALUE = D1 / (D2 x D3)	**US$/day**		**(D)**
SUB-TOTAL FOR OWNERSHIP COSTS = (C) - (D)			**(W)**

OPERATING COSTS

E SPARES & CONSUMABLES

Either predict daily costs from past records or select from the following:-

Select percentage of spares and consumables per year compared to machine current cost new,			
Suggested value between 2 and 10% of cost new (usually increases with age)	*% (E1)*		**Local currency**
DAILY COST OF SPARES = 0.01 x C3 x E1 / D3	**US$/day**		**(E)**

F SERVICING AND REPAIR (WORKSHOP LABOUR COSTS)

Either predict daily costs from past records or select from the following:-

Suggested value between 20% and 100% of (E)	*% (F1)*		**Local currency**
DAILY WORKSHOP LABOUR COSTS = 0.01 x E x F1	**US$/day**		**(F)**

G FUEL & LUBRICANTS

Cost of fuel per litre (add between 2 and 5% to cover lubricant costs)	*(G1)*		
Assumed fuel consumption in litres per day	*(G2)*		**Local currency**
DAILY FUEL COST = G1 x G2	**US$/day**		**(G)**

H OPERATORS (DAILY COSTS)

	Wages	Allowances	Other
Operator			
Assistant			
Other			
Sub-totals			

Local currency

US$/day ____ ____ **(H)**

SUB-TOTAL FOR OPERATING COSTS = (E) + (F) + (G) + (H) ____ ____ **(X)**

OVERHEADS

Predict from past records to include:-

I	Offices, Workshops, Tools & other Facilities		
J	Supervisory, management and clerical personnel		
K	Supervision and support vehicles		
L	Stores and other stock		
M	Insurances		
N	Banking and other finance charges not relating to the equipment item		
O	Administration, training, safety or other overhead costs		
P	Risk, late payment and other contingency items		
Q	Taxes, levies etc.		

US$/day **Local currency**

SUB-TOTAL FOR OVERHEADS = Daily allowance for items (I) to (Q) ____ ____ **(Y)**

US$/day **Local currency**

PROFIT **SUB-TOTAL PROFIT** ____ ____ **(Z)**

US$/day **Local currency**

TOTAL COST TO BE CHARGED = (W) + (X) + (Y) + (Z) = **US$/day** ____ ____

NOTES

1 Finance charge (Sheet 2) calculated by the formula:-

$$C2 = \frac{((N + 1) / 2N) \times \text{Purchase Price} \times \text{interest rate expressed as a decimal}}{\text{Hours per year}}$$

Where N = number of years (economic life)

2 To convert the US$ values to Local Currency multiply by the current exchange rate

Intech Associates
March 2012 *Ref: SRV-C.xls*

COST CALCULATION — Small Rural Vehicle (SRV)

Continued

SHEET 3 OF 3

WORKING SHEET

EXAMPLE

CONVERSION TO ADJUSTED DAILY CHARGE RATE

INTEREST RATE ASSUMED (Sheet 2) *10* %

OWNERSHIP COSTS

C ADJUSTMENT FOR ACTUAL COST OF PURCHASE

Selected Depreciation/replacement charge (US$/day) from Table A1	*1.67* (C1)		
Selected Finance charge (US$/day) from Table B1, B2 or B3 (or interpolation)	*0.92* (C2)		
Actual purchase/replacement cost in US$	*4,500* (C3)		**Local currency**
DAILY OWNERSHIP COST = (C1 + C2) x C3 / 4,000 =	**US$/day**	*2.91*	**(C)**

D ADJUSTMENT FOR EXPECTED RESIDUAL/SCRAP VALUE (IF ANY)

Assumed Residual/Scrap Value in US$	*340* (D1)		
Assumed Economic Life in years	*10* (D2)		
Assumed Utilisation in Days / Year	*240* (D3)		**Local currency**
ADJUSTMENT FOR RESIDUAL/SCRAP VALUE = D1 / (D2 x D3)	**US$/day**	*0.14*	**(D)**
SUB-TOTAL FOR OWNERSHIP COSTS = (C) - (D)		*2.77*	**(W)**

OPERATING COSTS

E SPARES & CONSUMABLES

Either predict daily costs from past records or select from the following:-

Select percentage of spares and consumables per year compared to machine current cost new, Suggested value between 2 and 10% of cost new (usually increases with age)	*5* % (E1)		**Local currency**
DAILY COST OF SPARES = 0.01 x C3 x E1 / D3	**US$/day**	*0.94*	**(E)**

F SERVICING AND REPAIR (WORKSHOP LABOUR COSTS)

Either predict daily costs from past records or select from the following:-

Suggested value between 20% and 100% of (E)	*50* % (F1)		**Local currency**
DAILY WORKSHOP LABOUR COSTS = 0.01 x E x F1	**US$/day**	*0.47*	**(F)**

G FUEL & LUBRICANTS

Cost of fuel per litre (add between 2 and 5% to cover lubricant costs)	*$0.40* (G1)		
Assumed fuel consumption in litres per day	*5.5* (G2)		**Local currency**
DAILY FUEL COST = G1 x G2	**US$/day**	*2.20*	**(G)**

H OPERATORS (DAILY COSTS)

	Wages	Allowances	Other
Operator	*$8.00*	*$1.00*	
Assistant			
Other			
Sub-totals	*$8.00*	*$1.00*	

Local currency

	US$/day	*9.00*	**(H)**
SUB-TOTAL FOR OPERATING COSTS = (E) + (F) + (G) + (H)		*12.61*	**(X)**

OVERHEADS

Predict from past records to include:-

I	Offices, Workshops, Tools & other Facilities	
J	Supervisory, management and clerical personnel	
K	Supervision and support vehicles	
L	Stores and other stock	
M	Insurances	
N	Banking and other finance charges not relating to the equipment item	
O	Administration, training, safety or other overhead costs	
P	Risk, late payment and other contingency items	
Q	Taxes, levies etc.	

US$/day **Local currency**

SUB-TOTAL FOR OVERHEADS = Daily allowance for items (I) to (Q)		*2.31*	**(Y)**
(assuming 15% in this example)	**US$/day**	**Local currency**	
PROFIT **SUB-TOTAL PROFIT**		*2.31*	**(Z)**
(assuming 15% in this example)	**US$/day**	**Local currency**	
TOTAL COST TO BE CHARGED = (W) + (X) + (Y) + (Z) =	**US$/day**	***20.0***	

NOTES

1 Finance charge (Sheet 2) calculated by the formula:-

$$C2 = \frac{((N + 1) / 2N) \times \text{Purchase Price} \times \text{interest rate expressed as a decimal}}{\text{Hours per year}}$$

Where N = number of years (economic life)

2 To convert the US$ values to Local Currency multiply by the current exchange rate

March 2012 *Intech Associates* *Ref: SRV-C.xls*

COST CALCULATION — 100hp (75kW) Agricultural TRACTOR (4WD)

TOTAL HOURLY CHARGE COMPRISES OWNERSHIP + OPERATING + OVERHEAD COSTS (+PROFIT).

OWNERSHIP COSTS COMPRISE:-
DEPRECIATION/REPLACEMENT (TABLE A1) PLUS FINANCE CHARGE (TABLE B1, B2 OR B3)

ALL TABLE A & B COSTS IN US$/HOUR

COST NEW- US$ 55,000 (INCLUDING ALL TAXES, DUTIES, CIF & DELIVERY CHARGES)
Note: This is the benchmark cost which is adjusted on Sheet 3 for the ACTUAL cost of purchase New or Second Hand

A1 - DEPRECIATION/REPLACEMENT CHARGE IN US$/HOUR

ECONOMIC LIFE	UTILISATION IN HOURS/YEAR									
YEARS	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
1	**275**	**138**	**92**	**69**	**55**	**46**	**39**	**34**	**31**	**28**
2	**138**	**69**	**46**	**34**	**28**	**23**	**20**	**17**	**15**	**14**
3	**92**	**46**	**31**	**23**	**18**	**15**	**13**	**11**	**10**	**9**
4	**69**	**34**	**23**	**17**	**14**	**11**	**10**	**9**	**8**	**7**
5	**55**	**28**	**18**	**14**	**11**	**9**	**8**	**7**	**6**	**6**
6	**46**	**23**	**15**	**11**	**9**	**8**	**7**	**6**	**5**	**5**
7	**39**	**20**	**13**	**10**	**8**	**7**	**6**	**5**	**4**	**4**
8	**34**	**17**	**11**	**9**	**7**	**6**	**5**	**4**	**4**	*3*
9	**31**	**15**	**10**	**8**	**6**	**5**	**4**	**4**	*3*	*3*
10	**28**	**14**	**9**	**7**	**6**	**5**	**4**	*3*	*3*	*3*
11	**25**	**13**	**8**	**6**	**5**	**4**	*4*	*3*	*3*	*3*
12	**23**	**11**	**8**	**6**	**5**	**4**	*3*	*3*	*3*	*2*
13	**21**	**11**	**7**	**5**	**4**	*4*	*3*	*3*	*2*	
14	**20**	**10**	**7**	**5**	**4**	*3*	*3*	*2*		
15	**18**	**9**	**6**	**5**	**4**	*3*	*3*	*2*		
16	**17**	**9**	**6**	**4**	*3*	*3*	*2*			
17	**16**	**8**	**5**	**4**	*3*	*3*	*2*			
18	**15**	**8**	**5**	**4**	*3*	*3*				
19	**14**	**7**	**5**	*4*	*3*	*2*				
20	**14**	**7**	**5**	*3*	*3*	*2*				

Ref: tractor100-A.xls *Intech Associates*
March 2012

NOTES

It is extremely unusual for the management, operational & support skills and resources to exist to achieve heavy equipment life of 15,000 hours or more.
Equipment lives of 15,000 hours or more should only be assumed in exceptional circumstances (figures in italics).

Circle or note the figure selected and insert the value in Box C1 on Sheet 3.

COST CALCULATION — 100hp (75kW) Agricultural TRACTOR (4WD)

Continued **SHEET 2 OF 3**

TOTAL HOURLY CHARGE COMPRISES OWNERSHIP + OPERATING + OVERHEAD COSTS (+PROFIT).

OWNERSHIP COSTS COMPRISE:-
DEPRECIATION/REPLACEMENT (TABLE A1) PLUS FINANCE CHARGE (TABLE B1, B2 OR B3)

ALL TABLE A & B COSTS IN US$/HOUR

COST NEW- US$ 55,000 (INCLUDING ALL TAXES, DUTIES, CIF & DELIVERY CHARGES)
Note: This is the benchmark cost which is adjusted on Sheet 3 for the ACTUAL cost of purchase New or Second Hand

TABLE B: FINANCE OR OPPORTUNITY COST OF CAPITAL

SELECT APPROPRIATE TABLE (B1, B2 OR B3) OR INTERPOLATE FOR AN INTERMEDIATE INTEREST RATE

B1 - FINANCE @ **10 % p.a.** **FINANCE CHARGE IN US$/HOUR**

ECONOMIC LIFE	UTILISATION IN HOURS/YEAR									
YEARS	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
1	**28**	**14**	**9**	**7**	**6**	**5**	**4**	**3**	**3**	**3**
2	**21**	**10**	**7**	**5**	**4**	**3**	**3**	**3**	**2**	**2**
3	**18**	**9**	**6**	**5**	**4**	**3**	**3**	**2**	**2**	**2**
4	**17**	**9**	**6**	**4**	**3**	**3**	**2**	**2**	**2**	**2**
5	**17**	**8**	**6**	**4**	**3**	**3**	**2**	**2**	**2**	**2**
6	**16**	**8**	**5**	**4**	**3**	**3**	**2**	**2**	**2**	**2**
7	**16**	**8**	**5**	**4**	**3**	**3**	**2**	**2**	**2**	**2**
8	**15**	**8**	**5**	**4**	**3**	**3**	**2**	**2**	**2**	*2*
9	**15**	**8**	**5**	**4**	**3**	**3**	**2**	**2**	*2*	*2*
10	**15**	**8**	**5**	**4**	**3**	**3**	**2**	*2*	*2*	*2*
11	**15**	**8**	**5**	**4**	**3**	**3**	*2*	*2*	*2*	*2*
12	**15**	**7**	**5**	**4**	**3**	**2**	*2*	*2*	*2*	*1*
13	**15**	**7**	**5**	**4**	**3**	*2*	*2*	*2*	*2*	
14	**15**	**7**	**5**	**4**	**3**	*2*	*2*	*2*		
15	**15**	**7**	**5**	**4**	**3**	*2*	*2*	*2*		

B2 - FINANCE @ **20 % p.a.** **FINANCE CHARGE IN US$/HOUR**

ECONOMIC LIFE	UTILISATION IN HOURS/YEAR									
YEARS	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
1	**55**	**28**	**18**	**14**	**11**	**9**	**8**	**7**	**6**	**6**
2	**41**	**21**	**14**	**10**	**8**	**7**	**6**	**5**	**5**	**4**
3	**37**	**18**	**12**	**9**	**7**	**6**	**5**	**5**	**4**	**4**
4	**34**	**17**	**11**	**9**	**7**	**6**	**5**	**4**	**4**	**3**
5	**33**	**17**	**11**	**8**	**7**	**6**	**5**	**4**	**4**	**3**
6	**32**	**16**	**11**	**8**	**6**	**5**	**5**	**4**	**4**	**3**
7	**31**	**16**	**10**	**8**	**6**	**5**	**4**	**4**	**3**	**3**
8	**31**	**15**	**10**	**8**	**6**	**5**	**4**	**4**	**3**	*3*
9	**31**	**15**	**10**	**8**	**6**	**5**	**4**	**4**	*3*	*3*
10	**30**	**15**	**10**	**8**	**6**	**5**	**4**	*4*	*3*	*3*
11	**30**	**15**	**10**	**8**	**6**	**5**	*4*	*4*	*3*	*3*
12	**30**	**15**	**10**	**7**	**6**	**5**	*4*	*4*	*3*	*3*
13	**30**	**15**	**10**	**7**	**6**	*5*	*4*	*4*	*3*	
14	**29**	**15**	**10**	**7**	**6**	*5*	*4*	*4*		
15	**29**	**15**	**10**	**7**	**6**	*5*	*4*	*4*		

B3 - FINANCE @ **30 % p.a.** **FINANCE CHARGE IN US$/HOUR**

ECONOMIC LIFE	UTILISATION IN HOURS/YEAR									
YEARS	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
1	**83**	**41**	**28**	**21**	**17**	**14**	**12**	**10**	**9**	**8**
2	**62**	**31**	**21**	**15**	**12**	**10**	**9**	**8**	**7**	**6**
3	**55**	**28**	**18**	**14**	**11**	**9**	**8**	**7**	**6**	**6**
4	**52**	**26**	**17**	**13**	**10**	**9**	**7**	**6**	**6**	**5**
5	**50**	**25**	**17**	**12**	**10**	**8**	**7**	**6**	**6**	**5**
6	**48**	**24**	**16**	**12**	**10**	**8**	**7**	**6**	**5**	**5**
7	**47**	**24**	**16**	**12**	**9**	**8**	**7**	**6**	**5**	**5**
8	**46**	**23**	**15**	**12**	**9**	**8**	**7**	**6**	**5**	*5*
9	**46**	**23**	**15**	**11**	**9**	**8**	**7**	**6**	*5*	*5*
10	**45**	**23**	**15**	**11**	**9**	**8**	**6**	*6*	*5*	*5*
11	**45**	**23**	**15**	**11**	**9**	**8**	*6*	*6*	*5*	*5*
12	**45**	**22**	**15**	**11**	**9**	**7**	*6*	*6*	*5*	*4*
13	**44**	**22**	**15**	**11**	**9**	*7*	*6*	*6*	*5*	
14	**44**	**22**	**15**	**11**	**9**	*7*	*6*	*6*		
15	**44**	**22**	**15**	**11**	**9**	*7*	*6*	*6*		

For periods over 15 years it is suggested that the figure for 15 years is used.

Circle or note the figure selected and insert the value in Box C2 on Sheet 3.

March 2012
Ref: tractor100-b.xls
Intech Associates

COST CALCULATION — 100hp (75kW) Agricultural TRACTOR (4WD)

Continued

SHEET 3 OF 3
WORKING SHEET

CONVERSION TO DAILY CHARGE RATE

INTEREST RATE ASSUMED (Sheet 2) ____ %

OWNERSHIP COSTS

C ADJUSTMENT FOR ACTUAL COST OF PURCHASE

Selected Depreciation/replacement charge (US$/hr) from Table A1	*(C1)*		
Selected Finance charge (US$/hr) from Table B1, B2 or B3 (or interpolation)	*(C2)*		
Actual purchase/replacement cost in US$	*(C3)*		
Assumed number of operating hours per day	*(C4)*		**Local currency**
DAILY OWNERSHIP COST = (C1 + C2) x C4 x C3 / 55,000 =	**US$/day**		**(C)**

D ADJUSTMENT FOR EXPECTED RESIDUAL/SCRAP VALUE (IF ANY)

Assumed Residual/Scrap Value in US$	*(D1)*		
Assumed Economic Life in years	*(D2)*		
Assumed Utilisation in Hours / Year	*(D3)*		**Local currency**
ADJUSTMENT FOR RESIDUAL/SCRAP VALUE = (D1 x C4) / (D2 x D3)	**US$/day**		**(D)**
SUB-TOTAL FOR OWNERSHIP COSTS = (C) - (D)			**(W)**

OPERATING COSTS

E SPARES & CONSUMABLES

Either predict daily costs from past records or select from the following:-

Select percentage of spares and consumables per year compared to machine current cost new,

Suggested value between 2 and 10% of cost new (usually increases with age)	*% (E1)*		**Local currency**
DAILY COST OF SPARES = 0.01 x C3 x C4 x E1 / D3	**US$/day**		**(E)**

F SERVICING AND REPAIR (WORKSHOP LABOUR COSTS)

Either predict daily costs from past records or select from the following:-

Suggested value between 20% and 100% of (E)	*% (F1)*		**Local currency**
DAILY WORKSHOP LABOUR COSTS = 0.01 x E x F1	**US$/day**		**(F)**

G FUEL & LUBRICANTS

Cost of fuel per litre (add between 2 and 5% to cover lubricant costs)	*(G1)*		
Assumed fuel consumption in litres per hour	*(G2)*		**Local currency**
DAILY FUEL COST = C4 x G1 x G2	**US$/day**		**(G)**

H OPERATORS (DAILY COSTS)

	Wages	Allowances	Other
Operator			
Assistant			
Other			
Sub-totals			

Local currency

US$/day ____ **(H)**

SUB-TOTAL FOR OPERATING COSTS = (E) + (F) + (G) + (H) ____ **(X)**

OVERHEADS

Predict from past records to include:-

I	Offices, Workshops, Tools & other Facilities	
J	Supervisory, management and clerical personnel	
K	Supervision and support vehicles	
L	Stores and other stock	
M	Insurances	
N	Banking and other finance charges not relating to the equipment item	
O	Administration, training, safety or other overhead costs	
P	Risk, late payment and other contingency items	
Q	Taxes, levies etc.	

