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assessment of logging costs from forest inventories in the tropics

2. data collection and calculations

forest resources division
forestry industries division
forestry department

with the assistance of the
swedish international development authority

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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PART TWO

CHAPTER 4

DATA BASE

All data are provided and readily processed prior to initiating the pre-calculations for the cost assessment. The data coding is recommended to be strictly adhered to and the data presented in tables as shown, in order to facilitate the numerous references required in the course of the subsequent calculations. The coding is independent of the one used for the manual itself, and identified by the symbol "DB" (Data Base) preceding the code number.

INDEX TO DATA BASE

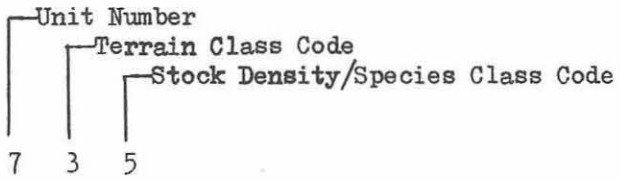
DB 1. AREA MAPS

DB 1

The basic map should preferably be a topographic map in scale 1:50 000 with contour lines at intervals of 20 m but otherwise as available. The map must cover the total assessment area and adjacent areas as required to locate delivery points and to evaluate the access to the area.

Based on the basic map, copies should be made in the form of skeleton maps which just show the exterior and the interior borderlines, the main rivers, major terrain features such as mountain ridges and massifs, lakes, permanent swamps etc. The skeleton maps should then be utilized for drawing specialized maps, especially the road map, with indications of optional/finally selected delivery point(s) and entry points, identified deposits of road materials (laterite, gravel, rock etc), existing major bridges and in general all information relevant to the exploitation.

Assessment units should be numbered and coded as follows:



DB 2. AREA SUMMARY

DB 2

ASSESSMENT UNIT	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	EXPLOITABLE FOREST AREA			NON-EXPLOITABLE AREAS					TOTAL ASSESS. AREA
	TOTAL 1/	Dry-land Forest	Swamp Forest	TOTAL	Other Wooded Areas	Non Forest Area	Water Areas	Inaccessible Areas	
OWN CODE:	2.1	2.1.1.	2.1.2	2.2	2.2.1	2.2.2	2.2.3	2.2.4	2.3
No. Terrain Code Stock Code	ha	ha	ha	ha	ha	ha	ha	ha	ha
TOTAL:									

1/ total productive area

DB 3. OVERALL DESCRIPTIVE DATA

DB 3

The purpose of the overall descriptive data is:

(i) to locate the area geographically in specific and exact terms;

(ii) broadly to classify the area in respect of the practical aspects of exploitation, in order to guide on the estimation of:

(a) optimal exploitation pattern, operational sequences and exploitation techniques;

(b) feasible operational periods within the year;

(c) general conditions for operational performance.

3.1 GEOGRAPHICAL DATA

DB 3.1

3.1.1 Continent:
3.1.2 Country:
3.1.3 Region/province:

	Longitude(s)		Latitude(s)
3.1.4 Location:	Extreme minimum	Extreme maximum	Dominating

3.1.5 Altitudes:
3.1.6 Zone (Coastal; inland):

3.2 TOPOGRAPHIC DATA

DB 3.2

3.2.1 Major land form: e.g. flat to gently rolling; undulating to hilly; mountainous.
3.2.2 Elevation: e.g. lowland; on lowland plateau on major slope; on mountain plateau.
3.2.3 Surface: e.g. smooth; dissected.

3.2.4 Mountain ridges or massifs: describe in general terms, but with view to indicating necessity for and possibilities of crossing or bypassing with artery roads; indicate areal extent and other characteristics.

3.2.5 Valleys: describe in general terms, but with specific view to indicating optimal location of artery road net; indicate width, steepness of bordering slopes.

3.2.6 River system: describe in general terms but with specific view to indicating feasibility and implications of (a) bridge constructions and (b) navigation. Indicate accessibility from adjacent areas (condition of banks), presence and magnitude of rapids, practicability of (i) floating (ii) rafting (iii) navigation by tug-boat (iv) navigation by larger vessels; inundation pattern, especially seasonal floods. Endeavour more precise indications of: length (within and outside the area), width, depth. Indicate flow speed (turbulent; swift; easy-flowing), general stream

pattern (sharply bending; gently winding; straight), daily and seasonal variations in level; state points of off-spring and termination.