US$/day **Local currency**

SUB-TOTAL FOR OVERHEADS = Daily allowance for items (I) to (Q) ____ **(Y)**

US$/day **Local currency**

PROFIT **SUB-TOTAL PROFIT** ____ **(Z)**

US$/day **Local currency**

TOTAL COST TO BE CHARGED = (W) + (X) + (Y) + (Z) = **US$/day** ____

NOTES

1 Finance charge (Sheet 2) calculated by the formula:-

$$C2 = \frac{((N + 1) / 2N) \times \text{Purchase Price} \times \text{interest rate expressed as a decimal}}{\text{Hours per year}}$$

Where N = number of years (economic life)

2 To convert the US$ values to Local Currency multiply by the current exchange rate

Intech Associates
March 2012 *Ref: tractor100-c.xls*

COST CALCULATION — 100hp (75kW) Agricultural TRACTOR (4WD)

Continued

SHEET 3 OF 3

WORKING SHEET

EXAMPLE

CONVERSION TO DAILY CHARGE RATE

INTEREST RATE ASSUMED (Sheet 2) 10 %

OWNERSHIP COSTS

C ADJUSTMENT FOR ACTUAL COST OF PURCHASE

Selected Depreciation/replacement charge (US$/hr) from Table A1	6 (C1)			
Selected Finance charge (US$/hr) from Table B1, B2 or B3 (or interpolation)	3 (C2)			
Actual purchase/replacement cost in US$	52,000 (C3)			
Assumed number of operating hours per day	7 (C4)		Local currency	
DAILY OWNERSHIP COST = (C1 + C2) x C4 x C3 / 55,000 =		US$/day	60	(C)

D ADJUSTMENT FOR EXPECTED RESIDUAL/SCRAP VALUE (IF ANY)

Assumed Residual/Scrap Value in US$	5,200 (D1)			
Assumed Economic Life in years	10 (D2)			
Assumed Utilisation in Hours / Year	1,000 (D3)		Local currency	
ADJUSTMENT FOR RESIDUAL/SCRAP VALUE = (D1 x C4) / (D2 x D3)		US$/day	4	(D)
SUB-TOTAL FOR OWNERSHIP COSTS = (C) - (D)			56	**(W)**

OPERATING COSTS

E SPARES & CONSUMABLES

Either predict daily costs from past records or select from the following:-

Select percentage of spares and consumables per year compared to machine current cost new,

Suggested value between 2 and 10% of cost new (usually increases with age)	6 % (E1)		Local currency	
DAILY COST OF SPARES = 0.01 x C3 x C4 x E1 / D3		US$/day	22	(E)

F SERVICING AND REPAIR (WORKSHOP LABOUR COSTS)

Either predict daily costs from past records or select from the following:-

Suggested value between 20% and 100% of (E)	70 % (F1)		Local currency	
DAILY WORKSHOP LABOUR COSTS = 0.01 x E x F1		US$/day	15	(F)

G FUEL & LUBRICANTS

Cost of fuel per litre (add between 2 and 5% to cover lubricant costs)	$0.40 (G1)			
Assumed fuel consumption in litres per hour	12 (G2)		Local currency	
DAILY FUEL COST = C4 x G1 x G2		US$/day	34	(G)

H OPERATORS (DAILY COSTS)

	Wages	Allowances	Other
Operator	$9.00	$2.00	$1.00
Assistant			
Other			
Sub-totals	$9.00	$2.00	$1.00

Local currency

US$/day 12 (H)

SUB-TOTAL FOR OPERATING COSTS = (E) + (F) + (G) + (H) 83 **(X)**

OVERHEADS

Predict from past records to include:-

I	Offices, Workshops, Tools & other Facilities		
J	Supervisory, management and clerical personnel		
K	Supervision and support vehicles		
L	Stores and other stock		
M	Insurances		
N	Banking and other finance charges not relating to the equipment item		
O	Administration, training, safety or other overhead costs		
P	Risk, late payment and other contingency items		
Q	Taxes, levies etc.		

US$/day Local currency

SUB-TOTAL FOR OVERHEADS = Daily allowance for items (I) to (Q) 21 **(Y)**

(assuming 15% in this example) US$/day Local currency

PROFIT **SUB-TOTAL PROFIT** 21 **(Z)**

(assuming 15% in this example) US$/day Local currency

TOTAL COST TO BE CHARGED = (W) + (X) + (Y) + (Z) = US$/day ***181***

NOTES

1 Finance charge (Sheet 2) calculated by the formula:-

$$C2 = \frac{((N + 1) / 2N) \times \text{Purchase Price} \times \text{interest rate expressed as a decimal}}{\text{Hours per year}}$$

Where N = number of years (economic life)

2 To convert the US$ values to Local Currency multiply by the current exchange rate

Intech Associates

March 2012 *Ref: tractor100-d.xls*

COST CALCULATION

5 tonne Heavy Towed GRADER

TOTAL HOURLY CHARGE COMPRISES OWNERSHIP + OPERATING + OVERHEAD COSTS (+PROFIT).

OWNERSHIP COSTS COMPRISE:-
DEPRECIATION/REPLACEMENT (TABLE A1) PLUS FINANCE CHARGE (TABLE B1, B2 OR B3)

ALL TABLE A & B COSTS IN US$/HOUR

COST NEW- US$ 35,000 (INCLUDING ALL TAXES, DUTIES, CIF & DELIVERY CHARGES)
Note: This is the benchmark cost which is adjusted on Sheet 3 for the ACTUAL cost of purchase New or Second Hand

A1 - DEPRECIATION/REPLACEMENT CHARGE IN US$/HOUR

ECONOMIC LIFE	UTILISATION IN HOURS/YEAR									
YEARS	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
1	**175**	**88**	**58**	**44**	**35**	**29**	**25**	**22**	**19**	**18**
2	**88**	**44**	**29**	**22**	**18**	**15**	**13**	**11**	**10**	**9**
3	**58**	**29**	**19**	**15**	**12**	**10**	**8**	**7**	**6**	**6**
4	**44**	**22**	**15**	**11**	**9**	**7**	**6**	**5**	**5**	**4**
5	**35**	**18**	**12**	**9**	**7**	**6**	**5**	**4**	**4**	**4**
6	**29**	**15**	**10**	**7**	**6**	**5**	**4**	**4**	**3**	**3**
7	**25**	**13**	**8**	**6**	**5**	**4**	**4**	**3**	*3*	*3*
8	**22**	**11**	**7**	**5**	**4**	**4**	**3**	*3*	*2*	*2*
9	**19**	**10**	**6**	**5**	**4**	**3**	*3*	*2*	*2*	*2*
10	**18**	**9**	**6**	**4**	**4**	**3**	*3*	*2*	*2*	*2*
11	**16**	**8**	**5**	**4**	**3**	*3*	*2*	*2*	*2*	
12	**15**	**7**	**5**	**4**	**3**	*2*	*2*	*2*		
13	**13**	**7**	**4**	**3**	*3*	*2*	*2*			
14	**13**	**6**	**4**	**3**	*3*	*2*	*2*			
15	**12**	**6**	**4**	**3**	*2*	*2*				
16	**11**	**5**	**4**	*3*	*2*	*2*				
17	**10**	**5**	**3**	*3*	*2*					
18	**10**	**5**	**3**	*2*	*2*					
19	**9**	**5**	**3**	*2*	*2*					
20	**9**	**4**	**3**	*2*	*2*					

Ref: 5tgrader-a.xls *Intech Associates*
March 2012

NOTES

It is extremely unusual for the management, operational & support skills and resources to exist to achieve intermediate equipment life of 12,000 hours or more.
Equipment lives of 12,000 hours or more should only be assumed in exceptional circumstances (figures in italics).

Circle or note the figure selected and insert the value in Box C1 on Sheet 3.

COST CALCULATION — 5 tonne Heavy Towed GRADER

Continued **SHEET 2 OF 3**

TOTAL HOURLY CHARGE COMPRISES OWNERSHIP + OPERATING + OVERHEAD COSTS (+PROFIT).

OWNERSHIP COSTS COMPRISE:-
DEPRECIATION/REPLACEMENT (TABLE A1) PLUS FINANCE CHARGE (TABLE B1, B2 OR B3)

ALL TABLE A & B COSTS IN US$/HOUR

COST NEW- US$ 35,000 (INCLUDING ALL TAXES, DUTIES, CIF & DELIVERY CHARGES)
Note: This is the benchmark cost which is adjusted on Sheet 3 for the ACTUAL cost of purchase New or Second Hand

TABLE B: FINANCE OR OPPORTUNITY COST OF CAPITAL

SELECT APPROPRIATE TABLE (B1, B2 OR B3) OR INTERPOLATE FOR AN INTERMEDIATE INTEREST RATE

B1 - FINANCE (**10 % p.a.** **FINANCE CHARGE IN US$/HOUR**

ECONOMIC LIFE	UTILISATION IN HOURS/YEAR									
YEARS	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
1	**18**	**9**	**6**	**4**	**4**	**3**	**3**	**2**	**2**	**2**
2	**13**	**7**	**4**	**3**	**3**	**2**	**2**	**2**	**1**	**1**
3	**12**	**6**	**4**	**3**	**2**	**2**	**2**	**1**	**1**	**1**
4	**11**	**5**	**4**	**3**	**2**	**2**	**2**	**1**	**1**	**1**
5	**11**	**5**	**4**	**3**	**2**	**2**	**2**	**1**	**1**	**1**
6	**10**	**5**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**1**
7	**10**	**5**	**3**	**3**	**2**	**2**	**1**	**1**	*1*	*1*
8	**10**	**5**	**3**	**2**	**2**	**2**	**1**	*1*	*1*	*1*
9	**10**	**5**	**3**	**2**	**2**	**2**	*1*	*1*	*1*	*1*
10	**10**	**5**	**3**	**2**	**2**	**2**	*1*	*1*	*1*	*1*
11	**10**	**5**	**3**	**2**	**2**	*2*	*1*	*1*	*1*	
12	**9**	**5**	**3**	**2**	**2**	*2*	*1*	*1*		
13	**9**	**5**	**3**	**2**	*2*	*2*	*1*			
14	**9**	**5**	**3**	**2**	*2*	*2*	*1*			
15	**9**	**5**	**3**	**2**	*2*	*2*				

B2 - FINANCE (**20 % p.a.** **FINANCE CHARGE IN US$/HOUR**

ECONOMIC LIFE	UTILISATION IN HOURS/YEAR									
YEARS	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
1	**35**	**18**	**12**	**9**	**7**	**6**	**5**	**4**	**4**	**4**
2	**26**	**13**	**9**	**7**	**5**	**4**	**4**	**3**	**3**	**3**
3	**23**	**12**	**8**	**6**	**5**	**4**	**3**	**3**	**3**	**2**
4	**22**	**11**	**7**	**5**	**4**	**4**	**3**	**3**	**2**	**2**
5	**21**	**11**	**7**	**5**	**4**	**4**	**3**	**3**	**2**	**2**
6	**20**	**10**	**7**	**5**	**4**	**3**	**3**	**3**	**2**	**2**
7	**20**	**10**	**7**	**5**	**4**	**3**	**3**	**3**	*2*	*2*
8	**20**	**10**	**7**	**5**	**4**	**3**	**3**	*2*	*2*	*2*
9	**19**	**10**	**6**	**5**	**4**	**3**	*3*	*2*	*2*	*2*
10	**19**	**10**	**6**	**5**	**4**	**3**	*3*	*2*	*2*	*2*
11	**19**	**10**	**6**	**5**	**4**	*3*	*3*	*2*	*2*	
12	**19**	**9**	**6**	**5**	**4**	*3*	*3*	*2*		
13	**19**	**9**	**6**	**5**	*4*	*3*	*3*			
14	**19**	**9**	**6**	**5**	*4*	*3*	*3*			
15	**19**	**9**	**6**	**5**	*4*	*3*				

B3 - FINANCE (**30 % p.a.** **FINANCE CHARGE IN US$/HOUR**

ECONOMIC LIFE	UTILISATION IN HOURS/YEAR									
YEARS	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
1	**53**	**26**	**18**	**13**	**11**	**9**	**8**	**7**	**6**	**5**
2	**39**	**20**	**13**	**10**	**8**	**7**	**6**	**5**	**4**	**4**
3	**35**	**18**	**12**	**9**	**7**	**6**	**5**	**4**	**4**	**4**
4	**33**	**16**	**11**	**8**	**7**	**5**	**5**	**4**	**4**	**3**
5	**32**	**16**	**11**	**8**	**6**	**5**	**5**	**4**	**4**	**3**
6	**31**	**15**	**10**	**8**	**6**	**5**	**4**	**4**	**3**	**3**
7	**30**	**15**	**10**	**8**	**6**	**5**	**4**	**4**	*3*	*3*
8	**30**	**15**	**10**	**7**	**6**	**5**	**4**	*4*	*3*	*3*
9	**29**	**15**	**10**	**7**	**6**	**5**	*4*	*4*	*3*	*3*
10	**29**	**14**	**10**	**7**	**6**	**5**	*4*	*4*	*3*	*3*
11	**29**	**14**	**10**	**7**	**6**	*5*	*4*	*4*	*3*	
12	**28**	**14**	**9**	**7**	**6**	*5*	*4*	*4*		
13	**28**	**14**	**9**	**7**	*6*	*5*	*4*			
14	**28**	**14**	**9**	**7**	*6*	*5*	*4*			
15	**28**	**14**	**9**	**7**	*6*	*5*				

For periods over 15 years it is suggested that the figure for 15 years is used.

March 2012
Ref: 5tgrader-b.xls
Intech Associates

Circle or note the figure selected and insert the value in Box C2 on Sheet 3.

COST CALCULATION — 5 tonne Heavy Towed GRADER

Continued SHEET 3 OF 3

WORKING SHEET

CONVERSION TO DAILY CHARGE RATE

INTEREST RATE ASSUMED (Sheet 2) ____ %

OWNERSHIP COSTS

C ADJUSTMENT FOR ACTUAL COST OF PURCHASE

Selected Depreciation/replacement charge (US$/hr) from Table A1		*(C1)*	
Selected Finance charge (US$/hr) from Table B1, B2 or B3 (or interpolation)		*(C2)*	
Actual purchase/replacement cost in US$		*(C3)*	
Assumed number of operating hours per day		*(C4)*	**Local currency**
DAILY OWNERSHIP COST = (C1 + C2) x C4 x C3 / 35,000 =	**US$/day**		**(C)**

D ADJUSTMENT FOR EXPECTED RESIDUAL/SCRAP VALUE (IF ANY)

Assumed Residual/Scrap Value in US$		*(D1)*	
Assumed Economic Life in years		*(D2)*	
Assumed Utilisation in Hours / Year		*(D3)*	**Local currency**
ADJUSTMENT FOR RESIDUAL/SCRAP VALUE = (D1 x C4) / (D2 x D3)	**US$/day**		**(D)**
SUB-TOTAL FOR OWNERSHIP COSTS = (C) - (D)			**(W)**

OPERATING COSTS

E SPARES & CONSUMABLES

Either predict daily costs from past records or select from the following:-

Select percentage of spares and consumables per year compared to machine current cost new,

Suggested value between 2 and 10% of cost new (usually increases with age)		*% (E1)*	**Local currency**
DAILY COST OF SPARES = 0.01 x C3 x C4 x E1 / D3	**US$/day**		**(E)**

F SERVICING AND REPAIR (WORKSHOP LABOUR COSTS)

Either predict daily costs from past records or select from the following:-

Suggested value between 20% and 100% of (E)		*% (F1)*	**Local currency**
DAILY WORKSHOP LABOUR COSTS = 0.01 x E x F1	**US$/day**		**(F)**

G FUEL & LUBRICANTS

Cost of fuel per litre (add between 2 and 5% to cover lubricant costs)	*Not applicabl*	*(G1)*	
Assumed fuel consumption in litres per hour	*Not applicabl*	*(G2)*	**Local currency**
DAILY LUBRICANTS COST	**US$/day**		**(G)**

H OPERATORS (DAILY COSTS)

	Wages	Allowances	Other
Operator			
Assistant			
Other			
Sub-totals			

Local currency

US$/day **(H)**

SUB-TOTAL FOR OPERATING COSTS = (E) + (F) + (G) + (H) **(X)**

OVERHEADS

Predict from past records to include:-

I	Offices, Workshops, Tools & other Facilities		
J	Supervisory, management and clerical personnel		
K	Supervision and support vehicles		
L	Stores and other stock		
M	Insurances		
N	Banking and other finance charges not relating to the equipment item		
O	Administration, training, safety or other overhead costs		
P	Risk, late payment and other contingency items		
Q	Taxes, levies etc.		**US$/day** **Local currency**

SUB-TOTAL FOR OVERHEADS = Daily allowance for items (I) to (Q) **(Y)**

US$/day **Local currency**

PROFIT **SUB-TOTAL PROFIT** **(Z)**

US$/day **Local currency**

TOTAL COST TO BE CHARGED = (W) + (X) + (Y) + (Z) = US$/day

NOTES

1 Finance charge (Sheet 2) calculated by the formula:-

$$C2 = \frac{((N + 1) / 2N) \times \text{Purchase Price} \times \text{interest rate expressed as a decimal}}{\text{Hours per year}}$$

Where N = number of years (economic life)

2 To convert the US$ values to Local Currency multiply by the current exchange rate

Intech Associates

March 2012 *Ref: 5tgrader-c.xls*

COST CALCULATION — 5 tonne Heavy Towed GRADER

Continued

SHEET 3 OF 3

WORKING SHEET

EXAMPLE

CONVERSION TO DAILY CHARGE RATE

INTEREST RATE ASSUMED (Sheet 2): *10* %

OWNERSHIP COSTS

C ADJUSTMENT FOR ACTUAL COST OF PURCHASE

Selected Depreciation/replacement charge (US$/hr) from Table A1	*3*	*(C1)*		
Selected Finance charge (US$/hr) from Table B1, B2 or B3 (or interpolation)	*2*	*(C2)*		
Actual purchase/replacement cost in US$	*32,000*	*(C3)*		
Assumed number of operating hours per day	*7*	*(C4)*		**Local currency**
DAILY OWNERSHIP COST = (C1 + C2) x C4 x C3 / 35,000 =		**US$/day**	*32.0*	**(C)**

D ADJUSTMENT FOR EXPECTED RESIDUAL/SCRAP VALUE (IF ANY)

Assumed Residual/Scrap Value in US$	*2,000*	*(D1)*		
Assumed Economic Life in years	*15*	*(D2)*		
Assumed Utilisation in Hours / Year	*800*	*(D3)*		**Local currency**
ADJUSTMENT FOR RESIDUAL/SCRAP VALUE = (D1 x C4) / (D2 x D3)		**US$/day**	*1.2*	**(D)**
SUB-TOTAL FOR OWNERSHIP COSTS = (C) - (D)			*30.8*	**(W)**

OPERATING COSTS

E SPARES & CONSUMABLES

Either predict daily costs from past records or select from the following:-

Select percentage of spares and consumables per year compared to machine current cost new,

Suggested value between 2 and 10% of cost new (usually increases with age)	*6*	*% (E1)*		**Local currency**
DAILY COST OF SPARES = 0.01 x C3 x C4 x E1 / D3		**US$/day**	*16.8*	**(E)**

F SERVICING AND REPAIR (WORKSHOP LABOUR COSTS)

Either predict daily costs from past records or select from the following:-

Suggested value between 20% and 100% of (E)	*70*	*% (F1)*		**Local currency**
DAILY WORKSHOP LABOUR COSTS = 0.01 x E x F1		**US$/day**	*11.8*	**(F)**

G FUEL & LUBRICANTS

Cost of fuel per litre (add between 2 and 5% to cover lubricant costs)	*N/A*	*(G1)*		
Assumed fuel consumption in litres per hour	*N/A*	*(G2)*		**Local currency**
DAILY LUBRICANTS COST		**US$/day**	*1.5*	**(G)**

H OPERATORS (DAILY COSTS)

	Wages	Allowances	Other
Operator	*$9.00*	*$2.00*	*$1.00*
Assistant			
Other			
Sub-totals	*$9.00*	*$2.00*	*$1.00*

			Local currency
US$/day	*12.0*		**(H)**
SUB-TOTAL FOR OPERATING COSTS = (E) + (F) + (G) + (H)	*42.1*		**(X)**

OVERHEADS

Predict from past records to include:-

I	Offices, Workshops, Tools & other Facilities			
J	Supervisory, management and clerical personnel			
K	Supervision and support vehicles			
L	Stores and other stock			
M	Insurances			
N	Banking and other finance charges not relating to the equipment item			
O	Administration, training, safety or other overhead costs			
P	Risk, late payment and other contingency items			
Q	Taxes, levies etc.			
			US$/day	**Local currency**
	SUB-TOTAL FOR OVERHEADS = Daily allowance for items (I) to (Q)		*10.9*	**(Y)**
	(assuming 15% in this example)		**US$/day**	**Local currency**
PROFIT	**SUB-TOTAL PROFIT**		*10.9*	**(Z)**
	(assuming 15% in this example)		**US$/day**	**Local currency**
TOTAL COST TO BE CHARGED = (W) + (X) + (Y) + (Z) =		**US$/day**	***94.8***	

NOTES

1 Finance charge (Sheet 2) calculated by the formula:-

$$C2 = \frac{((N + 1) / 2N) \times \text{Purchase Price} \times \text{interest rate expressed as a decimal}}{\text{Hours per year}}$$

Where N = number of years (economic life)

2 To convert the US$ values to Local Currency multiply by the current exchange rate

Intech Associates

March 2012 *Ref: 5tgrader-d.xls*

COST CALCULATION — 60hp (45kW) Agricultural TRACTOR (2WD)

TOTAL HOURLY CHARGE COMPRISES OWNERSHIP + OPERATING + OVERHEAD COSTS (+PROFIT).

OWNERSHIP COSTS COMPRISE:-
DEPRECIATION/REPLACEMENT (TABLE A1) PLUS FINANCE CHARGE (TABLE B1, B2 OR B3)

ALL TABLE A & B COSTS IN US$/HOUR

COST NEW- US$ 30,000 (INCLUDING ALL TAXES, DUTIES, CIF & DELIVERY CHARGES)
Note: This is the benchmark cost which is adjusted on Sheet 3 for the ACTUAL cost of purchase New or Second Hand

A1 - DEPRECIATION/REPLACEMENT CHARGE IN US$/HOUR

ECONOMIC LIFE	UTILISATION IN HOURS/YEAR									
YEARS	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
1	**150**	**75**	**50**	**38**	**30**	**25**	**21**	**19**	**17**	**15**
2	**75**	**38**	**25**	**19**	**15**	**13**	**11**	**9**	**8**	**8**
3	**50**	**25**	**17**	**13**	**10**	**8**	**7**	**6**	**6**	**5**
4	**38**	**19**	**13**	**9**	**8**	**6**	**5**	**5**	**4**	**4**
5	**30**	**15**	**10**	**8**	**6**	**5**	**4**	**4**	**3**	**3**
6	**25**	**13**	**8**	**6**	**5**	**4**	**4**	**3**	**3**	**3**
7	**21**	**11**	**7**	**5**	**4**	**4**	**3**	**3**	*2*	*2*
8	**19**	**9**	**6**	**5**	**4**	**3**	**3**	*2*	*2*	*2*
9	**17**	**8**	**6**	**4**	**3**	**3**	*2*	*2*	*2*	*2*
10	**15**	**8**	**5**	**4**	**3**	**3**	*2*	*2*	*2*	*2*
11	**14**	**7**	**5**	**3**	**3**	*2*	*2*	*2*	*2*	
12	**13**	**6**	**4**	**3**	**3**	*2*	*2*	*2*		
13	**12**	**6**	**4**	**3**	*2*	*2*	*2*			
14	**11**	**5**	**4**	**3**	*2*	*2*	*2*			
15	**10**	**5**	**3**	**3**	*2*	*2*				
16	**9**	**5**	**3**	*2*	*2*	*2*				
17	**9**	**4**	**3**	*2*	*2*					
18	**8**	**4**	**3**	*2*	*2*					
19	**8**	**4**	**3**	*2*	*2*					
20	**8**	**4**	**3**	*2*	*2*					

Ref: tractor60-a.xls *Intech Associates*
March 2012

NOTES

It is extremely unusual for the management, operational & support skills and resources to exist to achieve intermediate equipment life of 12,000 hours or more.
Equipment lives of 12,000 hours or more should only be assumed in exceptional circumstances (figures in italics).

Circle or note the figure selected and insert the value in Box C1 on Sheet 3.

COST CALCULATION 60hp (45kW) Agricultural TRACTOR (2WD)

Continued **SHEET 2 OF 3**

TOTAL HOURLY CHARGE COMPRISES OWNERSHIP + OPERATING + OVERHEAD COSTS (+PROFIT).

OWNERSHIP COSTS COMPRISE:-
DEPRECIATION/REPLACEMENT (TABLE A1) PLUS FINANCE CHARGE (TABLE B1, B2 OR B3)

ALL TABLE A & B COSTS IN US$/HOUR

COST NEW- US$ 30,000 (INCLUDING ALL TAXES, DUTIES, CIF & DELIVERY CHARGES)
Note: This is the benchmark cost which is adjusted on Sheet 3 for the ACTUAL cost of purchase New or Second Hand

TABLE B: FINANCE OR OPPORTUNITY COST OF CAPITAL

SELECT APPROPRIATE TABLE (B1, B2 OR B3) OR INTERPOLATE FOR AN INTERMEDIATE INTEREST RATE

B1 - FINANCE (**10 % p.a.** **FINANCE CHARGE IN US$/HOUR**

ECONOMIC LIFE	UTILISATION IN HOURS/YEAR									
YEARS	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
1	**15**	**8**	**5**	**4**	**3**	**3**	**2**	**2**	**2**	**2**
2	**11**	**6**	**4**	**3**	**2**	**2**	**2**	**1**	**1**	**1**
3	**10**	**5**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**1**
4	**9**	**5**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**1**
5	**9**	**5**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**1**
6	**9**	**4**	**3**	**2**	**2**	**1**	**1**	**1**	**1**	**1**
7	**9**	**4**	**3**	**2**	**2**	**1**	**1**	**1**	*1*	*1*
8	**8**	**4**	**3**	**2**	**2**	**1**	**1**	*1*	*1*	*1*
9	**8**	**4**	**3**	**2**	**2**	**1**	*1*	*1*	*1*	*1*
10	**8**	**4**	**3**	**2**	**2**	**1**	*1*	*1*	*1*	*1*
11	**8**	**4**	**3**	**2**	**2**	*1*	*1*	*1*	*1*	
12	**8**	**4**	**3**	**2**	**2**	*1*	*1*	*1*		
13	**8**	**4**	**3**	**2**	*2*	*1*	*1*			
14	**8**	**4**	**3**	**2**	*2*	*1*	*1*			
15	**8**	**4**	**3**	**2**	*2*	*1*				

B2 - FINANCE (**20 % p.a.** **FINANCE CHARGE IN US$/HOUR**

ECONOMIC LIFE	UTILISATION IN HOURS/YEAR									
YEARS	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
1	**30**	**15**	**10**	**8**	**6**	**5**	**4**	**4**	**3**	**3**
2	**23**	**11**	**8**	**6**	**5**	**4**	**3**	**3**	**3**	**2**
3	**20**	**10**	**7**	**5**	**4**	**3**	**3**	**3**	**2**	**2**
4	**19**	**9**	**6**	**5**	**4**	**3**	**3**	**2**	**2**	**2**
5	**18**	**9**	**6**	**5**	**4**	**3**	**3**	**2**	**2**	**2**
6	**18**	**9**	**6**	**4**	**4**	**3**	**3**	**2**	**2**	**2**
7	**17**	**9**	**6**	**4**	**3**	**3**	**2**	**2**	*2*	*2*
8	**17**	**8**	**6**	**4**	**3**	**3**	**2**	*2*	*2*	*2*
9	**17**	**8**	**6**	**4**	**3**	**3**	*2*	*2*	*2*	*2*
10	**17**	**8**	**6**	**4**	**3**	**3**	*2*	*2*	*2*	*2*
11	**16**	**8**	**5**	**4**	**3**	*3*	*2*	*2*	*2*	
12	**16**	**8**	**5**	**4**	**3**	*3*	*2*	*2*		
13	**16**	**8**	**5**	**4**	*3*	*3*	*2*			
14	**16**	**8**	**5**	**4**	*3*	*3*	*2*			
15	**16**	**8**	**5**	**4**	*3*	*3*				

B3 - FINANCE (**30 % p.a.** **FINANCE CHARGE IN US$/HOUR**

ECONOMIC LIFE	UTILISATION IN HOURS/YEAR									
YEARS	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
1	**45**	**23**	**15**	**11**	**9**	**8**	**6**	**6**	**5**	**5**
2	**34**	**17**	**11**	**8**	**7**	**6**	**5**	**4**	**4**	**3**
3	**30**	**15**	**10**	**8**	**6**	**5**	**4**	**4**	**3**	**3**
4	**28**	**14**	**9**	**7**	**6**	**5**	**4**	**4**	**3**	**3**
5	**27**	**14**	**9**	**7**	**5**	**5**	**4**	**3**	**3**	**3**
6	**26**	**13**	**9**	**7**	**5**	**4**	**4**	**3**	**3**	**3**
7	**26**	**13**	**9**	**6**	**5**	**4**	**4**	**3**	*3*	*3*
8	**25**	**13**	**8**	**6**	**5**	**4**	**4**	*3*	*3*	*3*
9	**25**	**13**	**8**	**6**	**5**	**4**	*4*	*3*	*3*	*3*
10	**25**	**12**	**8**	**6**	**5**	**4**	*4*	*3*	*3*	*2*
11	**25**	**12**	**8**	**6**	**5**	*4*	*4*	*3*	*3*	
12	**24**	**12**	**8**	**6**	**5**	*4*	*3*	*3*		
13	**24**	**12**	**8**	**6**	*5*	*4*	*3*			
14	**24**	**12**	**8**	**6**	*5*	*4*	*3*			
15	**24**	**12**	**8**	**6**	*5*	*4*				

For periods over 15 years it is suggested that the figure for 15 years is used.

March 2012
Ref: tractor60-b.xls
Intech Associates

Circle or note the figure selected and insert the value in Box C2 on Sheet 3.

COST CALCULATION — 60hp (45kW) Agricultural TRACTOR (2WD)

Continued

SHEET 3 OF 3
WORKING SHEET

CONVERSION TO DAILY CHARGE RATE

INTEREST RATE ASSUMED (Sheet 2) ____ %

OWNERSHIP COSTS

C ADJUSTMENT FOR ACTUAL COST OF PURCHASE

Selected Depreciation/replacement charge (US$/hr) from Table A1	*(C1)*		
Selected Finance charge (US$/hr) from Table B1, B2 or B3 (or interpolation)	*(C2)*		
Actual purchase/replacement cost in US$	*(C3)*		
Assumed number of operating hours per day	*(C4)*	**Local currency**	
DAILY OWNERSHIP COST = (C1 + C2) x C4 x C3 / 30,000 =	**US$/day**		**(C)**

D ADJUSTMENT FOR EXPECTED RESIDUAL/SCRAP VALUE (IF ANY)

Assumed Residual/Scrap Value in US$	*(D1)*		
Assumed Economic Life in years	*(D2)*		
Assumed Utilisation in Hours / Year	*(D3)*	**Local currency**	
ADJUSTMENT FOR RESIDUAL/SCRAP VALUE = (D1 x C4) / (D2 x D3)	**US$/day**		**(D)**
SUB-TOTAL FOR OWNERSHIP COSTS = (C) - (D)			**(W)**

OPERATING COSTS

E SPARES & CONSUMABLES

Either predict daily costs from past records or select from the following:-			
Select percentage of spares and consumables per year compared to machine current cost new,			
Suggested value between 2 and 10% of cost new (usually increases with age)	*% (E1)*	**Local currency**	
DAILY COST OF SPARES = 0.01 x C3 x C4 x E1 / D3	**US$/day**		**(E)**

F SERVICING AND REPAIR (WORKSHOP LABOUR COSTS)

Either predict daily costs from past records or select from the following:-			
Suggested value between 20% and 100% of (E)	*% (F1)*	**Local currency**	
DAILY WORKSHOP LABOUR COSTS = 0.01 x E x F1	**US$/day**		**(F)**

G FUEL & LUBRICANTS

Cost of fuel per litre (add between 2 and 5% to cover lubricant costs)	*(G1)*		
Assumed fuel consumption in litres per hour	*(G2)*	**Local currency**	
DAILY FUEL COST = C4 x G1 x G2	**US$/day**		**(G)**

H OPERATORS (DAILY COSTS)

	Wages	Allowances	Other
Operator			
Assistant			
Other			
Sub-totals			

Local currency

US$/day ____ ____ **(H)**

SUB-TOTAL FOR OPERATING COSTS = (E) + (F) + (G) + (H) ____ ____ **(X)**

OVERHEADS

Predict from past records to include:-

I	Offices, Workshops, Tools & other Facilities	
J	Supervisory, management and clerical personnel	
K	Supervision and support vehicles	
L	Stores and other stock	
M	Insurances	
N	Banking and other finance charges not relating to the equipment item	
O	Administration, training, safety or other overhead costs	
P	Risk, late payment and other contingency items	
Q	Taxes, levies etc.	

US$/day **Local currency**

SUB-TOTAL FOR OVERHEADS = Daily allowance for items (I) to (Q) ____ ____ **(Y)**

US$/day **Local currency**

PROFIT **SUB-TOTAL PROFIT** ____ ____ **(Z)**

US$/day **Local currency**

TOTAL COST TO BE CHARGED = (W) + (X) + (Y) + (Z) = **US$/day** ____ ____

NOTES

1 Finance charge (Sheet 2) calculated by the formula:-

$$C2 = \frac{((N + 1) / 2N) \times \text{Purchase Price} \times \text{interest rate expressed as a decimal}}{\text{Hours per year}}$$

Where N = number of years (economic life)

2 To convert the US$ values to Local Currency multiply by the current exchange rate

Intech Associates
March 2012 *Ref: tractor60-c.xls*

COST CALCULATION — 60hp (45kW) Agricultural TRACTOR (2WD)

Continued

SHEET 3 OF3

WORKING SHEET

EXAMPLE

CONVERSION TO DAILY CHARGE RATE

INTEREST RATE ASSUMED (Sheet 2) *10* %

OWNERSHIP COSTS

C ADJUSTMENT FOR ACTUAL COST OF PURCHASE

Selected Depreciation/replacement charge (US$/hr) from Table A1	*4* (C1)		
Selected Finance charge (US$/hr) from Table B1, B2 or B3 (or interpolation)	*2* (C2)		
Actual purchase/replacement cost in US$	*28,000* (C3)		
Assumed number of operating hours per day	*7* (C4)		**Local currency**
DAILY OWNERSHIP COST = (C1 + C2) x C4 x C3 / 30,000 =	**US$/day**	*39*	**(C)**

D ADJUSTMENT FOR EXPECTED RESIDUAL/SCRAP VALUE (IF ANY)

Assumed Residual/Scrap Value in US$	*2,800* (D1)		
Assumed Economic Life in years	*8* (D2)		
Assumed Utilisation in Hours / Year	*1,000* (D3)		**Local currency**
ADJUSTMENT FOR RESIDUAL/SCRAP VALUE = (D1 x C4) / (D2 x D3)	**US$/day**	*2*	**(D)**
SUB-TOTAL FOR OWNERSHIP COSTS = (C) - (D)		*37*	**(W)**

OPERATING COSTS

E SPARES & CONSUMABLES

Either predict daily costs from past records or select from the following:-

Select percentage of spares and consumables per year compared to machine current cost new, Suggested value between 2 and 10% of cost new (usually increases with age)	*6* % (E1)		**Local currency**
DAILY COST OF SPARES = 0.01 x C3 x C4 x E1 / D3	**US$/day**	*12*	**(E)**

F SERVICING AND REPAIR (WORKSHOP LABOUR COSTS)

Either predict daily costs from past records or select from the following:-

Suggested value between 20% and 100% of (E)	*70* % (F1)		**Local currency**
DAILY WORKSHOP LABOUR COSTS = 0.01 x E x F1	**US$/day**	*8*	**(F)**

G FUEL & LUBRICANTS

Cost of fuel per litre (add between 2 and 5% to cover lubricant costs)	*$0.40* (G1)		
Assumed fuel consumption in litres per hour	*8* (G2)		**Local currency**
DAILY FUEL COST = C4 x G1 x G2	**US$/day**	*22*	**(G)**

H OPERATORS (DAILY COSTS)

	Wages	Allowances	Other
Operator	*$9.00*	*$2.00*	*$1.00*
Assistant			
Other			
Sub-totals	*$9.00*	*$2.00*	*$1.00*

Local currency

US$/day *12* **(H)**

SUB-TOTAL FOR OPERATING COSTS = (E) + (F) + (G) + (H) *54* **(X)**

OVERHEADS

Predict from past records to include:-

I	Offices, Workshops, Tools & other Facilities		
J	Supervisory, management and clerical personnel		
K	Supervision and support vehicles		
L	Stores and other stock		
M	Insurances		
N	Banking and other finance charges not relating to the equipment item		
O	Administration, training, safety or other overhead costs		
P	Risk, late payment and other contingency items		
Q	Taxes, levies etc.		**US$/day** **Local currency**

SUB-TOTAL FOR OVERHEADS = Daily allowance for items (I) to (Q) *14* **(Y)**

(assuming 15% in this example) **US$/day** **Local currency**

PROFIT **SUB-TOTAL PROFIT** *14* **(Z)**

(assuming 15% in this example) **US$/day** **Local currency**

TOTAL COST TO BE CHARGED = (W) + (X) + (Y) + (Z) = **US$/day** ***119***

NOTES

1 Finance charge (Sheet 2) calculated by the formula:-

$$C2 = \frac{((N + 1) / 2N) \times \text{Purchase Price} \times \text{interest rate expressed as a decimal}}{\text{Hours per year}}$$

Where N = number of years (economic life)

2 To convert the US$ values to Local Currency multiply by the current exchange rate

Intech Associates

March 2012 *Ref: tractor60-d.xls*

COST CALCULATION

2 tonne Towed GRADER

TOTAL HOURLY CHARGE COMPRISES OWNERSHIP + OPERATING + OVERHEAD COSTS (+PROFIT).