3.2.7 Creek pattern: describe in general terms, but with specific view to indicating possible impeding impact on cross-country traffic and road constructions.

3.2.8 Swamps: describe in general terms, but with specific view to indicating (a) conditions for extraction and (b) influence on artery road net. Indicate nature (tidal swamp; permanently wet; seasonally dry); areal extent; shape; location; necessity and possibility of crossing or bypassing by roads.

3.2.9 Major terrain obstacles: describe in general terms, but with specific view to indicating possible impeding impact on exploitation operations, specifically road constructions. Indicate areal extent and location. Obstacles may be scattered major rock outcrops, isolated mountain peaks, lakes, etc.

3.3 SOIL DATA 1/

DB 3.3

3.3.1 Geological origin:

3.3.2 Dominating soil type(s):

3.3.3 Erosion susceptibility: describe in general terms, however, with specific view to indicating possible adverse impact on road constructions; identify and locate areas of high susceptibility.

3.3.4 Drainage ability: describe in general terms, however, with specific view to indicating the surface condition before and after rain and at different seasons.

3.3.5 Mud-forming susceptibility: endeavour to indicate to what extent seasonal formation of mud can be suspected to impede operation (a) in the terrain and (b) on the roads.

3.4 CLIMATIC DATA

DB 3.4

Code	Particulars	January	February	...	December	The year
3.4.1	Precipitation (rain only)					
3.4.1.1	Quantity (mm)					
3.4.1.2	No. of rainy days (no.)					
3.4.1.3	No. of rainy hours (no.)					
3.4.1.4	Average no. of rainy hours per rainy day (no.)					
3.4.1.5	Average quantity per rainy day (mm)					
3.4.1.6	Average quantity per rainy hour (mm)					

3.4.1.7 Rain pattern: endeavour to describe the rain pattern and give indications of the time when dominating rainfall occurs (morning; midday; throughout day/night, etc.); indicate seasonal differences.

1/ The data recorded here are overall, prevailing or dominating in general in the whole assessment area or - if more appropriate - in major geographical area units which may be distinguished.

Code	Particulars	January	February	...	December	The year
3.4.2	Temperature					
3.4.2.1	Day: min. (C°)					
3.4.2.2	max. (C°)					
3.4.2.3	mean (C°)					
3.4.2.4	Night min. (C°)					
3.4.2.5	max. (C°)					
3.4.2.6	mean (C°)					
3.4.3	Relative Humidity					
3.4.3.1	Average max. (%)					
3.4.3.2	Average min. (%)					
3.4.3.3	Average mean (%)					
3.4.4	Insolation					
3.4.4.1	No. of days with sunshine (no.)					
3.4.4.2	No. of hours with sunshine (no.)					
3.4.4.3	No. of sunshine hours per sunshine day (no.)					
3.4.4.4	Hour of sunrise (hour)					
3.4.5	Wind Velocity					
3.4.5.1	Average velocity (m/sec.)					

3.4.6 Seasonal pattern: describe in general terms, but specify distinct seasons by months as determined by local custom; specify seasonal wind pattern (monsoon, hamatan etc.) and indicate periods of regularly occurring storm hazards. If off-coast log loading can be considered, state period(s) of feasibility.

3.5 FOREST DATA

DB 3.5

3.5.1 Composition: e.g. coniferous; mixed coniferous and broad-leaved; broad-leaved deciduous; broad-leaved evergreen (or semi deciduous).

3.5.2 Species heterogenity: e.g. one to few species only; less than 15 species dominating; extreme species mix. Indicate number of species.

3.5.3 Stocking: e.g. well stocked and dense forest with closed canopy; moderately stocked and rather open forest; poorly stocked very open forest; scattered trees or groups of trees.

3.5.4 Structure: e.g. single-storeyed; multi-storeyed.

3.5.5 Degradation: e.g. primary forest; previously selectively exploited; secondary growth.

3.5.6 Future land-use: e.g. managed forest; unmanaged forest; transformed to plantation or agricultural land.

3.5.7 Shifting cultivation: e.g. non-existent; sporadic; severe.

DB 4. SPECIFIC EXPLOITATION DATA

DB 4

4.1 FELLING STIPULATIONS

DB 4.1

The felling stipulations must contain all pertinent information in sufficient details as to identify exactly which species and dimensions are to be included as "Exploitable Stock".