OWNERSHIP COSTS COMPRISE:-
DEPRECIATION/REPLACEMENT (TABLE A1) PLUS FINANCE CHARGE (TABLE B1, B2 OR B3)

ALL TABLE A & B COSTS IN US$/HOUR

COST NEW- US$ 18,000 (INCLUDING ALL TAXES, DUTIES, CIF & DELIVERY CHARGES)
Note: This is the benchmark cost which is adjusted on Sheet 3 for the ACTUAL cost of purchase New or Second Hand

A1 - DEPRECIATION/REPLACEMENT CHARGE IN US$/HOUR

ECONOMIC LIFE	UTILISATION IN HOURS/YEAR									
YEARS	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
1	**90.0**	**45.0**	**30.0**	**22.5**	**18.0**	**15.0**	**12.9**	**11.3**	**10.0**	**9.0**
2	**45.0**	**22.5**	**15.0**	**11.3**	**9.0**	**7.5**	**6.4**	**5.6**	**5.0**	**4.5**
3	**30.0**	**15.0**	**10.0**	**7.5**	**6.0**	**5.0**	**4.3**	**3.8**	**3.3**	**3.0**
4	**22.5**	**11.3**	**7.5**	**5.6**	**4.5**	**3.8**	**3.2**	**2.8**	**2.5**	**2.3**
5	**18.0**	**9.0**	**6.0**	**4.5**	**3.6**	**3.0**	**2.6**	**2.3**	**2.0**	**1.8**
6	**15.0**	**7.5**	**5.0**	**3.8**	**3.0**	**2.5**	**2.1**	**1.9**	**1.7**	**1.5**
7	**12.9**	**6.4**	**4.3**	**3.2**	**2.6**	**2.1**	**1.8**	**1.6**	*1.4*	*1.3*
8	**11.3**	**5.6**	**3.8**	**2.8**	**2.3**	**1.9**	**1.6**	*1.4*	*1.3*	*1.1*
9	**10.0**	**5.0**	**3.3**	**2.5**	**2.0**	**1.7**	*1.4*	*1.3*	*1.1*	*1.0*
10	**9.0**	**4.5**	**3.0**	**2.3**	**1.8**	**1.5**	*1.3*	*1.1*	*1.0*	*0.9*
11	**8.2**	**4.1**	**2.7**	**2.0**	**1.6**	*1.4*	*1.2*	*1.0*	*0.9*	
12	**7.5**	**3.8**	**2.5**	**1.9**	**1.5**	*1.3*	*1.1*	*0.9*		
13	**6.9**	**3.5**	**2.3**	**1.7**	*1.4*	*1.2*	*1.0*			
14	**6.4**	**3.2**	**2.1**	**1.6**	*1.3*	*1.1*	*0.9*			
15	**6.0**	**3.0**	**2.0**	**1.5**	*1.2*	*1.0*				
16	**5.6**	**2.8**	**1.9**	*1.4*	*1.1*	*0.9*				
17	**5.3**	**2.6**	**1.8**	*1.3*	*1.1*					
18	**5.0**	**2.5**	**1.7**	*1.3*	*1.0*					
19	**4.7**	**2.4**	**1.6**	*1.2*	*0.9*					
20	**4.5**	**2.3**	**1.5**	*1.1*	*0.9*					

Ref: 2tgrader-a.xls *Intech Associates*

NOTES March 2012

It is extremely unusual for the management, operational & support skills and resources to exist to achieve intermediate equipment life of 12,000 hours or more.

Equipment lives of 12,000 hours or more should only be assumed in exceptional circumstances (figures in italics).

Circle or note the figure selected and insert the value in Box C1 on Sheet 3.

COST CALCULATION — 2 tonne Towed GRADER

Continued **SHEET 2 OF 3**

TOTAL HOURLY CHARGE COMPRISES OWNERSHIP + OPERATING + OVERHEAD COSTS (+PROFIT).

OWNERSHIP COSTS COMPRISE:-
DEPRECIATION/REPLACEMENT (TABLE A1) PLUS FINANCE CHARGE (TABLE B1, B2 OR B3)

ALL TABLE A & B COSTS IN US$/HOUR

COST NEW- US$ 18,000 (INCLUDING ALL TAXES, DUTIES, CIF & DELIVERY CHARGES)
Note: This is the benchmark cost which is adjusted on Sheet 3 for the ACTUAL cost of purchase New or Second Hand

TABLE B: FINANCE OR OPPORTUNITY COST OF CAPITAL

SELECT APPROPRIATE TABLE (B1, B2 OR B3) OR INTERPOLATE FOR AN INTERMEDIATE INTEREST RATE

B1 - FINANCE @ **10 % p.a.** **FINANCE CHARGE IN US$/HOUR**

ECONOMIC LIFE	UTILISATION IN HOURS/YEAR									
YEARS	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
1	**9.0**	**4.5**	**3.0**	**2.3**	**1.8**	**1.5**	**1.3**	**1.1**	**1.0**	**0.9**
2	**6.8**	**3.4**	**2.3**	**1.7**	**1.4**	**1.1**	**1.0**	**0.8**	**0.8**	**0.7**
3	**6.0**	**3.0**	**2.0**	**1.5**	**1.2**	**1.0**	**0.9**	**0.8**	**0.7**	**0.6**
4	**5.6**	**2.8**	**1.9**	**1.4**	**1.1**	**0.9**	**0.8**	**0.7**	**0.6**	**0.6**
5	**5.4**	**2.7**	**1.8**	**1.4**	**1.1**	**0.9**	**0.8**	**0.7**	**0.6**	**0.5**
6	**5.3**	**2.6**	**1.8**	**1.3**	**1.1**	**0.9**	**0.8**	**0.7**	**0.6**	**0.5**
7	**5.1**	**2.6**	**1.7**	**1.3**	**1.0**	**0.9**	**0.7**	**0.6**	*0.6*	*0.5*
8	**5.1**	**2.5**	**1.7**	**1.3**	**1.0**	**0.8**	**0.7**	*0.6*	*0.6*	*0.5*
9	**5.0**	**2.5**	**1.7**	**1.3**	**1.0**	**0.8**	*0.7*	*0.6*	*0.6*	*0.5*
10	**5.0**	**2.5**	**1.7**	**1.2**	**1.0**	**0.8**	*0.7*	*0.6*	*0.6*	*0.5*
11	**4.9**	**2.5**	**1.6**	**1.2**	**1.0**	*0.8*	*0.7*	*0.6*	*0.5*	
12	**4.9**	**2.4**	**1.6**	**1.2**	**1.0**	*0.8*	*0.7*	*0.6*		
13	**4.8**	**2.4**	**1.6**	**1.2**	*1.0*	*0.8*	*0.7*			
14	**4.8**	**2.4**	**1.6**	**1.2**	*1.0*	*0.8*	*0.7*			
15	**4.8**	**2.4**	**1.6**	**1.2**	*1.0*	*0.8*				

B2 - FINANCE @ **20 % p.a.** **FINANCE CHARGE IN US$/HOUR**

ECONOMIC LIFE	UTILISATION IN HOURS/YEAR									
YEARS	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
1	**18.0**	**9.0**	**6.0**	**4.5**	**3.6**	**3.0**	**2.6**	**2.3**	**2.0**	**1.8**
2	**13.5**	**6.8**	**4.5**	**3.4**	**2.7**	**2.3**	**1.9**	**1.7**	**1.5**	**1.4**
3	**12.0**	**6.0**	**4.0**	**3.0**	**2.4**	**2.0**	**1.7**	**1.5**	**1.3**	**1.2**
4	**11.3**	**5.6**	**3.8**	**2.8**	**2.3**	**1.9**	**1.6**	**1.4**	**1.3**	**1.1**
5	**10.8**	**5.4**	**3.6**	**2.7**	**2.2**	**1.8**	**1.5**	**1.4**	**1.2**	**1.1**
6	**10.5**	**5.3**	**3.5**	**2.6**	**2.1**	**1.8**	**1.5**	**1.3**	**1.2**	**1.1**
7	**10.3**	**5.1**	**3.4**	**2.6**	**2.1**	**1.7**	**1.5**	**1.3**	*1.1*	*1.0*
8	**10.1**	**5.1**	**3.4**	**2.5**	**2.0**	**1.7**	**1.4**	*1.3*	*1.1*	*1.0*
9	**10.0**	**5.0**	**3.3**	**2.5**	**2.0**	**1.7**	*1.4*	*1.3*	*1.1*	*1.0*
10	**9.9**	**5.0**	**3.3**	**2.5**	**2.0**	**1.7**	*1.4*	*1.2*	*1.1*	*1.0*
11	**9.8**	**4.9**	**3.3**	**2.5**	**2.0**	*1.6*	*1.4*	*1.2*	*1.1*	
12	**9.8**	**4.9**	**3.3**	**2.4**	**2.0**	*1.6*	*1.4*	*1.2*		
13	**9.7**	**4.8**	**3.2**	**2.4**	*1.9*	*1.6*	*1.4*			
14	**9.6**	**4.8**	**3.2**	**2.4**	*1.9*	*1.6*	*1.4*			
15	**9.6**	**4.8**	**3.2**	**2.4**	*1.9*	*1.6*				

B3 - FINANCE @ **30 % p.a.** **FINANCE CHARGE IN US$/HOUR**

ECONOMIC LIFE	UTILISATION IN HOURS/YEAR									
YEARS	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
1	**27.0**	**13.5**	**9.0**	**6.8**	**5.4**	**4.5**	**3.9**	**3.4**	**3.0**	**2.7**
2	**20.3**	**10.1**	**6.8**	**5.1**	**4.1**	**3.4**	**2.9**	**2.5**	**2.3**	**2.0**
3	**18.0**	**9.0**	**6.0**	**4.5**	**3.6**	**3.0**	**2.6**	**2.3**	**2.0**	**1.8**
4	**16.9**	**8.4**	**5.6**	**4.2**	**3.4**	**2.8**	**2.4**	**2.1**	**1.9**	**1.7**
5	**16.2**	**8.1**	**5.4**	**4.1**	**3.2**	**2.7**	**2.3**	**2.0**	**1.8**	**1.6**
6	**15.8**	**7.9**	**5.3**	**3.9**	**3.2**	**2.6**	**2.3**	**2.0**	**1.8**	**1.6**
7	**15.4**	**7.7**	**5.1**	**3.9**	**3.1**	**2.6**	**2.2**	**1.9**	*1.7*	*1.5*
8	**15.2**	**7.6**	**5.1**	**3.8**	**3.0**	**2.5**	**2.2**	*1.9*	*1.7*	*1.5*
9	**15.0**	**7.5**	**5.0**	**3.8**	**3.0**	**2.5**	*2.1*	*1.9*	*1.7*	*1.5*
10	**14.9**	**7.4**	**5.0**	**3.7**	**3.0**	**2.5**	*2.1*	*1.9*	*1.7*	*1.5*
11	**14.7**	**7.4**	**4.9**	**3.7**	**2.9**	*2.5*	*2.1*	*1.8*	*1.6*	
12	**14.6**	**7.3**	**4.9**	**3.7**	**2.9**	*2.4*	*2.1*	*1.8*		
13	**14.5**	**7.3**	**4.8**	**3.6**	*2.9*	*2.4*	*2.1*			
14	**14.5**	**7.2**	**4.8**	**3.6**	*2.9*	*2.4*	*2.1*			
15	**14.4**	**7.2**	**4.8**	**3.6**	*2.9*	*2.4*				

For periods over 15 years it is suggested that the figure for 15 years is used.

March 2012
Ref: 2tgrader-b.xls
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Circle or note the figure selected and insert the value in Box C2 on Sheet 3.

COST CALCULATION — 2 tonne Towed GRADER

Continued

SHEET 3 OF 3

WORKING SHEET

CONVERSION TO DAILY CHARGE RATE

INTEREST RATE ASSUMED (Sheet 2) ____ %

OWNERSHIP COSTS

C ADJUSTMENT FOR ACTUAL COST OF PURCHASE

Selected Depreciation/replacement charge (US$/hr) from Table A1		*(C1)*	
Selected Finance charge (US$/hr) from Table B1, B2 or B3 (or interpolation)		*(C2)*	
Actual purchase/replacement cost in US$		*(C3)*	
Assumed number of operating hours per day		*(C4)*	**Local currency**
DAILY OWNERSHIP COST = (C1 + C2) x C4 x C3 / 18,000 =	**US$/day**		**(C)**

D ADJUSTMENT FOR EXPECTED RESIDUAL/SCRAP VALUE (IF ANY)

Assumed Residual/Scrap Value in US$		*(D1)*	
Assumed Economic Life in years		*(D2)*	
Assumed Utilisation in Hours / Year		*(D3)*	**Local currency**
ADJUSTMENT FOR RESIDUAL/SCRAP VALUE = (D1 x C4) / (D2 x D3)	**US$/day**		**(D)**
SUB-TOTAL FOR OWNERSHIP COSTS = (C) - (D)			**(W)**

OPERATING COSTS

E SPARES & CONSUMABLES

Either predict daily costs from past records or select from the following:-

Select percentage of spares and consumables per year compared to machine current cost new,

Suggested value between 2 and 10% of cost new (usually increases with age)		*% (E1)*	**Local currency**
DAILY COST OF SPARES = 0.01 x C3 x C4 x E1 / D3	**US$/day**		**(E)**

F SERVICING AND REPAIR (WORKSHOP LABOUR COSTS)

Either predict daily costs from past records or select from the following:-

Suggested value between 20% and 100% of (E)		*% (F1)*	**Local currency**
DAILY WORKSHOP LABOUR COSTS = 0.01 x E x F1	**US$/day**		**(F)**

G FUEL & LUBRICANTS

Cost of fuel per litre (add between 2 and 5% to cover lubricant costs)	*N/A*	*(G1)*	
Assumed fuel consumption in litres per hour	*N/A*	*(G2)*	**Local currency**
DAILY LUBRICANTS COST	**US$/day**		**(G)**

H OPERATORS (DAILY COSTS)

	Wages	Allowances	Other
Operator			
Assistant			
Other			
Sub-totals			

Local currency

US$/day _____ _____ **(H)**

SUB-TOTAL FOR OPERATING COSTS = (E) + (F) + (G) + (H) _____ _____ **(X)**

OVERHEADS

Predict from past records to include:-

I	Offices, Workshops, Tools & other Facilities		
J	Supervisory, management and clerical personnel		
K	Supervision and support vehicles		
L	Stores and other stock		
M	Insurances		
N	Banking and other finance charges not relating to the equipment item		
O	Administration, training, safety or other overhead costs		
P	Risk, late payment and other contingency items		
Q	Taxes, levies etc.		**US$/day** **Local currency**

SUB-TOTAL FOR OVERHEADS = Daily allowance for items (I) to (Q) _____ _____ **(Y)**

US$/day **Local currency**

PROFIT **SUB-TOTAL PROFIT** _____ _____ **(Z)**

US$/day **Local currency**

TOTAL COST TO BE CHARGED = (W) + (X) + (Y) + (Z) = **US$/day** _____ _____

NOTES

1 Finance charge (Sheet 2) calculated by the formula:-

$$C2 = \frac{((N + 1) / 2N) \times \text{Purchase Price} \times \text{interest rate expressed as a decimal}}{\text{Hours per year}}$$

Where N = number of years (economic life)

2 To convert the US$ values to Local Currency multiply by the current exchange rate

Intech Associates

March 2012 *Ref: 2tgrader-c.xls*

COST CALCULATION — 2 tonne Towed GRADER

Continued

SHEET 3 OF 3

WORKING SHEET

EXAMPLE

CONVERSION TO DAILY CHARGE RATE

INTEREST RATE ASSUMED (Sheet 2) *10* %

OWNERSHIP COSTS

C ADJUSTMENT FOR ACTUAL COST OF PURCHASE

Selected Depreciation/replacement charge (US$/hr) from Table A1	*1.5*	*(C1)*		
Selected Finance charge (US$/hr) from Table B1, B2 or B3 (or interpolation)	*1.2*	*(C2)*		
Actual purchase/replacement cost in US$	*16,800*	*(C3)*		
Assumed number of operating hours per day	*7*	*(C4)*		**Local currency**
DAILY OWNERSHIP COST = (C1 + C2) x C4 x C3 / 18,000 =		**US$/day**	*17.6*	**(C)**

D ADJUSTMENT FOR EXPECTED RESIDUAL/SCRAP VALUE (IF ANY)

Assumed Residual/Scrap Value in US$	*900*	*(D1)*		
Assumed Economic Life in years	*15*	*(D2)*		
Assumed Utilisation in Hours / Year	*800*	*(D3)*		**Local currency**
ADJUSTMENT FOR RESIDUAL/SCRAP VALUE = (D1 x C4) / (D2 x D3)		**US$/day**	*0.5*	**(D)**
SUB-TOTAL FOR OWNERSHIP COSTS = (C) - (D)			*17.1*	**(W)**

OPERATING COSTS

E SPARES & CONSUMABLES

Either predict daily costs from past records or select from the following:-

Select percentage of spares and consumables per year compared to machine current cost new,				
Suggested value between 2 and 10% of cost new (usually increases with age)	*6*	*% (E1)*		**Local currency**
DAILY COST OF SPARES = 0.01 x C3 x C4 x E1 / D3		**US$/day**	*8.8*	**(E)**

F SERVICING AND REPAIR (WORKSHOP LABOUR COSTS)

Either predict daily costs from past records or select from the following:-

Suggested value between 20% and 100% of (E)	*70*	*% (F1)*		**Local currency**
DAILY WORKSHOP LABOUR COSTS = 0.01 x E x F1		**US$/day**	*6.2*	**(F)**

G FUEL & LUBRICANTS

Cost of fuel per litre (add between 2 and 5% to cover lubricant costs)	*N/A*	*(G1)*		
Assumed fuel consumption in litres per hour	*N/A*	*(G2)*		**Local currency**
DAILY LUBRICANTS COST		**US$/day**	*0.5*	**(G)**

H OPERATORS (DAILY COSTS)

	Wages	Allowances	Other
Operator	*$7.00*	*$2.00*	*$1.00*
Assistant			
Other			
Sub-totals	*$7.00*	*$2.00*	*$1.00*

Local currency

US$/day	*10.0*		**(H)**
SUB-TOTAL FOR OPERATING COSTS = (E) + (F) + (G) + (H)	*25.5*		**(X)**

OVERHEADS

Predict from past records to include:-

I	Offices, Workshops, Tools & other Facilities		
J	Supervisory, management and clerical personnel		
K	Supervision and support vehicles		
L	Stores and other stock		
M	Insurances		
N	Banking and other finance charges not relating to the equipment item		
O	Administration, training, safety or other overhead costs		
P	Risk, late payment and other contingency items		
Q	Taxes, levies etc.		