4.2 SPECIES DISTRIBUTION: EXPLOITABLE STOCK

DB 4.2

ASSESSMENT UNIT:				
SPECIES/SPECIES GROUP			EXPLOITABLE STOCK	
BOTANICAL NAME	VERN./COMMERCIAL NAME	SPECIES CODE	TREES PER HA	VOLUME PER HA
			4.2.1	4.2.2
			(nos)	(m^3)

4.3 INVENTORY DATA: EXPLOITABLE STOCK

DB 4.3

ASSESSMENT UNIT			Trees per ha	Volume per ha	Volume per tree	Mean DBH	Mean height
OWN CODE:			4.3.1	4.3.2	4.3.3	4.3.4	4.3.5
No.	Terrain Code	Stock Code	(nos)	(m^3)	(m^3)	(cm)	(m)

4.4 UTILIZATION RATIOS

DB 4.4

SPECIES/SPP. GROUP	(1) Felling Ratios: Trees Fell. / Trees Expl. (trees)	(2) Felling Ratios: Fell. Stock / Exploit.Stock (volume)	(3) Extraction Ratios: Trees Extr. / Trees Fell. (trees)	(4) Extraction Ratios: Extract Vol. / Felled Stock (volume)	(5) Yield Ratio: Net Yield / Extr. Vol. (volume)	(6) Log Ratios: Logs Extract / Trees Extr. (logs)	(7) Log Ratios: Logs Deliv. / Logs Extr. (logs)	(8) Felling Time Adjustment Coefficient: reciprocal of (4.4.3)	(9) Cost/Volume Adjustment Coefficient: reciprocal of (4.4.5)
OWN CODE:	4.4.1	4.4.2	4.4.3	4.4.4	4.4.5	4.4.6	4.4.7	4.4.8*	4.4.9*

* Input parameter (i.e. used as input in production and/or economic formulae)

4.5 STAND, TREE AND LOG DATA I : FELLED

DB 4.5

ASSESSMENT UNIT	(1) Trees per ha	(2) Volume per ha	(3) Volume per tree	(4) Mean DBH	(5) Mean height
OWN CODE:	4.5.1*	4.5.2	4.5.3	4.5.4*	4.5.5
No Terrain Code Stock Code	(nos)	(m^3)	(m^3)	(cm)	(m)

* Input parameter (see DB 4.4)

4.6 STAND, TREE AND LOG DATA II : EXTRACTED/FELLING YIELD

DB 4.6

ASSESSMENT UNIT	(1) Trees per ha	(2) Volume per ha	(3) Volume per tree	(4) Logs per tree	(5) Logs per ha	(6) Volume per log	(7) Mean Diameter (log)	(8) Mean Length (log)
OWN CODE:	4.6.1*	4.6.2*	4.6.3*	4.6.4*	4.6.5*	4.6.6*	4.6.7*	4.6.8*
No. Terrain Code Stock Code	(nos)	(m^3)	(m^3)	(nos)	(nos)	(m^3)	(cm)	(m)

* Input parameter (see DB 4.4)

4.7 STAND, TREE AND LOG DATA III : DELIVERED/NET YIELD

DB 4.7

ASSESSMENT UNIT	Logs per Log (Extr.)	Volume per Log	Mean Diameter (log)	Mean Length (log)
OWN CODE:	4.7.1*	4.7.2*	4.7.3*	4.7.4*
No. Terrain Code Stock Code	(nos)	(m^3)	(cm)	(m)

* Input parameter (see DB 4.4)

DB 4.8

4.8 CONDITIONING FACTOR VALUES

ASSESSMENT UNIT	Tree Factors		Terrain/Soil Factors			
	Buttress-ness	De-Barking Requirem.	Under Brush	Surface Evenness	Surface Obstacles	Soil Firmness
OWN CODE:	4.8.1	4.8.2	4.8.3	4.8.4	4.8.5	4.8.6
No. Terrain Code Stock Code						

4.9 ROAD, TRANSPORT AND ACCESS DATA

DB 4.9

4.9.1 Delivery point(s):

Describe in general terms to which destinations the logs from the exploitation may be delivered, i.e. existing sawmills or veneer plants in the region, existing consumer centres, railway points, existing export harbours etc.

If no obvious indications can be obtained, for instance, if the exploitation is planned in an entirely undeveloped region, endeavour to envisage where a sawmill could be established as an integrated unit with the exploitation and/or to where logs would most likely be delivered for long distance transport (e.g. at a point on a main river). Mark the optional delivery points on a map. Use "A" as the code for delivery points, further qualifying optional points by "A_1", "A_2", etc.