US$/day **Local currency**

SUB-TOTAL FOR OVERHEADS = Daily allowance for items (I) to (Q)	*6.4*	**(Y)**
(assuming 15% in this example) **US$/day** **Local currency**		
PROFIT — SUB-TOTAL PROFIT	*6.4*	**(Z)**
(assuming 15% in this example) **US$/day** **Local currency**		
TOTAL COST TO BE CHARGED = (W) + (X) + (Y) + (Z) = US$/day	***55.4***	

NOTES

1 Finance charge (Sheet 2) calculated by the formula:-

$$C2 = \frac{((N + 1) / 2N) \times \text{Purchase Price} \times \text{interest rate expressed as a decimal}}{\text{Hours per year}}$$

Where N = number of years (economic life)

2 To convert the US$ values to Local Currency multiply by the current exchange rate

Intech Associates

March 2012 *Ref: 2tgrader-d.xls*

COST CALCULATION

120hp (90kW) MOTORGRADER

TOTAL HOURLY CHARGE COMPRISES OWNERSHIP + OPERATING + OVERHEAD COSTS (+PROFIT).

OWNERSHIP COSTS COMPRISE:-
DEPRECIATION/REPLACEMENT (TABLE A1) PLUS FINANCE CHARGE (TABLE B1, B2 OR B3)

ALL TABLE A & B COSTS IN US$/HOUR

COST NEW- US$ 250,000 (INCLUDING ALL TAXES, DUTIES, CIF & DELIVERY CHARGES)
Note: This is the benchmark cost which is adjusted on Sheet 3 for the ACTUAL cost of purchase New or Second Hand

A1 - DEPRECIATION/REPLACEMENT CHARGE IN US$/HOUR

ECONOMIC LIFE	UTILISATION IN HOURS/YEAR									
YEARS	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
1	**1,250**	**625**	**417**	**313**	**250**	**208**	**179**	**156**	**139**	**125**
2	**625**	**313**	**208**	**156**	**125**	**104**	**89**	**78**	**69**	**63**
3	**417**	**208**	**139**	**104**	**83**	**69**	**60**	**52**	**46**	**42**
4	**313**	**156**	**104**	**78**	**63**	**52**	**45**	**39**	**35**	**31**
5	**250**	**125**	**83**	**63**	**50**	**42**	**36**	**31**	**28**	**25**
6	**208**	**104**	**69**	**52**	**42**	**35**	**30**	**26**	**23**	**21**
7	**179**	**89**	**60**	**45**	**36**	**30**	**26**	**22**	**20**	**18**
8	**156**	**78**	**52**	**39**	**31**	**26**	**22**	**20**	**17**	*16*
9	**139**	**69**	**46**	**35**	**28**	**23**	**20**	**17**	*15*	*14*
10	**125**	**63**	**42**	**31**	**25**	**21**	**18**	*16*	*14*	*13*
11	**114**	**57**	**38**	**28**	**23**	**19**	*16*	*14*	*13*	*11*
12	**104**	**52**	**35**	**26**	**21**	**17**	*15*	*13*	*12*	*10*
13	**96**	**48**	**32**	**24**	**19**	*16*	*14*	*12*	*11*	
14	**89**	**45**	**30**	**22**	**18**	*15*	*13*	*11*		
15	**83**	**42**	**28**	**21**	**17**	*14*	*12*	*10*		
16	**78**	**39**	**26**	**20**	*16*	*13*	*11*			
17	**74**	**37**	**25**	**18**	*15*	*12*	*11*			
18	**69**	**35**	**23**	**17**	*14*	*12*				
19	**66**	**33**	**22**	*16*	*13*	*11*				
20	**63**	**31**	**21**	*16*	*13*	*10*				

Ref: motorgrader-a.xls *Intech Associates*
March 2012

NOTES
It is extremely unusual for the management, operational & support skills and resources to exist to achieve heavy equipment life of 15,000 hours or more.
Equipment lives of 15,000 hours or more should only be assumed in exceptional circumstances (figures in italics).

Circle or note the figure selected and insert the value in Box C1 on Sheet 3.

COST CALCULATION **120hp (90kW) MOTORGRADER**

Continued **SHEET 2 OF 3**

TOTAL HOURLY CHARGE COMPRISES OWNERSHIP + OPERATING + OVERHEAD COSTS (+PROFIT).

OWNERSHIP COSTS COMPRISE:-
DEPRECIATION/REPLACEMENT (TABLE A1) PLUS FINANCE CHARGE (TABLE B1, B2 OR B3)

ALL TABLE A & B COSTS IN US$/HOUR

COST NEW- US$ 250,000 (INCLUDING ALL TAXES, DUTIES, CIF & DELIVERY CHARGES)
Note: This is the benchmark cost which is adjusted on Sheet 3 for the ACTUAL cost of purchase New or Second Hand

TABLE B: FINANCE OR OPPORTUNITY COST OF CAPITAL

SELECT APPROPRIATE TABLE (B1, B2 OR B3) OR INTERPOLATE FOR AN INTERMEDIATE INTEREST RATE

B1 - FINANCE @ **10 % p.a.** **FINANCE CHARGE IN US$/HOUR**

ECONOMIC LIFE	UTILISATION IN HOURS/YEAR									
YEARS	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
1	**125**	**63**	**42**	**31**	**25**	**21**	**18**	**16**	**14**	**13**
2	**94**	**47**	**31**	**23**	**19**	**16**	**13**	**12**	**10**	**9**
3	**83**	**42**	**28**	**21**	**17**	**14**	**12**	**10**	**9**	**8**
4	**78**	**39**	**26**	**20**	**16**	**13**	**11**	**10**	**9**	**8**
5	**75**	**38**	**25**	**19**	**15**	**13**	**11**	**9**	**8**	**8**
6	**73**	**36**	**24**	**18**	**15**	**12**	**10**	**9**	**8**	**7**
7	**71**	**36**	**24**	**18**	**14**	**12**	**10**	**9**	**8**	**7**
8	**70**	**35**	**23**	**18**	**14**	**12**	**10**	**9**	**8**	*7*
9	**69**	**35**	**23**	**17**	**14**	**12**	**10**	**9**	*8*	*7*
10	**69**	**34**	**23**	**17**	**14**	**11**	**10**	*9*	*8*	*7*
11	**68**	**34**	**23**	**17**	**14**	**11**	*10*	*9*	*8*	*7*
12	**68**	**34**	**23**	**17**	**14**	**11**	*10*	*8*	*8*	*7*
13	**67**	**34**	**22**	**17**	**13**	*11*	*10*	*8*	*7*	
14	**67**	**33**	**22**	**17**	**13**	*11*	*10*	*8*		
15	**67**	**33**	**22**	**17**	**13**	*11*	*10*	*8*		

B2 - FINANCE @ **20 % p.a.** **FINANCE CHARGE IN US$/HOUR**

ECONOMIC LIFE	UTILISATION IN HOURS/YEAR									
YEARS	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
1	**250**	**125**	**83**	**63**	**50**	**42**	**36**	**31**	**28**	**25**
2	**188**	**94**	**63**	**47**	**38**	**31**	**27**	**23**	**21**	**19**
3	**167**	**83**	**56**	**42**	**33**	**28**	**24**	**21**	**19**	**17**
4	**156**	**78**	**52**	**39**	**31**	**26**	**22**	**20**	**17**	**16**
5	**150**	**75**	**50**	**38**	**30**	**25**	**21**	**19**	**17**	**15**
6	**146**	**73**	**49**	**36**	**29**	**24**	**21**	**18**	**16**	**15**
7	**143**	**71**	**48**	**36**	**29**	**24**	**20**	**18**	**16**	**14**
8	**141**	**70**	**47**	**35**	**28**	**23**	**20**	**18**	**16**	*14*
9	**139**	**69**	**46**	**35**	**28**	**23**	**20**	**17**	*15*	*14*
10	**138**	**69**	**46**	**34**	**28**	**23**	**20**	*17*	*15*	*14*
11	**136**	**68**	**45**	**34**	**27**	**23**	*19*	*17*	*15*	*14*
12	**135**	**68**	**45**	**34**	**27**	**23**	*19*	*17*	*15*	*14*
13	**135**	**67**	**45**	**34**	**27**	*22*	*19*	*17*	*15*	
14	**134**	**67**	**45**	**33**	**27**	*22*	*19*	*17*		
15	**133**	**67**	**44**	**33**	**27**	*22*	*19*	*17*		

B3 - FINANCE @ **30 % p.a.** **FINANCE CHARGE IN US$/HOUR**

ECONOMIC LIFE	UTILISATION IN HOURS/YEAR									
YEARS	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
1	**375**	**188**	**125**	**94**	**75**	**63**	**54**	**47**	**42**	**38**
2	**281**	**141**	**94**	**70**	**56**	**47**	**40**	**35**	**31**	**28**
3	**250**	**125**	**83**	**63**	**50**	**42**	**36**	**31**	**28**	**25**
4	**234**	**117**	**78**	**59**	**47**	**39**	**33**	**29**	**26**	**23**
5	**225**	**113**	**75**	**56**	**45**	**38**	**32**	**28**	**25**	**23**
6	**219**	**109**	**73**	**55**	**44**	**36**	**31**	**27**	**24**	**22**
7	**214**	**107**	**71**	**54**	**43**	**36**	**31**	**27**	**24**	**21**
8	**211**	**105**	**70**	**53**	**42**	**35**	**30**	**26**	**23**	*21*
9	**208**	**104**	**69**	**52**	**42**	**35**	**30**	**26**	*23*	*21*
10	**206**	**103**	**69**	**52**	**41**	**34**	**29**	*26*	*23*	*21*
11	**205**	**102**	**68**	**51**	**41**	**34**	*29*	*26*	*23*	*20*
12	**203**	**102**	**68**	**51**	**41**	**34**	*29*	*25*	*23*	*20*
13	**202**	**101**	**67**	**50**	**40**	*34*	*29*	*25*	*22*	
14	**201**	**100**	**67**	**50**	**40**	*33*	*29*	*25*		
15	**200**	**100**	**67**	**50**	**40**	*33*	*29*	*25*		

For periods over 15 years it is suggested that the figure for 15 years is used.

March 2012
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Circle or note the figure selected and insert the value in Box C2 on Sheet 3.

COST CALCULATION — 120hp (90kW) MOTORGRADER

Continued

SHEET 3 OF 3
WORKING SHEET

CONVERSION TO DAILY CHARGE RATE

INTEREST RATE ASSUMED (Sheet 2) ____ %

OWNERSHIP COSTS

C ADJUSTMENT FOR ACTUAL COST OF PURCHASE

Selected Depreciation/replacement charge (US$/hr) from Table A1		*(C1)*	
Selected Finance charge (US$/hr) from Table B1, B2 or B3 (or interpolation)		*(C2)*	
Actual purchase/replacement cost in US$		*(C3)*	
Assumed number of operating hours per day		*(C4)*	**Local currency**
DAILY OWNERSHIP COST = (C1 + C2) x C4 x C3 / 250,000 =	**US$/day**		**(C)**

D ADJUSTMENT FOR EXPECTED RESIDUAL/SCRAP VALUE (IF ANY)

Assumed Residual/Scrap Value in US$		*(D1)*	
Assumed Economic Life in years		*(D2)*	
Assumed Utilisation in Hours / Year		*(D3)*	**Local currency**
ADJUSTMENT FOR RESIDUAL/SCRAP VALUE = (D1 x C4) / (D2 x D3)	**US$/day**		**(D)**

SUB-TOTAL FOR OWNERSHIP COSTS = (C) - (D) **(W)**

OPERATING COSTS

E SPARES & CONSUMABLES

Either predict daily costs from past records or select from the following:-

Select percentage of spares and consumables per year compared to machine current cost new, Suggested value between 2 and 10% of cost new (usually increases with age)		*% (E1)*	**Local currency**
DAILY COST OF SPARES = 0.01 x C3 x C4 x E1 / D3	**US$/day**		**(E)**

F SERVICING AND REPAIR (WORKSHOP LABOUR COSTS)

Either predict daily costs from past records or select from the following:-

Suggested value between 20% and 100% of (E)		*% (F1)*	**Local currency**
DAILY WORKSHOP LABOUR COSTS = 0.01 x E x F1	**US$/day**		**(F)**

G FUEL & LUBRICANTS

Cost of fuel per litre (add between 2 and 5% to cover lubricant costs)		*(G1)*	
Assumed fuel consumption in litres per hour		*(G2)*	**Local currency**
DAILY FUEL COST = C4 x G1 x G2	**US$/day**		**(G)**

H OPERATORS (DAILY COSTS)

	Wages	Allowances	Other
Operator			
Assistant			
Other			
Sub-totals			

Local currency

US$/day ____ **(H)**

SUB-TOTAL FOR OPERATING COSTS = (E) + (F) + (G) + (H) **(X)**

OVERHEADS

Predict from past records to include:-

I	Offices, Workshops, Tools & other Facilities	
J	Supervisory, management and clerical personnel	
K	Supervision and support vehicles	
L	Stores and other stock	
M	Insurances	
N	Banking and other finance charges not relating to the equipment item	
O	Administration, training, safety or other overhead costs	
P	Risk, late payment and other contingency items	
Q	Taxes, levies etc.	

US$/day **Local currency**

SUB-TOTAL FOR OVERHEADS = Daily allowance for items (I) to (Q) **(Y)**

US$/day **Local currency**

PROFIT **SUB-TOTAL PROFIT** **(Z)**

US$/day **Local currency**

TOTAL COST TO BE CHARGED = (W) + (X) + (Y) + (Z) = **US$/day**

NOTES

1 Finance charge (Sheet 2) calculated by the formula:-

$$C2 = \frac{((N + 1) / 2N) \times \text{Purchase Price} \times \text{interest rate expressed as a decimal}}{\text{Hours per year}}$$

Where N = number of years (economic life)

2 To convert the US$ values to Local Currency multiply by the current exchange rate

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COST CALCULATION — 120hp (90kW) MOTORGRADER

Continued

SHEET 3 OF 3

WORKING SHEET

EXAMPLE

CONVERSION TO DAILY CHARGE RATE

INTEREST RATE ASSUMED (Sheet 2) *10* %

OWNERSHIP COSTS

C ADJUSTMENT FOR ACTUAL COST OF PURCHASE

Selected Depreciation/replacement charge (US$/hr) from Table A1	*21* (C1)		
Selected Finance charge (US$/hr) from Table B1, B2 or B3 (or interpolation)	*17* (C2)		
Actual purchase/replacement cost in US$	*235,000* (C3)		
Assumed number of operating hours per day	*7* (C4)		**Local currency**
DAILY OWNERSHIP COST = (C1 + C2) x C4 x C3 / 250,000 =	**US$/day**	*250*	**(C)**

D ADJUSTMENT FOR EXPECTED RESIDUAL/SCRAP VALUE (IF ANY)

Assumed Residual/Scrap Value in US$	*18,100* (D1)		
Assumed Economic Life in years	*15* (D2)		
Assumed Utilisation in Hours / Year	*800* (D3)		**Local currency**
ADJUSTMENT FOR RESIDUAL/SCRAP VALUE = (D1 x C4) / (D2 x D3)	**US$/day**	*11*	**(D)**
SUB-TOTAL FOR OWNERSHIP COSTS = (C) - (D)		*239*	**(W)**

OPERATING COSTS

E SPARES & CONSUMABLES

Either predict daily costs from past records or select from the following:-

Select percentage of spares and consumables per year compared to machine current cost new,

Suggested value between 2 and 10% of cost new (usually increases with age)	*6* % (E1)		**Local currency**
DAILY COST OF SPARES = 0.01 x C3 x C4 x E1 / D3	**US$/day**	*123*	**(E)**

F SERVICING AND REPAIR (WORKSHOP LABOUR COSTS)

Either predict daily costs from past records or select from the following:-

Suggested value between 20% and 100% of (E)	*70* % (F1)		**Local currency**
DAILY WORKSHOP LABOUR COSTS = 0.01 x E x F1	**US$/day**	*86*	**(F)**

G FUEL & LUBRICANTS

Cost of fuel per litre (add between 2 and 5% to cover lubricant costs)	*$0.40* (G1)		
Assumed fuel consumption in litres per hour	*15* (G2)		**Local currency**
DAILY FUEL COST = C4 x G1 x G2	**US$/day**	*42*	**(G)**

H OPERATORS (DAILY COSTS)

	Wages	Allowances	Other
Operator	*$12.00*	*$3.00*	*$1.00*
Assistant	*$4.00*	*$1.00*	
Other			
Sub-totals	*$16.00*	*$4.00*	*$1.00*

			Local currency
	US$/day	*21*	**(H)**
SUB-TOTAL FOR OPERATING COSTS = (E) + (F) + (G) + (H)		*273*	**(X)**

OVERHEADS

Predict from past records to include:-

I	Offices, Workshops, Tools & other Facilities		
J	Supervisory, management and clerical personnel		
K	Supervision and support vehicles		
L	Stores and other stock		
M	Insurances		
N	Banking and other finance charges not relating to the equipment item		
O	Administration, training, safety or other overhead costs		
P	Risk, late payment and other contingency items		
Q	Taxes, levies etc.		

		US$/day	**Local currency**
SUB-TOTAL FOR OVERHEADS = Daily allowance for items (I) to (Q)		*77*	**(Y)**
(assuming 15% in this example)		**US$/day**	**Local currency**
PROFIT	**SUB-TOTAL PROFIT**	*77*	**(Z)**
(assuming 15% in this example)		**US$/day**	**Local currency**
TOTAL COST TO BE CHARGED = (W) + (X) + (Y) + (Z) =	**US$/day**	***666***	

NOTES

1 Finance charge (Sheet 2) calculated by the formula:-

$$C2 = \frac{((N + 1) / 2N) \times \text{Purchase Price} \times \text{interest rate expressed as a decimal}}{\text{Hours per year}}$$

Where N = number of years (economic life)

2 To convert the US$ values to Local Currency multiply by the current exchange rate

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PART 3
HOW TO SELECT A PIECE OF EQUIPMENT

3.1 INTRODUCTION

This Part of the Handbook has been prepared to assist contractors and road authority personnel to select, specify and procure intermediate equipment for road works and other related activities in emerging and developing countries.

The need for such guidelines has been prompted by the widespread occurrence of inappropriate (in type and specification) equipment in contractor's and road authority equipment fleets, or inadequate operational/support arrangements for the procured equipment.

Contractors often do not have the experience or information immediately available to enable them to make sensible decisions regarding equipment procurement. It is intended that this section will prompt inquiries, analysis and assessments which will help the contractor to make the appropriate final decision regarding any equipment procurement.

Equipment procurement systems are established for many road authorities and international agencies, however these systems are often not designed for the procurement of small quantities of intermediate equipment, which may be fabricated or assembled in developing countries. Furthermore the personnel procuring the equipment are often not fully aware of the exact needs of the user, the mechanical support available, the equipment management arrangements or the competence of the personnel involved with the direction, operation and mechanical support of the equipment. These guidelines are intended to try to improve awareness regarding the varied and specific needs of the process, to encourage substantial improvements.