4.9.2 Entry point(s):

For each existing (or envisaged) access road, an entry point on the borderline of the assessment area can be determined; more than one route may reach the border in the same point.

Mark the optional entry points on the map using the code ENT or - if several options can be envisaged - ENT_1, ENT_2, etc: at the same time, mark the corresponding transport routes on the map.

4.9.3 Access:

Describe in general terms the possibility of, and conditions for, establishing transport connection between each delivery point and the corresponding entry point.

If roads exist, the solution may be obvious, otherwise optional road sites may be envisaged. In many cases roads will exist around and through the delivery points but a connecting link to the assessment area may be missing.

In developing regions, endeavour to obtain information on possibly contemplated public or private road extensions.

If additional road constructions are required, endeavour to record pertinent observations on the adjacent areas relevant to road constructions which do not obviously appear from the map.

4.9.4 External roads (existing):

4.9.4.1 Ownership: Record the pertinent ownership of the road (or road section) distinguishing between (a) public and (b) other (e.g. another existing exploitation). Mark and code terminal points of road sections of different ownership on the map.

4.9.4.2 Condition: Describe in general terms the condition of the road - sectionwise, as required - referring to markings on the map. Note especially seasonal changes and the carrying capacity of existing bridges.

4.9.4.3 Present use: Indicate the intensity and type of traffic on the road.

4.9.4.4 Potential use: (in relation to the exploitation): Indicate possible restrictions on the use of the road (e.g. road taxes, weight restrictions). If private ownership applies, endeavour to indicate the possibility for and implication of a joint utilization of the road, for instance on a cost-sharing basis.

4.9.5 Costs:

If feasible, obtain as comprehensive construction cost indications as possible from (a) public road departments, (b) road construction entrepreneurs and/or (c) existing enterprises operating private roads in the region. Endeavour to obtain the same information in respect of bridge constructions.

4.9.6 Internal Roads (existing):

4.9.6.1 Ownership: (as DB 4.9.4.1)

4.9.6.2 Condition: (as DB 4.9.4.2)

4.9.6.3 Present Use: (as DB 4.9.4.3)

4.9.6.4 Potential Use: (as DB 4.9.4.4)

4.9.7 Road materials:

The information to be obtained and supplied serves the purpose of estimating (a) the availability and (b) the cost of suitable road materials for own road construction and maintenance. In general, notice should be taken and observations recorded, as to the presence of such materials whether commonly occurring - e.g., the subsoil consisting of laterite - or concentrated in deposits - e.g. shoals of laterite, riverbeds with stone (larger stones; fist-sized stones; smaller stones; gravel; coarse sand etc.), rock outcrops, apparently suitable for establishment of quarries, accessible coral amassments, etc.

4.9.7.1 Duties or Royalties per m^3: if applicable.

4.9.7.2 Outside supplies: If suitable road materials are found to be scarce, endeavour to obtain information on possibility for and cost implications of obtaining supplies from outside, possibly delivered by contractors.

DB 5. ECONOMIC AND SOCIO-ECONOMIC DATA

Where operating enterprises exist, endeavours should be made to obtain most economic data as practically experienced average figures from such enterprises. Support the recorded observations by attaching copies of possibly existing official labour laws, regulations, etc. In case of extreme underdevelopment, endeavour to obtain relevant indications from other regions of the country, possibly other countries.

5.1 CURRENCY

i.e. the national currency, which is to be used in the economic calculation.

5.2 RATE OF EXCHANGE

i.e. the rate of exchange to US$, however, where the economy of the region is closely dependant on any other foreign currency, also state such rate of exchange.

5.3 RATE OF INTEREST

i.e. the rate(s) applicable to outside financing whether financing is required or not.

5.4 RATE OF INSURANCE

Specify in brief terms the various insurance types generally applicable or available (labourer insurance, accident insurance, insurance of machinery etc.). State the different charges in percent of the amount on which the insurance is based.

5.5 TAXATION

Specify and quantify the various taxations applicable:

5.5.1 Area fees
5.5.2 Stumpage fees
5.5.3 Other taxations related to the exploitation.

5.6 EQUIPMENT AND MATERIALS

The aim should be to supply adequate information for the calculation of the total cost of various units of equipment and materials, delivered to an assembly point in the immediate vicinity of the assessment area:

5.6.1 Acquisition cost
5.6.2 Important duties (if not included in the acquisition cost)
5.6.3 Cost of insurance of the equipment (materials) in transit or during transport.
5.6.4 All handling and transport charges from point of acquisition to point of assembly.