The guidelines are presented in the form of a checklist of questions which should be asked as part of the management process of selecting, specifying and procuring equipment. Commentary is provided where appropriate.

3.2

37 Essential Questions to ask BEFORE procuring ANY equipment

3.2.1 INITIAL SELECTION

Q1 Have I owned and operated one of these machines before for at least 5 years, do I know its performance and ALL costs? *If not, be extremely careful!*

If you have been owning and operating a similar machine for some time and have adequate records of utilisation and costs, you will have a good basis for assessing the workload and costs of another. If not, you will be making a large number of assumptions, which may be quite incorrect or unjustifiable.

Q2 Am I competent to decide what I need and procure it ? (Do I need advice? Where can I get it)?

Do I really have the knowledge and experience to make procurement decisions unassisted? Have my past decisions on procurement been good? Should I talk to other contractors/authorities about their experiences with this machine type? Where can I obtain objective, impartial advice?

Contractor's associations, international road associations, specialist international organisations, or professional bodies such as the UK Institutions of Agricultural or Mechanical Engineers may be able to put you in touch with an expert with APPROPRIATE experience with a particular type of equipment. They may be able to direct you to relevant reports, evaluations or trials.

Q3 Do I really need this machine or can I manage without it?

Q4 What is the task, will this type of machine do it satisfactorily?

Define the work that the machine will do, the quantity of work, the required daily output. Consider other ways of doing the same task (other equipment types or with just labour).

Q5 What are the TOTAL costs of procurement and delivery to my depot?

Include the price to be paid minus any discount. Include costs of freight, transport, insurances, taxes, duties, levies, dealer's charges, inspection fees, quality assurance fees, delivery to the depot.

Q6 Do I have the cash resources to procure the equipment? Do I need to

finance the purchase? Is finance available? At what cost?

Will it be a cash purchase or will at least part of the procurement require financing? Is financing available? What is the cost (interest, arrangement, other non-capital charges)? What security or capital will be required by the lender and what are the risks involved if I have difficulty in paying, or payments are late?

Q7 How will the equipment be maintained and repaired?

Will I maintain and repair the equipment with my own mechanics and facilities, will I use the supplier's mechanics or their agents, or a local workshop? What is the quality of this support? Will the maintenance support be on-site or will the equipment have to be taken to the workshop?

Q8 What are the ownership costs?

What are the REALISTIC costs of depreciation and finance? (see Parts 1 & 2 of this Handbook)

Be particularly careful regarding these figures because important assumptions have to be made about economic life and annual utilisation. Be REALISTIC in these assumptions and explore a range of assumptions.

Q9 What are the operating costs?

What are the REALISTIC costs of operation? (see Parts 1 & 2 of this Handbook)

Will a low loader or other vehicle be needed to transport or attend the machine?

Q10 What are the overhead costs?

What are the REALISTIC costs of all overheads? (see Parts 1 & 2 of this Handbook)

Q11 What are the costs when it is NOT working?

What will be the costs if I do not achieve the expected rates of utilisation?

It is suggested that the cost calculations are also made for a 'worst case' scenario. You can then assess the costs for every hour below your target utilisation that the machine is not working each year.

Q12 Could I hire it out when I don't need to use it?

Is there a market to hire the machine out if I do not have work for it? What is

the market rate of hire? Do the potential clients have a good reputation for payment in full and on time?

Q13 Could I instead hire the equipment in only when I need it?

Is this type of machine available to hire-in when I will need it? What condition is the available equipment in (reliable/regularly breaking down)? What are the hire costs? What are the transport costs and arrangements (low loader required)?

Q14 Should I buy new or secondhand?

If the capital cost of a new machine is too high and the expected utilisation rather low, is a secondhand purchase a possible option? What is the condition of available secondhand equipment? What are the risks? Is there any warranty? What is the expected availability and residual life?

Q15 Will it be profitable?

3.2.2 SPECIFICATION

Q16 What is the expected workload for the machine through the year?

What is the expected quantity of this type of work?

Q17 What size should it be to compromise achieving adequate daily output with overall annual workload? Should I buy 2 smaller ones instead? Will the machine work with attachments or other equipment items?

Try to match the expected capacity of the machine to the workload, without the machine standing idle for excessive periods. Where machines are working together on a task (e.g. tractors and trailers, or haulage and compaction) the sizes and specifications should be compatible.

Q18 Will it only carry out one task for one client/user, or will it be flexible for various applications?

Are there a range of applications/clients which will allow high utilisation of the equipment through the year?

Q19 How many days a year will it work? Will there be enough work to keep the equipment operating effectively/profitably throughout the year?

Q20 Is it robust enough to do the job in the local working environment? Is it sustainable?

Q21 Is it too sophisticated for the available mechanical support?

Q22 Do I already have one of these models in my fleet? If not are there any implications for not standardising?

It is possible to assess the costs of not standardising in terms of the additional expenses of spares stocks, storage space, tools, training. An example format for assessment is contained in Appendix 2.

Q23 Will it be profitable?

3.2.3 PROCUREMENT

Q24 What is the REALISTIC delivery time?

Q25 What is the population of the manufacturer's specific model in-country?

The population in-country will influence the size and extent of spares stocks held by the local agent, resale value, local experience and risks.

Q26 What is the likely resale or scrap value of the particular model?

Enquire about similar models.

Q27 What training will be required for:
- **me**
- **my supervisors**
- **my operators**
- **my mechanical support personnel?**

What will this training cost?

Q28 Is there a competent local agent to support the equipment?
- **workshop and stores near me?**
- **good reputation?**
- **adequate stock of spares (value?) for the particular model?**

Q29 What quality assurance arrangements can I make to ensure that what I get is what I ordered?

This is particularly important for limited run production of equipment from local workshops. It is necessary to ensure that production models are to the same quality standards as showroom or proven prototype examples. It is possible to arrange for quality assurance inspections during production and on delivery.

Q30 What warranty is being offered by the supplier? Period? Spares and labour costs covered? On site? Replacement machine while it is being repaired?

Q31 Are there particular requirements for the intended application?

For example: Are the tyre sizes to be specified available locally? Should I consider heavy duty tyres on availability, expected performance and cost considerations? What operator safety and protection equipment should be fitted? If there is a hitching system, what Category and type is required for the application and compatibility with other equipment.

Q32 What essential spares, fast-moving parts and tools should I procure with the equipment?

If the supplier offers you a list of suggested spare parts, get this independently checked to ensure that you are not having inappropriate items 'dumped' on you.

Be more specific than requesting, say, 10% value of the new price in spares. For example, request a suggested list of spares necessary to support 2,000 hours or 2 years of operation. This will possibly include the parts necessary for 8 routine preventive maintenance services.

It is advisable to obtain a current list of spare parts retail prices. This will help in later negotiations if the costs rise above the rate of inflation.

Q33 To what extent is it likely that the equipment can be maintained or even upgraded in the future?

Many farms have working agricultural tractors that are more than 50 years old. This is partly because of continued availability of spares and possibilities to upgrade to changing requirements.

Q34 Can I afford it? Can I afford NOT to have it?

Q35 Am I being realistic?

Q36 What are the risks?

Q37 Will it be profitable?

REMEMBER - THE LOWEST INITIAL-COST MACHINE MAY NOT HAVE THE LOWEST WHOLE-LIFE COSTS.

3.3 SPECIFICATIONS

The specifications set out in Part 4 of this document are drawn from the experience of a number of programmes. They are not definitive and do not offer any guarantee of being appropriate or adequate for a particular task. However they do form the basis for a request and evaluation of tenders or quotations. The format of the specifications allows the prospective purchaser to obtain important details from suppliers and to compare these with the suggested specifications. Comparisons may be made between different suppliers and models, and the suggested requirements; this may be used as the basis for further investigations if necessary.

Additional details or refinements may be found to be desirable by some purchasers.

PART 4
EXAMPLE PROCUREMENT SPECIFICATIONS FOR INDIVIDUAL EQUIPMENT ITEMS

PART 4 – RECOMMENDED EQUIPMENT SPECIFICATIONS FOR PROCUREMENT

The following specifications are recommended to be used as the basis, with the standard local or international procurement documentation, for invitations for equipment supply. Adaptions or modifications may be required to suit local conditions, experience or practices.

CONTENTS

EXAMPLE GENERAL REQUIREMENTS

[The procurer should review/amend text in italics]

Introduction

The following requirements apply to all of the items listed for procurement. The Bidder must verify that the items being offered will comply with the following.

G.1 The Bid – The Bidding Document requests submissions for a range of equipment items. The Bidder may submit a bid for any one item, a number of items or all items. The Client reserves the right to accept or reject any bid for any or all of the items.

G.2 General – The equipment offered shall be new, unused and current model production, which is substantially the same as the prototype or other model in successful use for not less than 1 year or 2000 hours.

G.3 Supplier – If the Bidder is not the manufacturer of the item, the Bidder will ensure that the item is manufactured and supplied in accordance with the requirements of the specification.

G.4 Language – All documents, manuals, charts, drawings and manufacturer's specification literature included with the bid shall be in the English language.

G.5 Compliance Certification – All Bidders will provide their Statement of Compliance and Clause by Clause commentary for all parameters and any data by certifying at the right side column of the individual specifications.

G.6 Compliance to Requirements – Bidders are expected to offer equipment that meets or is better than the Specification requirements. Under the SUPPLIER/TENDERER OFFER column the Bidder will either enter 'Complies' or inserts the improvements offered FOR EACH SPECIFICATION REQUIREMENT.

G.7 Service Requirements – The equipment offered to be supplied will be suitable to be used on road construction and maintenance works anywhere in the *[state country/region]* where:-

- Climate varies from humid tropical to arid desert.
- Ambient shade temperatures vary from *[0°C to 50°C].*
- Annual rainfall varies between less than *[500 mm/year to 2500 mm/year].*
- Altitudes vary from below sea level to *[3000 metres above sea level].*

The equipment shall accordingly be extra heavy duty for tropical conditions capable of rendering *[10 years or 10000 hours]* of service with scheduled maintenance and without the need for major refurbishment/rehabilitation in adverse conditions that will include possible low grade/contaminated fuels and dusty conditions.

G.8 Manufacturing materials – All materials shall be free from defects, which would adversely affect the performance or maintainability of individual components or the overall assembly.

G.9 Manufacturing construction – The unit and its components and accessories shall be designed and constructed to facilitate field maintenance. All adjustment features, routine maintenance spares and replaceable parts shall be easily accessible.

G.10 Additional features – Additional or better features which are not mentioned in the Specification, but which are a part of the manufacturer's standard product shall be included in the unit being offered.

G.11 On Site Warranty –

a) The Bidder/Supplier guarantees that all materials, parts, components, accessories and attachments will be manufactured and assembled to high quality and good workmanship. The Bidder/Supplier also guarantees to replace at his own cost (including any freight, taxes, duties and labour) any part or component that may break or fail for reason of inferior or defective design, material or workmanship within the warranty period.
b) The warranty period shall be 12 months or 2000 hours (whichever is sooner) from the date of formal acceptance.
c) The Bidder/Supplier shall undertake to rectify each and every fault under warranty upon notification by *[the Customer]* within a maximum of 45 calendar days from the date of notification of such occurrences. Failure to do so will result in remedial action being taken by *[the Customer]* at the risk and expense of the Bidder/Supplier.
d) *[the Customer]* reserves the right to further claim for consequential down time costs if the faults are not rectified within the time period specified above.

G.12 After Sales Service Facility – A Bidder/Supplier who has an established dealership and after sales service facility in *[state country/region]* , or an officially appointed agency providing such equipped and trained personnel facilities will be given preference in bid evaluation to one who has not.

G.13 Pre-delivery service – The Bidder shall arrange for the manufacturer's scheduled and checklist certified pre-delivery inspection and servicing of the unit with the manufacturer's representative or local agent, including removal of transit protection and packaging, washing, greasing, lubrication, adjustment and calibration (if any) at his own cost (including parts, materials and labour etc.) to *[the Customer]* 's satisfaction before formal acceptance of the unit at the final destination.

G.14 Training – Technical training shall be provided at the *[state location of training]* Training Centre at the expense of the Supplier as follows:-

- In operation of the unit to the Training Centre Trainer and at least two operators per unit.
- In repair and maintenance of the unit the Training Centre Trainer and at least two mechanics.

G.15 Documentation – The Bidder/Supplier shall provide the following additional documents with his bid:-

a) Technical Specifications and manufacturer's brochures describing in detail the unit being offered including all standard and optional equipment.
b) If the unit includes an engine, the Certified Engine data to ISO or other acceptable standard showing net flywheel power, torque and fuel consumption curves at sea level and at an altitude of 2000 metres above sea level.
c) Other supporting documentation, certification or validation as appropriate.

G.16 Supply requirements – Each unit shall be supplied with the following:-

a) Manuals – One copy each of the Operators Manual, Maintenance Manual and Workshop/Repair Manual plus one additional copy of each manual for the total order quantity. Manuals are to cover the units and any attachments or accessories.
b) Standard Tools – A set of essential tools (to include grease gun, spanners etc.) shall be provided in a lockable toolbox with each unit.
c) Special Tools – Any tools not expected to be available in a standard workshop toolkit shall be provided at the rate of one set for every unit.
d) Fire-extinguisher – If the unit includes an engine, a fire extinguisher suitable for fuel and electrical fires shall be provided with each unit.
e) Optional Equipment – Any items considered by the Bidder/Supplier to be vital for the safe, effective and efficient operation of the equipment and not specified, shall be quoted separately as a supply option.

G.17 Other Information – Data to be provided by the Bidder

a) Number of units of the offered make and model in service in a) *[state country/region]* and b) Elsewhere and the address of at least two organisations using them.
b) Approximate number of line items and value of spares stock for the offered units at the local agent/dealership guaranteed to be in place on delivery of the order if awarded.
c) Maximum parts supply time from agent/dealership order to delivery from factory to agent/dealership premises both by air freight and sea freight.
d) Locations of agencies/dealerships and branches within *[state country/region]* and length of time that these have been established.
e) Number and level of technical staff employed by the local agents/dealerships for carrying out after sales service and warranty claims.
f) Manufacturer's recommended lubricants and their renewal intervals (greases, engine transmission drive and hydraulic oils etc.) allowing for a 1% sulphur content in the diesel fuel working under normal conditions and work on dusty unpaved roads.
g) Manufacturer's recommendations regarding change intervals for any filters (Air Cleaner, fuel, engine oil, hydraulic oil, transmission oil etc.) allowing for a 1% sulphur content in the diesel fuel working under normal conditions and work on dusty unpaved roads.
h) Work load fuel consumption data
i) Details of workshop tools, testing facilities and equipment required for all scheduled services.

G.18 Specification Waiver – *[the Customer]* reserves the right to partially or fully waive compliance to any of the requirements or Specifications, and make awards on the basis of serving the best interests of the *[the Customer]* .

Supplier Company Stamp

Authorizing Signature
Certifying Compliance

Date …….

75/90kW (100/120 HP) 4WD TRACTOR **NO. REQUIRED: .....**

SPECIFICATION	RECOMMENDED	SUPPLIER/TENDERER OFFER
1. General 4 Wheel drive Wheeled Tractor, Heavy Duty Tropical Specifications, ROPS & sun protection canopy, Heavy Duty Drawbar and 3 point Hitches, *[state country]* road legal		
2. Engine Diesel fuel, 4 stroke, turbocharged, water cooled		
Max Power (DIN) (SAE net) (ISO-14396) (9768-EC) Max Torque (DIN) Piston Displacement Air Filtration Fuel filtration heavy duty Lubrication system	Min 75 kW Min 75 kW Min 79 kW Min 79 kW Min 400Nm Min 4.50 litres Heavy Duty suitable for abrasive dusty conditions(e.g. 2 stage dry type fitted with cyclone pre-cleaner and restriction indicator light) With water separator Fully pressurised and filtered	
3. Electrical, 12 v Alternator Battery	Starter, Charging and lighting Heavy Duty 45 ampere Min 100 Ah Min, Holder Lockable	
4. Power Take Off (PTO) Independent, single selector lever clutch operation, 540/1000 rpm options		
5. Transmission Clutch Gear Box Drive Max Road Speed (kph)	Manual type Heavy Duty, self adjusting, mechanical Synchromesh, Min 10 forward & 2 reverse gears 4 x 4 Min 25	
6. Steering	Hydrostatic and centre mounted	

75/90kW (100/120 HP) 4WD TRACTOR (CONT)

SPECIFICATION	RECOMMENDED	SUPPLIER/TENDERER OFFER
7. Wheels and Tyres		
Wheels Front Rear	Heavy Duty Min 14.9 - 28, 8 PR, Traction type Industrial radial suitable for Max load of 1800 kg min Min 18.4 - 38, 8 PR, Traction type Industrial radial tractor, suitable for Max load of 4000 kg min	
8. Dimensions		
Overall Length Overall Width Overall height (bare) Ground clearance under axle housing and hitch	Max 5500 mm Max 2500 mm Max 2500 mm(to top of steering wheel) Min 350 mm	
9. Operational weight		
Inc. fuel oil water & weights, but excluding ROPS Rear Axle Capacity	Min 4000 kg Max 5500 kg Min 5000 kg	
10. Brakes		
Service Brake System Parking Brake Brake couplings for towed items Brake Performance	Hydraulic, on all wheels Independent hand operated on rear wheels Yes Capable of controlling and holding the tractor and an 8 tonne towed item on a 20% grade	
11. Fuel Tank	Min 120 litre, lockable with filler strainer	

75/90kW (100/120 HP) 4WD TRACTOR (CONT)

SPECIFICATION	RECOMMENDED	SUPPLIER/TENDERER OFFER
12. Lighting and Reflectors *[country]* Road legal. Headlights, Direction indicators, Stop & tail lights, Panel lights, Number plate light, Hazard warning, Park Brake, and working front and rear lights, warning lights for Oil Pressure, Water Temperature, Alternator charge.		
13. Instruments Speedometer metric (km/hr), Service (hour) meter to 9999 hours, Fuel gauge, Alternator charge, Water temperature gauge, Oil pressure gauge		
14. Hitches Heavy Duty fixed drawbar hitch, secured with at least 8 bolts, to BS 6108/ISO 6489, pin (suitably hardened) and 50 mm eye fitting, for towing up to 10000 kg load. Vertical transfer load up to 3000 kg, Tow height 450 mm Category 3 Three-point hitch		
15. Hydraulics (Auxiliary)		
Hydraulic pump flow rate	60 litres/minute Min	
Operational pressure	12MPA (1800 psi) Min	
Valves	2 No. Double acting spool valves	
Couplings	Flow and return - quick release action couplings for towed items – 13mm ISO	
16. Miscellaneous Full front mounted and rear wheel Ballast weights Tool Kit (Specify) Operation, Workshop and Spare Parts Manuals Spares as per Specification 1.2 Steel Roll Over Protection Structure and sun/rain canopy to be fitted		

75/90kW (100/120 HP) 4WD TRACTOR (CONT)

SPECIFICATION	RECOMMENDED	SUPPLIER/TENDERER OFFER
16. Miscellaneous (cont.) Full corrosion protection and finished in paintwork of Purchaser's colour choice Hydraulic connection and control for towed trailer tipping operation 7 pin ISO trailer power supply socket Large rear view mirrors to be fitted to provide clear view of towed items Electrical, steering wheel mounted horn operation Fuses, circuit breakers or equal protection against damage of short circuits shall adequately protect all electrical circuits		

SUPPLIER/TENDERER'S SPECIFICATION	
MAKE: MODEL: COUNTRY OF ORIGIN :	

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Date …….

SPARES FOR 75/90kW (100/120 HP) 4WD TRACTOR

SUPPLIER/TENDERER'S SPECIFICATION MAKE: MODEL: COUNTRY OF ORIGIN :	

Supplier/Tenderer to list recommended initial spares inventory to be supplied with **each** tractor unit sufficient for 2 years or 2,000 hours operation, including consumable and service items.

PART DESCRIPTION	PART NUMBER	NUMBER TO BE SUPPLIED	UNIT PRICE	TOTAL PRICE

Supplier Company Stamp **Authorizing Signature**
Certifying Compliance

Date …….

HEAVY TOWED GRADER (5 TONNE) **NO. REQUIRED: .....**

SPECIFICATION	RECOMMENDED	SUPPLIER/TENDERER OFFER
1. General Heavy duty, single axle or tandem axle pair, towed grader for construction, reconstruction and maintenance of camber on earth or gravel roads, construction or maintenance of side and turn-out (mitre) drains. Complete with heavy duty scarifier to loosen hard compacted material		
2. Towing Equipment Required (not supplied under this Specification item – see item 1.1)	Wheeled agricultural tractor, 4 wheel drive, Min 75kW (100HP)SAE net	
3. Dimensions a) Max Overall Length b) Max Overall Width	 6500 mm (ex-scarifier) 2500 mm (with blade stowed for travel)	
4. Construction Heavy duty, welded steel. Main frame of Rolled Steel Channels. Turntable on "A" frame with hydraulically operated height and sideshift control. Greased wear - adjustable ball (80 mm Min) and socket joint connection of "A" frame apex to main frame. Turntable lockable in range of positions. Rear mounted, hydraulically operated scarifier. Operator control platform behind and in full view of blade		
5. Weights a) Gross Weight b) At hitch (static)	 Min 4500 kg Max 6500 kg Min 1500 kg, Max 3000 kg	
6. Axle Heavy duty stub axles each 5,000 kg Min load rating. Stub axles welded in position. 8 No. high tensile steel studs		
7. Wheels 8" (200 mm) rims. Rated load Min 5000 kg. Braked		
8. Tyres	1000 - 20, 14 PR, or 1100 – 20, 16 PR	

HEAVY TOWED GRADER (5 TONNE) (CONT)

SPECIFICATION	RECOMMENDED	SUPPLIER/TENDERER OFFER
9. Lights and Reflectors Tail, brake, reversing and direction lights on rear. Front and rear reflectors. Wiring and 7 pin ISO connection		
10. Towing Eye Heavy duty swivel hitch with towing eye, welded or bolted to chassis, fitted for 450 mm hitch towing height	BS 5891 (1980) or ISO 5692 (1979) Inside hole dia. 50 mm Swivel barrel 76 mm dia. shaft into bush bearing	
11. Parking Stand Fold back/adjustable heavy duty parking stand for 450 mm height of towing eye		
12. Mouldboard length	3600mm (12') nominal 3000mm (10') option	
13. Mouldboard depth	500 mm nominal	
14. Mouldboard thickness	18 mm Min	
15. Mouldboard pitch	6 positions, manual adjustment	
16. Mouldboard positions	Min 6 left, 6 right, hydraulic locking device. Turntable turning angle from centre position ±55° Min	
17. Turntable Diameter	1200 mm approx	
18. Cutting Edges	Standard Caterpillar / Komatsu specifications and end overlays	
19. Hydraulics Main lift rams (2 No) Side shift rams Turntable Lock Ram Scarifier Ram	 Stroke 700 mm Bore 80 mm Stroke 700 mm Bore 80 mm Stroke 100 mm Bore 50 mm Stroke 400 mm Bore 100 mm	
20. Working pressure	Minimum 1,500 psi Maximum 2,250 psi	

HEAVY TOWED GRADER (5 TONNE) (CONT)

SPECIFICATION	RECOMMENDED	SUPPLIER/TENDERER OFFER
21. Controls on grader	5 element spool valve	
22. Hydraulic lines to tractor	One delivery One return	
23. Hoses	Quick release couplings 13 mm ISO. Dummy couplings for disengaged situation	
24. Oil Supply assumed	60 litres/min Min	
25. Safety	Heavy duty roll bar & overhead operator sun/rain protection	
26. Jacking Points	At hitch and at each side of the grader close to stub axles	
27. Scarifier	Hydraulically operated with 4/5 replaceable tines and replaceable tips. Penetration 300mm Min	
28. Miscellaneous Brake lines and connection, and parking brake Spare wheel-tyre and lockable carrier mounted on body Tool Kit in lockable box (specify) Operation, Workshop and Spare Parts Manuals Spares as per Specification 2.2 Full corrosion protection, finish in yellow paintwork		
SUPPLIER/TENDERER'S SPECIFICATION MAKE: MODEL: COUNTRY OF ORIGIN :		

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SPARES FOR HEAVY TOWED GRADER (5 TONNE)

SUPPLIER/TENDERER'S SPECIFICATION MAKE: MODEL: COUNTRY OF ORIGIN :	

Supplier/Tenderer to list recommended initial spares inventory to be supplied with **each** towed grader unit sufficient for 2 years or 2,000 hours operation, including consumable and service items.

Recommended Minimum Service & Repair Kit Spares	*4 sets of ram seals,* *1 set of hydraulic hoses and couplings, 12 sets of cutting edges,* *2 sets of end overlays,* *1 set of nuts and bolts for the above*

PART DESCRIPTION	PART NUMBER	NUMBER TO BE SUPPLIED	UNIT PRICE	TOTAL PRICE

Supplier Company Stamp **Authorizing Signature**
Certifying Compliance

Date …….

5 TONNE HEAVY DUTY TIPPING TRAILER **NO. REQUIRED: .....**

SPECIFICATION	RECOMMENDED	SUPPLIER/TENDERER OFFER
1. General Heavy Duty, single axle, tipping dump body with vertical/sloping front, sloping sides and open scow back, suitable for gravel, stone and aggregate haulage on unpaved roads and manual/machine loading, min 3 cubic metre struck and 5 - 8 tonne payload capacity.		
2. Dimensions a) Max Overall Length b) Max Overall Width c) Max height of body sides from ground d) Body struck capacity allowing for material to rest at 45° at rear of load bay	 5500 mm 2500 mm 1500 mm Min 3.0m³	
3. Body and Chassis Heavy duty, reinforced welded steel tipping body on welded rolled steel section chassis. Body Floor Min metal thickness 4.00 mm. Sides and Front Min metal thickness 3.00 mm, steel channel reinforced.		
4. Weights a) Gross Weight b) Design Payload Min c) At hitch (loaded)	 9000 kg (Max) 5500 kg (excl body) Min 500kg, Max 2000kg	
5. Hydraulic Tipping System Delivery and return lines and couplings and dummy covers. Lifting capacity 10 tonnes		
6. Hoses Quick release coupling type 13 mm ISO. Dummy couplings for disengaged situation		
7. Axle Beam mounted under chassis with stub axles welded in position. Heavy duty braked stub axles each 5,500 kg Min load rating, fitted with 8 No. high tensile steel studs		

5 TONNE HEAVY DUTY TIPPING TRAILER (CONT)

SPECIFICATION	RECOMMENDED	SUPPLIER/TENDERER OFFER
8. Wheels 8" (200mm) rims. Rated load Min 5,500kg braked		
9. Tyres	1000 - 20, 14 PR or 1100 – 20, 16 PR	
10. Lights & Reflectors Tail, brake, reversing and direction lights on rear. Front and rear reflectors. Wiring and 7 pin ISO connection		
11. Towing Eye Heavy duty hitch with towing eye, welded or bolted to chassis, fitted for 450 mm hitch towing height	BS 5891 (1980) or ISO 5692 (1979) Inside hole diam 50 mm	
12. Skid Stand	Fixed skid stand for parking, extending 150 mm below lower face of towing eye	
13. Jacking Points	At each side of the trailer behind and near to axle	
14. Miscellaneous Brake lines and connection, and parking brake Drawbar of sufficient length to avoid fouling trailer body or fittings when towing tractor turns Heavy duty suspension system Spare wheel and lockable carrier mounted on front of body Tool Kit(specify) Operation, Workshop and Spare Parts Manuals Spares as per Specification 3.2 Full corrosion protection and finished in yellow paintwork		

5 TONNE HEAVY DUTY TIPPING TRAILER (CONT)

SUPPLIER/TENDERER'S SPECIFICATION MAKE: MODEL: COUNTRY OF ORIGIN :	

Supplier Company Stamp

Authorizing Signature
Certifying Compliance

Date ……

SPARES FOR 5 TONNE HD TIPPING TRAILER

SUPPLIER/TENDERER'S SPECIFICATION MAKE: MODEL: COUNTRY OF ORIGIN :	

Supplier/Tenderer to list recommended initial spares inventory to be supplied with **each** trailer unit sufficient for 2 years or 2,000 hours operation, including consumable and service items.

PART DESCRIPTION	PART NUMBER	NUMBER TO BE SUPPLIED	UNIT PRICE	TOTAL PRICE

Supplier Company Stamp **Authorizing Signature**
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Date …….

FRONT END LOADER ATTACHMENT **NO. REQUIRED: .....**

SPECIFICATION	RECOMMENDED	SUPPLIER/TENDERER OFFER
1. General Hydraulically operated front end loader attachment suitable for earth, gravel, sand and crushed aggregate filling and loading and to be compatible to fit to Specification Item 1.1		
2. Dimensions a) Min Overall Width of bucket b) Min lift height to underside of bucket (tilted) c) Bucket Body struck capacity d) Min Scooping depth e) Lift arm & bucket	 1800 mm 2500 mm Min 0.5m³ 200 mm Double acting type	
3. Bucket Detachable heavy duty steel digging bucket complete with replaceable teeth		
4. Lift Capacity Min	2.0 tonnes	
5. Hydraulic lines to tractor	One delivery One return	
6. Miscellaneous Fixings and Hydraulic fittings compatible with Specification Item 1.1 Operation, Workshop and Spare Parts Manuals Spares as per Specification 4.2 Full corrosion protection and paintwork		
SUPPLIER/TENDERER'S SPECIFICATION MAKE: MODEL: COUNTRY OF ORIGIN :		

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Date …….

SPARES FOR FRONT END LOADER ATTACHMENT

SUPPLIER/TENDERER'S SPECIFICATION MAKE: MODEL: COUNTRY OF ORIGIN :	

Supplier/Tenderer to list recommended initial spares inventory to be supplied with **each** loader unit sufficient for 2 years or 2,000 hours operation, including consumable and service items.

PART DESCRIPTION	PART NUMBER	NUMBER TO BE SUPPLIED	UNIT PRICE	TOTAL PRICE

Supplier Company Stamp **Authorizing Signature**
Certifying Compliance

Date …….

BACKHOE LOADER ATTACHMENT **NO. REQUIRED: .....**

SPECIFICATION	RECOMMENDED	SUPPLIER/TENDERER OFFER
1. General Hydraulically operated back hoe loader attachment suitable for earth and gravel excavation and loading and to be compatible to fit to three-point linkage at rear of Specification Item 1.1		
2. Dimensions a) Overall width of interchangeable buckets (both to be provided) b) Min bucket reach from pivot point c) Min lift height to underside of bucket	 300 mm and 500 mm 3000 mm 2500 mm	
3. Bucket Heavy duty steel digging bucket complete with replaceable teeth		
4. Lift Capacity Min	0.4 tonnes	
5. Hydraulic lines to tractor	One delivery One return	
6. Swing arc	180 degrees	
7. Miscellaneous Fixings and Hydraulic fittings compatible with Specification Item 1.1 Operator seat and control console Hydraulically operated outriggers and stability pads Operation, Workshop and Spare Parts Manuals Spares as per Specification 5.2 Full corrosion protection and paintwork		
SUPPLIER/TENDERER'S SPECIFICATION MAKE: MODEL: COUNTRY OF ORIGIN :		

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SPARES FOR FRONT END LOADER ATTACHMENT

SUPPLIER/TENDERER'S SPECIFICATION MAKE: MODEL: COUNTRY OF ORIGIN :	

Supplier/Tenderer to list recommended initial spares inventory to be supplied with **each** loader unit sufficient for 2 years or 2,000 hours operation, including consumable and service items.

PART DESCRIPTION	PART NUMBER	NUMBER TO BE SUPPLIED	UNIT PRICE	TOTAL PRICE

Supplier Company Stamp **Authorizing Signature**
Certifying Compliance

Date …….

TOWED VIBRATING ROLLER **NO. REQUIRED: .....**

SPECIFICATION	RECOMMENDED	SUPPLIER/TENDERER OFFER
1. General 5 tonne single smooth drum vibrating roller suitable for towing by wheeled tractor for compaction of all soil types, gravels, road base and sub-base materials and rock fill		
2. Dimensions a) Drum width b) Drum diameter c) Max Overall length d) Drum shell thickness	 1700 mm 1500 mm 5000 mm 22mm min	
3. Static Weight Min	5.0 tonnes	
4. Power unit fuel	Diesel	
5. Power unit engine Min	50 hp (SAE)	
6. Centrifugal force Min	12 tonne	
7. Vibration Frequency	28 Hertz	
8. Vibration Amplitude	1.5mm min	
9. Towing hitch eye dia. Min	45 mm	
10. Miscellaneous Operation, Workshop and Spare Parts Manuals Spares as per Specification 6.2 Full corrosion protection and paintwork		
SUPPLIER/TENDERER'S SPECIFICATION MAKE: MODEL: COUNTRY OF ORIGIN :		

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Date …….

SPARES FOR TOWED VIBRATING ROLLER

SUPPLIER/TENDERER'S SPECIFICATION MAKE: MODEL: COUNTRY OF ORIGIN :	

Supplier/Tenderer to list recommended initial spares inventory to be supplied with **each** roller unit sufficient for 2 years or 2,000 hours operation, including consumable and service items.

PART DESCRIPTION	PART NUMBER	NUMBER TO BE SUPPLIED	UNIT PRICE	TOTAL PRICE

Supplier Company Stamp **Authorizing Signature**
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Date …….

TOWED EARTH SCRAPER **NO. REQUIRED: .....**

SPECIFICATION	RECOMMENDED	SUPPLIER/TENDERER OFFER
1. General 3 tonne towed earth scraper (dam scoop) suitable for towing by wheeled tractor		
2. Dimensions a) Width of cut b) Body capacity	 1600 mm 1.7m³	
3. Operation	By tractor link arms Self opening and closing bucket mechanism Cord operated dump-spread	
4. Tyres	2 No. 600 x 16 rubber tyred wheels	
5. Cutting edges	Replaceable	
6. Miscellaneous Operation, Workshop and Spare Parts Manuals Spares as per Specification 6.2 Full corrosion protection and paintwork		
SUPPLIER/TENDERER'S SPECIFICATION MAKE: MODEL: COUNTRY OF ORIGIN :		

Supplier Company Stamp

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Date …….

SPARES FOR TOWED EARTH SCRAPER

SUPPLIER/TENDERER'S SPECIFICATION MAKE: MODEL: COUNTRY OF ORIGIN :	

Supplier/Tenderer to list recommended initial spares inventory to be supplied with **each** scraper unit sufficient for 2 years or 2,000 hours operation, including consumable and service items.

PART DESCRIPTION	PART NUMBER	NUMBER TO BE SUPPLIED	UNIT PRICE	TOTAL PRICE

Supplier Company Stamp **Authorizing Signature**
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Date …….

52kW (70HP) TRACTOR **NO. REQUIRED: .....**

SPECIFICATION	RECOMMENDED	SUPPLIER/TENDERER OFFER
1. General 2 Wheel drive Wheeled Tractor, Heavy Duty Tropical Specifications, ROPS & sun protection canopy, Heavy Duty Drawbar and 3 point Hitches, *[state country]* road legal		
2. Engine Diesel fuel, 4 stroke, turbocharged, water cooled		
Max Power (DIN) (SAE net) (ISO-14396) (9768-EC) Max Torque (DIN) Piston Displacement Air Filtration Fuel filtration heavy duty Lubrication system	Min 52 kW/70HP Min 52 kW/70HP Min 55 kW/74HP Min 55 kW/74HP Min 230 Nm Min 3.00 litres Heavy Duty suitable for abrasive dusty conditions(e.g. 2 stage dry type fitted with cyclone pre-cleaner and restriction indicator light) With water separator Fully pressurised and filtered	
3. Electrical, 12v Alternator Battery	Starter, Charging and lighting Heavy duty 30 ampere Min 80 Ah Min, Holder Lockable	
4. Power Take Off (PTO) Independent, single selector lever clutch operation, 540 rpm		
5. Transmission Clutch Gear Box Drive Max Road Speed (kph)	Manual Type Heavy Duty, self adjusting, mechanical Synchromesh, Min 8 forward & 2 reverse gears 4 x 2 Min 25	
6. Steering	Manual	

52kW (70HP) TRACTOR (CONT)

SPECIFICATION	RECOMMENDED	SUPPLIER/TENDERER OFFER
7. Wheels & Tyres		
Wheels	Heavy Duty	
Front	750 - 16, 8 PR, suitable for Max load of 1000 kg	
Rear	Min 1690 - 30, 12 PR, Traction type Industrial radial tractor, suitable for Max load of 3000 kg	
8. Dimensions		
Overall Length	Max 4100 mm	
Overall Width	Max 2200 mm	
Overall height (bare)	Max 2200 mm(to top of steering wheel)	
Ground clearance under axle housing and hitch	Min 300 mm	
9. Operational weight		
inc fuel oil water & weights, but excluding ROPS	Min 2500 kg Max 4000 kg	
Rear Axle Capacity	Min 3000 kg	
10. Brakes		
Service Brake System	Mechanical/Hydraulic on rear wheels, oil bath	
Parking Brake	Independent hand operated on rear wheels	
11. Fuel Tank	Min 65 litre, lockable with filler strainer	
12. Lighting and Reflectors *[state country]* Road legal. Headlights, Direction indicators, Stop & tail lights, Panel lights, Number plate light, Hazard warning, Park Brake, and working front and rear lights, warning lights for Oil Pressure, Water Temperature, Alternator charge.		
13. Instruments Speedometer metric (km/hr), Service (hour) meter to 9999 hours, Fuel gauge, Alternator charge, Water temperature gauge, Oil pressure gauge.		