The cost indications should refer to the equipment (material) actually required, but must - if actual requirements are not specified - at least comprise:

Approx.	3.5 HP [1]	Powersaw
"	175 HP	Wheeled Skidder
"	175 HP	Crawler Tractor
"	225 HP	Truck with pole-trailer
"	200 HP	Front-end Loader

Diesel Fuel
Gasoline
Complete set of tyres for Wheeled Skidder
Complete set of tyres for Truck and Trailer

The cost of the off-road transport equipment must include the necessary logging accessories, i.e. towing winch, dozer blade and canopy. Cost of fuel must include cost of possibly required transport containers and storage expenses.

5.7 LABOUR TIME AND COST

The aim should be to supply adequate information for the calculation of total labour costs per effective working hour for the various categories of labourers:

Powersaw operator
Skidder operator
Crawler operator
Loader operator
Truck driver
Labourer Foreman
Workshop Mechanic
Ordinary Labourer (semi-skilled)

The following information is required:

5.7.1 Time:

5.7.1.1 Yearly operational time: i.e. the number of months per year and number of days per month when operations are feasible. Normally all operations are carried out, respectively stopped during the same period, but exceptions are frequent (e.g. river transport in periods when mechanical transport is not feasible). The number of days worked per month may be - and usually is - different in different periods, owing to climatic changes. Sundays may be worked as an established routine during the most favourable period.

1/ Although it has been agreed internationally to use kW (kilowatt) as power unit, HP is used in this manual for the sake of convenience.

5.7.1.2 Daily working hours: i.e. the hours per day when the labourer is at the disposal of the enterprise (paid time). In some cases labour laws stipulate a number of hours per day (or per week), otherwise the number of hours may be determined on the basis of local customs. The time includes time for transport and regular meal breaks, but possibly reduced efficiency owing to climatic (seasonal) differences is to be disregarded.

5.7.1.3 Down-time: i.e. especially the estimated time for transport to and from the working site and regular rest time (meal break).

5.7.1.4 Annual leave time: i.e. the time per year when the labourer is paid during non-working periods. It may be stipulated by labour laws as a fixed number of days per month worked.

5.7.1.5 Compulsory holidays: state the number of compulsory (customary) holidays per year. State if wage payment is compulsory (customary) on certain (all) holidays.

5.7.2 Cost:

5.7.2.1 Basic wage: i.e. the basic pay in respect of rendered working time. Labour laws may stipulate monthly, weekly or daily rates (rarely hourly rates).

5.7.2.2 Leave pay: indicate applicable regulations in respect of payment during authorized leave.

5.7.2.3 Overtime pay, etc: specify regulations related to overtime work and work on Sundays/ holidays and the appropriate rates per day or hour.

5.7.2.4 Other direct payments: indicate other direct payments which may possibly apply, such as food allowance, yearly bonus, etc. Specify the applicable rates in such a way as to enable the calculation of the cost as a percentage of the basic wage.

5.7.2.5 Indirect payments: indicate indirect payments which may possibly apply, such as medical services, housing facilities, labourer insurances, pension and provident fund schemes etc. Endeavour to specify relevant costs, however, this may prove extremely complicated, especially when information is not obtainable from operating enterprises, in which case make special notice of facilities which are not readily available or may not apply: e.g. no public hospital in the region, or: labourers to be accommodated in own houses etc.

5.8 LABOURER CONDITIONS

Describe in brief terms the feasibility of recruiting local labourers indicating the general level of skill. Also the overall state of development of the region relevant to labour problems e.g. whether labour laws are existing etc.

5.9 MISCELLANEOUS OBSERVATIONS

Describe in brief terms the general conditions of the region relevant to the operations of a forest enterprise such as the availability and location of outside workshop facilities, supplies of materials, spare parts, fuel etc. If not available within the region, indicate where available (possibly only outside the country, e.g. factory service of heavy equipment).

CHAPTER 5

PRECALCULATIONS

This chapter provides guidelines and predesigned tables. When options are possible (e.g. skidder or crawler), both possibilities should be calculated enabling an indication of the most advantageous choice. All derived data are coded, the code number being preceded by "PC".