52 kW (70HP) TRACTOR (CONT)

SPECIFICATION	RECOMMENDED	SUPPLIER/TENDERER OFFER
14. Hitches Heavy Duty fixed drawbar hitch, secured with at least 8 bolts, to BS 6108/ISO 6489, pin (suitably hardened) and 50 mm eye fitting, for towing up to 8000 kg load. Vertical transfer load up to 3000 kg, Tow height 400 mm Category 2 Three-point hitch		
15. Miscellaneous Full front mounted and rear wheel Ballast weights Tool Kit (Specify) Operation, Workshop and Spare Parts Manuals Spares as per Specification 8.2 Steel Roll Over Protection Structure and sun/rain canopy to be fitted Full corrosion protection and finished in paintwork of Purchaser's colour choice Large rear view mirrors to be fitted to provide clear view of towed items Electrical, steering wheel mounted horn operation Fuses, circuit breakers or equal protection against damage of short circuits shall adequately protect all electrical circuits		
SUPPLIER/TENDERER'S SPECIFICATION MAKE: MODEL: COUNTRY OF ORIGIN :		

Supplier Company Stamp

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Date …….

SPARES FOR 52kW (70HP) TRACTOR

SUPPLIER/TENDERER'S SPECIFICATION MAKE: MODEL: COUNTRY OF ORIGIN :	

Supplier/Tenderer to list recommended initial spares inventory to be supplied with **each** tractor unit sufficient for 2 years or 2,000 hours operation, including consumable and service items.

PART DESCRIPTION	PART NUMBER	NUMBER TO BE SUPPLIED	UNIT PRICE	TOTAL PRICE

Supplier Company Stamp **Authorizing Signature**
Certifying Compliance

Date …….

TOWED GRADER (2 TONNE) **NO. REQUIRED: .....**

SPECIFICATION	RECOMMENDED	SUPPLIER/TENDERER OFFER
1. General Two axle, mechanical towed grader for maintenance of camber on earth or gravel roads, construction or maintenance of turn-out (mitre) drains. Complete with scarifier to loosen hard compacted material		
2. Towing Equipment Required (not supplied under this Specification item)	Wheeled agricultural tractor, 2 wheel drive, Min 52kW (70HP) SAE net	
3. Dimensions a) Overall Length b) Overall Width c) Height overall d) Wheelbase	 6375 mm 2260 mm (with blade stowed for travel) 2209 mm 4267 mm	
4. Construction Heavy duty, welded steel. Main frame of Rolled Steel Channels. Turntable on "A" frame with manual-mechanically operated height and sideshift control. Greased wear - adjustable ball and socket joint connection of "A" frame apex to main frame. Turntable lockable in range of positions. Rear mounted, manual-mechanically operated scarifier. Operator control platform behind and in full view of blade		
5. Weights a) Gross Weight b) On front axle b) On rear axle	 1880 kg 900 kg 980 kg	
6. Axle Front axle (swivel) – single channel section 203x76 mm Rear axle – box section 102x127 mm Heavy duty stub axles.		
7. Wheels Pressed steel rims.		
8. Tyres	750x16x8 PR	
9. Reflectors	Front and rear	
10. Drawbar & Towing Eye Towing drawbar with eye	 BS 5891 (1980) or ISO 5692 (1979) Inside hole dia. 50 mm	

TOWED GRADER (2 TONNE) (CONT)

SPECIFICATION	RECOMMENDED	SUPPLIER/TENDERER OFFER
11. Mouldboard length	2743mm (12')	
12. Mouldboard depth	406 mm nominal	
13. Mouldboard thickness	12.7 mm	
14. Mouldboard pitch	3 positions, manual adjustment	
15. Mouldboard positions	Side shift 2 left or right, 152 mm Blade positions 8 left or right Max blade reach outside rear wheel 838 mm Ground clearance stowed 381 mm Max blade inclination 25°	
16. Cutting depth	Max 114 mm	
17. Cutting Edges	Hardened steel and end overlays	
18. Controls on Grader	Left and right blade height adjustment operator wheels	
19. Safety	Heavy duty roll bar and overhead operator sun/rain protection	
20. Jacking Points	Near each end of axle and front of mainframe	
21. Scarifier Width of swath 463mm Ground clearance stowed 220 mm	Rear mounted manually operated with 3 No. replaceable tines and replaceable tips. Max Penetration 127 mm	
22. Hitch Option Towing eye attachment to be supplied for alternative single axle operation by removing the front axle and hitching the grader mainframe directly to the tractor (This significantly increases load transfer to the tractor rear axle and improves performance and versatility). Complete with 50mm internal diameter towing eye to BS5891 1980) or ISO 5692 (1979) or similar swivel barrel seating. Adjustable parking stand to be fitted to the front of the towed grader mainframe for 450mm towing height.		

TOWED GRADER (2 TONNE) (CONT)

SPECIFICATION	RECOMMENDED	SUPPLIER/TENDERER OFFER
23. Miscellaneous Spare wheel and lockable carrier mounted on body Tool Kit in lockable box (specify) Operation, Workshop and Spare Parts Manuals Spares as per Specification 9.2 Full corrosion protection, finish in yellow paintwork		
SUPPLIER/TENDERER'S SPECIFICATION MAKE: MODEL: COUNTRY OF ORIGIN :		

Supplier Company Stamp

Authorizing Signature
Certifying Compliance

Date …….

SPARES FOR TOWED GRADER (2 TONNE)

SUPPLIER/TENDERER'S SPECIFICATION MAKE: MODEL: COUNTRY OF ORIGIN :	

Supplier/Tenderer to list recommended initial spares inventory to be supplied with **each** towed grader unit sufficient for 2 years or 2,000 hours operation, including consumable and service items.

PART DESCRIPTION	PART NUMBER	NUMBER TO BE SUPPLIED	UNIT PRICE	TOTAL PRICE

Supplier Company Stamp **Authorizing Signature**
Certifying Compliance

Date …….

5 TONNE GENERAL PURPOSE TRAILER **NO. REQUIRED: .....**

SPECIFICATION	RECOMMENDED	SUPPLIER/TENDERER OFFER
1. General Heavy Duty, two axle, fixed/tipping body with drop sides and rear, suitable for building materials, gravel, stone and aggregate haulage on unpaved roads and manual/machine loading, 3 cubic metre and 5 tonne payload capacity.		
2. Dimensions a) Max Overall Length b) Max Overall Width c) Max height of body sides from ground d) Body struck capacity	 6000 mm 2500 mm 1500 mm Min 3.0m³	
3. Body and Chassis Heavy duty, welded steel fixed/tipping body on welded rolled steel section chassis. Body Floor Min. metal thickness 4.00 mm. Sides and Front Min. metal thickness 3.00 mm.		
4. Weights a) Gross Weight b) Design Payload Min.	 7000 kg (Max.) 5000 kg (excl body)	
5. Axles Beam mounted under chassis with stub axles welded in position. Front axle swivel. Heavy duty un-braked stub axles each 4000 kg Min. load rating		
6. Wheels Pressed steel rims.		
7. Tyres	1000 - 20, 14 PR or 1100 – 20, 16 PR	
8. Reflectors	Front and rear	
9. Drawbar & Towing Eye Towing drawbar with eye	 BS 5891 (1980) or ISO 5692 (1979) Inside hole dia. 50 mm	
10. Jacking Points	Near each end of axle and front of mainframe	

5 TONNE GENERAL PURPOSE TRAILER (CONT)

SPECIFICATION	RECOMMENDED	SUPPLIER/TENDERER OFFER
11. Miscellaneous Hand operated parking brake Drawbar of sufficient length to avoid fouling trailer body or fittings when towing tractor turns Spare wheel and lockable carrier mounted on front of body Tool Kit (specify) Operation, Workshop and Spare Parts Manuals Spares as per Specification 10.2 Full corrosion protection and finished in yellow paintwork		
SUPPLIER/TENDERER'S SPECIFICATION MAKE: MODEL: COUNTRY OF ORIGIN :		

Supplier Company Stamp

Authorizing Signature
Certifying Compliance

Date …….

SPARES FOR 5 TONNE GENERAL PURPOSE TRAILER

SUPPLIER/TENDERER'S SPECIFICATION MAKE: MODEL: COUNTRY OF ORIGIN :	

Supplier/Tenderer to list recommended initial spares inventory to be supplied with **each** trailer unit sufficient for 2 years or 2,000 hours operation, including consumable and service items.

PART DESCRIPTION	**PART NUMBER**	**NUMBER TO BE SUPPLIED**	**UNIT PRICE**	**TOTAL PRICE**

Supplier Company Stamp **Authorizing Signature**
Certifying Compliance

Date …….

5000 LITRE TOWED WATER BOWSER **NO. REQUIRED: .....**

SPECIFICATION	RECOMMENDED	SUPPLIER/TENDERER OFFER
1. General Heavy Duty, single axle, towed water bowser, suitable for haulage on unpaved roads, 4500 litre min. capacity		
2. Dimensions a) Max. Overall Length b) Max. Overall Width c) Max. height of body sides from ground d) Tank body capacity	 5250 mm 2500 mm 2000 mm 4500 litres min.	
3. Body and Chassis Heavy duty, welded steel tank body on welded rolled steel section chassis. Body base and sides Min. metal thickness 4.50 mm. Body top Min metal thickness 3.00 mm. Min 3 No. internal baffles to reduce slop. Filler/entry manhole in top 600 mm Min. diameter, hinged with butterfly nut or other quick release securing bolt(s), rubber seal		
4. Weights a) Gross Weight b) Design Payload Min c) At hitch (loaded)	 6500 kg (Max) 5000 kg (excl body) Min 500kg, Max 1000kg	
5. Portable pump	Portable 75 mm dia. Delivery hose and lockable mounting. Petrol/Diesel engine	
6. Axle Beam mounted under chassis with stub axles welded in position. Heavy duty stub axles each 5,000 kg Min load rating, fitted with 8 No. high tensile steel studs		
7. Wheels 8" (200mm) rims. Rated load Min 5,000kg		
8. Tyres	1000 - 20, 14 PR or 1100 – 20, 16 PR	
9. Reflectors	Front and rear	

5000 LITRE TOWED WATER BOWSER (CONT)

SPECIFICATION	RECOMMENDED	SUPPLIER/TENDERER OFFER
10. Towing Eye Heavy duty swivel hitch with towing eye, welded or bolted to chassis, fitted for 450 mm hitch towing height	BS 5891 (1980) or ISO 5692 (1979) Inside hole dia. 50 mm	
11. Parking Stand Adjustable heavy duty parking stand to allow hitch to vary 150 - 550 mm above ground level.		
12. Outlet & Spray bar 50 mm galvanised steel pipe gravity feed outlet fitted with heavy duty gate valve at rear. Removable coupling and spray bar 2500 - 3000 mm long with outlets at 150 mm centres		
13. Jacking Points	At each side of the bowser behind and near to axle	
14. Miscellaneous Hand operated parking brake Drawbar of sufficient length to avoid fouling trailer body or fittings when towing tractor turns Spare wheel and lockable carrier mounted on front of body Tool Kit (specify) Operation, Workshop and Spare Parts Manuals Spares as per Specification 11.2 Full corrosion protection and finished in yellow paintwork		
SUPPLIER/TENDERER'S SPECIFICATION MAKE: MODEL: COUNTRY OF ORIGIN :		

Supplier Company Stamp

Authorizing Signature
Certifying Compliance

SPARES FOR 5000 LITRE TOWED WATER BOWSER

SUPPLIER/TENDERER'S SPECIFICATION MAKE: MODEL: COUNTRY OF ORIGIN :	

Supplier/Tenderer to list recommended initial spares inventory to be supplied with **each** bowser unit sufficient for 2 years or 2,000 hours operation, including consumable and service items.

PART DESCRIPTION	PART NUMBER	NUMBER TO BE SUPPLIED	UNIT PRICE	TOTAL PRICE

Supplier Company Stamp **Authorizing Signature**
Certifying Compliance

Date …….

SPECIFICATIONS for items 12 – 17 are to be developed after consultations with specialist agricultural engineering experts.

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APPENDIX 1 – EQUIPMENT SUPPLIERS

1. INTRODUCTION

This appendix is not comprehensive. It lists the contact details for some of the suppliers and manufacturers of intermediate equipment for the road works sector. It is intended that this listing will be developed into a more comprehensive directory as suppliers provide details of their products to the author.

2. SINGLE & TWO AXLE TRACTORS

There are a large number of manufacturers and suppliers of these items internationally. Many countries have established local dealers. The addresses and contact details can be obtained by web search and consulting local directories.

3. SKID STEER EQUIPMENT

Brands available on the international market include:

- Bobcat
- Case
- Caterpillar
- GEHL
- JCB
- John Deere
- Volvo

4. INTERMEDIATE EQUIPMENT & TRACTOR ATTACHMENTS

a. Landmech
69 Harding Street Richmond
PO Box 771
Richmond 3780
KZN, South Africa
Tel: 0860 G-r-a-d-e-r or +27 (0)33 212 2332
E-mail: neil@landmech.co.za
Web: www.landmech.co.za

b. CMC Motors Group Ltd
Engineering Division
P O Box 43070-00100
Chepkerio Road, Off Lusaka Road, Industrial Area
Nairobi, Kenya
Tel: +254 20 6932244
Fax:+254 20 552463/650795
Mobile:+254 722 982773; +254 734 248464
Email: amakaa@cmcmotors.com
Web: www.cmcmotors.com

c. Arthur Garden
Attn. Walter W Mudzvova
Divisional Operations Manager
Starafricacorporation t/a Arthur Garden Engineering
Harare, Zimbabwe
Tel: +263 912745898
Tel: +263 4 755465-7
Email: wmudzvova@starafrica.co.zw
Web: www.starafricacorporation.com

APPENDIX 1 – EQUIPMENT SUPPLIERS

d. William Bain
35 Douglas Road
Workington, Harare, Zimbabwe
Tel : 04 -Switch Board 2911285-90/621081-8/664831/6633-4/662610, Implements- 2911029, Spares- 2911038, Marketing -2911877, Manufacturing -2911879, Purchasing -2911878/040, Finance- 2911876, General Manager - 2911033, Human Resources- 2911875
Fax 263-04-621089, 2911880
Cell 0912 377427
Web: www.bain.co.zw

e. Bell Equipment (Agents for Bomag Fayat)
Head Office: Richards Bay, KwaZulu Natal, SouthAfrica.
Tel: + 27(0) 35 907 9111 + 27(0) 35 907 9111
Fax: + 27(0) 35 797 4336
Email: sales@bellequipment.com
www.bellequipment.com/

f. Broons
2 Maritime Court, Gillman, 5013, South Australia, Australia
Tel: **(08) 8268 1988 (08) 8268 1988**
Fax: (08) 8268 1576
Email: info@broons.com
www.broons.com/

g. Dove Group of Companies
The Silom Galleria, Silom Road,
919/363, 29th Floor, Bangrak,
Bangkok 10500, Thailand
Tel: (+662) 630-1750 – 53, (+662) 630-3064
Fax: (+662) 630-3065
Email: sales@dovemining.com
www.dovemining.com/

h. JCB
J C Bamford Excavators Limited
Registered Office: Rocester Staffordshire
England ST14 5JP, United Kingdom
Email: jcb.internet@jcb.com
www.jcb.com/

i. Hasst Zimbabwe, formerly Tinto #
TH Zimbabwe Ltd
P O Box 661177
Kopje
Harare
Zimbabwe
Tel: +263 4 75-8650
Unable to confirm details to date

j. TBF Thompson
TBF Thompson (Garvagh) Ltd
6-10 Killyvalley Road
Garvagh
BT51 5JZ
UK
Tel: 028 2955 6201
Email: raymondc@tbfthompson.com
www.tbfthompson.com

k. Hebziba General Trading PLC
P O Box 16477
Addis Ababa
Ethiopia
Tel: 0114196064165
Mob: 0911207718
Email: milliontem@yahoo.com

5. AGRICULTURAL TRACTOR REFURBISHMENT

The following are examples of companies offering refurbished popular models of agricultural tractors.

a. **Dumelow International Limited**
Unit 7
Boundoak Industrial Estate
Eversley Road
Arborfield
Reading
RG2 9PN
UK
Tel: +44 (0) 118 9487000
Email: sales@dumelow.co.uk
www.dumelow.co.uk

b Howard & Sons Export Ltd
Manor Farm
Devizes
Wiltshire
SN10 5SQ
UK
Tel: +44 (0)1380 723986
Email: info@howardandsons.co.uk
www.howardandsons.co.uk

c John E Hitchings (Hereford) Limited
Rotherwas Industrial Estate
Hereford
HR2 6JR
UK
Tel: International:+44 (0)1432 272584
Email: hitchingsofhereford@msn.com
www.hitchingsofhereford.co.uk

APPENDIX 2 – THE COST OF LOSS OF STANDARDISATION

NOTE: This example is taken from a situation where it is proposed to expand an existing tractor fleet of 10 No. identical tractors to a total fleet of 20 No. tractors.

The two options are to procure a further 10 No. of the same standard models, or procure 10 'non standard' units of a different manufacturer/model.

The organisation handles its own spare parts storage, and tractor repair. The purchase price of the tractors is taken as £12,000.

	ITEM	ADDITIONAL INITIAL INVESTMENT		
		STANDARD MODELS	NON STANDARD MODELS	ADDITIONAL COST
		£ (STERLING)		
1	ADDITIONAL SPARE PARTS REQUIRED FOR STOCK TO MAINTAIN PRESENT LEVEL OF COVERAGE (BASED ON STOCK HOLDING OF 10% OF REPLACEMENT VALUE PER UNIT FOR 10 UNITS, AND 8% FOR 20 UNITS)	7,200	12,000	4,800
2	ADDITIONAL FLOOR SPACE, AND/OR RACKING AND BINS FOR PARTS STORE	400	2,000	1,600
3	ADDITIONAL SPECIAL TOOLS REQUIRED		1,600	1,600
4	ADDITIONAL TRAINING EXTERNAL – EXPENSES FOR 1 MECHANIC FOR 2 WEEKS INTERNAL – 20 MAN DAYS @ £10/MAN DAY		 400 200	 400 200
5	INCREASED STOCKING OF LUBRICATING OIL (3 X 45 GALLONS		400	400
TOTAL ADDITIONAL INVESTMENT REQUIRED IF NON STANDARD UNITS PURCHASED				**9,000**
(EXPRESSED AS % OF PURCHASE COST OF TRACTORS)				**7½%**
		ADDITIONAL 'ON-GOING' COSTS (P.A.)		
1	STOREMAN MADE UP TO FULL TIME ON STORES WORK (I.E. ADD 2 DAYS/WEEK)		1,000	1,000
2	ADDITIONAL COST OF PROCUREMENT (MORE SMALL ORDERS – LOSS OF DISCOUNTS, INCREASED COSTS OF CARRIAGE) ESTIMATED AT 5% OF SPARES COSTS (£20,000 P.A.)		1,000	1,000
TOTAL ADDITIONAL 'ON-GOING' COSTS (P.A.)				**2,000**

SOURCE: Developed from *'The Specification of Agricultural Machinery for use in Developing Countries, A. A. Metianu, Silsoe, for ODA, 1979'.*