The indicated "Reference (Code)" refers to either the Data Base or to other Precalculations. The calculation method is in each case indicated in the heading of the table or in the "remarks" following each table.

INDEX TO PRECALCULATIONS

PC 13 ROAD HAULING DISTANCES
PC 14 PRODUCTION (PERFORMANCE) CALCULATIONS
14.1 STUMP OPERATION (POWERSAW)
14.2 OFF-ROAD TRANSPORT OPERATION
14.3 LANDING
14.4 LOADING
14.5 MAIN TRANSPORT (TRUCK HAULING)

1. EXPLOITATION PATTERN (PRODUCTION FLOW) AND OPERATIONAL TECHNIQUES

PC 1

1.1 Determination of Delivery Points and Access Routes

Consider all relevant information supplied in the data base and study the map carefully. Endeavour to determine the most likely final destinations of the logs. These may for instance be an existing port, say 600 km from the area and a sawmill located in a main rown of the region, say 60 km from the area.

Assuming that a road to the town site passes 10 km from the area and the adjacent area is not excessively rugged, an obvious solution for deliveries to the sawmill may be truck hauling directly to the mill site. The delivery point is then the sawmill site.

Furthermore, assuming that no truck road or railway exists which leads to the export harbour, but a major river terminating at the harbour actually crosses the town road, say 20 km beyond the town. An abvious solution may then be to deliver logs for export to the cross-point between the river and the town road, which will then be the second delivery point (the assessment does not include a possible long-distance transport).

It may, however, also be that an obvious solution appears to be truck hauling of all logs to a river point inside the area from where all logs are floated to a town, partly to be delivered to a sawmill there, partly to be reforwarded by an existing railway to an export harbour.

In that case, the outlined assessment still only permits calculations to the river point, but if floating can be envisaged to be an integrated operation of the exploitation, a separate calculation of the river transport must be carried out. Substantially more specific data as well as specialized expertise are then required, which the outline of the manual at this stage does not consider, but in principle a calculation can of course be made along the same general lines as the other operational cost assessment.

In any event, for a particular assessment a transport pattern must be selected and the corresponding delivery points and access routes determined.

1.2 Determination of Exploitation Pattern and Operational Techniques

Concerning the techniques a decision is also required. The outlined assessment does only consider those which in the large majority of cases will be obvious options when rational exploitation methods should be adhered to, viz. felling and cross cutting by power-saw, off-road transport either by crawler or skidder or the two in coordination and truck hauling. If other techniques have to be considered, for instance elephant extraction, a

special calculation must be made, but - as mentioned above in connection with river transport - very specialized expertise is then required and other pertinent data must be collected which the present guidelines do not consider. Likewise, should cable yarding prove necessary, for instance because the terrain is mountainous, the present outline is also in this case not applicable, as only ground skidding topography is actually considered. However, cable yarding should only be contemplated when ground skidding, even by crawler, is entirely ruled out, and in that case quite different conditions, for instance for road constructions, would also apply. The overall cost assessment would in such cases require quite different guidelines than provided here.

As far as ground skidding is concerned, usually both skidder and crawler can be considered, as in many cases the conditions are neither obvious for skidder nor for crawler extraction. In such cases both possibilities should be calculated.

Rough guidelines in selecting off-road transport techniques are:

Terrain Class	Skidder	Crawler
1	optimum	suitable
2	suitable	suitable possibly optimum
3	doubtful	suitable
4	not feasible	doubtful

175 HP skidders and crawlers, and pole-trailer trucks capable of carrying a payload of 25 - 30 tons, are considered standard equipment. Other weight classes of equipment may be considered simply by altering the indicated load capacities.

The result of considerations made as indicated above should be recapitulated in (a) a fixed exploitation pattern and (b) determined techniques. In both cases, alternative possibilities might be assessed.

2. EXPLOITATION INTENSITY - ANNUAL AND TOTAL PRODUCTION/ANNUAL FELLING AREA - DURATION OF EXPLOITATION

PC 2

ASSESSMENT UNIT	(1) Product. Area	(2) Volume per ha (Felled)	(3) Volume per ha (Extract)	(4) Yield Ratio	(5) Volume per ha (net yield)	(6) Total Volumes Felled	(7) Total Volumes Extract.	(8) Total Volumes Net Yield
REFERENCE (CODE)	DB 2.1	DB 4.5.2	DB 4.6.2	DB 4.4.5	(3)x(4)	(1)x(2)	(1)x(3)	(1)x(5)
No. Terrain Code Stock Code	(ha)	(m^3)	(m^3)		(m^3)	(m^3)	(m^3)	(m^3)
TOTAL (or Weighted Average)								
CODES:	PC 2.1				PC 2.2		PC 2.3	

Evaluating the total volume figures, foreseen capital availability, general marketing conditions etc. decide on an annual production capacity and recapitulate as follows:

Annual Volumes			Total Exploit. Period	Annual Felling Area		
Felled	Extracted	Net Yield		Maximum	Minimum	Average
(m^3)	(m^3)	(m^3)	years	(ha)	(ha)	(ha)

3. YIELD DISTRIBUTION TO DESTINATIONS

PC 3

Usually two main categories of logs will be produced, export logs and logs for local consumption. For the purpose of calculating the marketing and sales aspects the distinction is obviously required but in order to calculate logging costs the criterion is the possibly different delivery points of the two (or more) log categories.

Based on the indications from the data base in respect of distribution of the net yield to log categories and the decision on delivery points, as made in PC 1 recapitulate as follows:

ASSESSMENT UNIT	(1)	(2)	(3)	(4)	(5)	(6)
	Percentage (in decimals) of Net Yield Despatched to					
	A1	A2	A3	A4	A5	A6
No. Terrain Code Stock Code						

4. OVERALL CONDITIONING FACTORS

PC 4

Based on an overall evaluation of the data provided in the data base and the determined exploitation pattern and intensity, endeavour to estimate the following overall conditioning factors, segregating only in:

average, i.e. a condition which is not adverse, keeping in mind that conditions for tropical forest exploitations are rarely easy or favourable.

adverse, i.e. excessively adverse conditions.

4.1 Strain on Equipment

PC 4.1

Besides overall prevailing terrain and climatical conditions, also consider how remote the area is from social centres and how well long-distance communications are developed. Whether access to outside workshop facilities is easy or not. Whether supplies of spares, tyres, fuel, etc., will be readily available. Whether the contemplated exploitation will be large-scale and, therefore, likely to overcome possible adverse conditions in such respects. Whether the envisaged level of labour skill - especially in respect of handling heavy equipment - is high.

Based on such considerations, endeavour to evaluate whether the equipment will be rationally and efficiently maintained and utilized ("average") or likely to be more strained than usual, even under tropical conditions ("adverse").

4.2 General Organization

PC 4.2

Based on similar broad considerations, endeavour to evaluate whether the operations will be efficiently carried out, for instance that labour housing, medical facilities, transport of labourers, etc., will be adequately provided and supervision well organized ("average") or the general operational efficiency can be expected to be somewhat lagging due, for instance, to small-scale operation ("adverse").

4.3 Strain on Labourers

PC 4.3

Consider especially the climatic factors and information on the general health condition and physical ability of the labourers. Endeavour to evaluate whether the labour force will perform reasonably efficiently ("average") or the general working capacity might be expected to be somewhat reduced ("adverse").

5. LABOUR TIME AND TIME COSTS

PC 5

5.1 Man/Crew Cost per Work Day

PC 5.1

LABOURER/CREW CATEGORY	(1) Basic Wage	(2) Leave Pay	(3) Other Direct Payments	(4) Indirect Payments	(5) Total Fringe Benefits	(6) Total Cost per 12 months	(7) Man Cost per Work Day	(8) Crew Cost per Work Day
REFERENCE (CODE)	DB 5.7.2.1	DB 5.7.2.2	DB 5.7.2.4	DB 5.7.2.5	(2)+(3)+(4)	-	-	-
	currency	←——as fractions of (1)——→				currency	currency	currency
Operator - Power Saw								
" - Skidder								
" - Crawler								
" - Loader								
Truck Driver								
Labourer Foreman								n.a.*
Workshop Mechanic								n.a.*
Labourer								n.a.*

*not applicable

CODES: PC 5.1.1 PC 5.1.2

Remarks:

(1): extract the pertinent data from the data base and assume that 12 months active service is rendered and accordingly paid for. If wage data are provided as a daily rate, consider the year to contain 310 paid days. Insert the calculated yearly basic wage cost in (1).

(6): calculate by multiplying (1) by [(5) + 1,00]

(7): calculate by dividing (6) by 250 1/, thus assuming that 250 effective man days are rendered per 12 months' paid service.

(8): calculate by multiplying (7) by 1.65, thus assuming that cost of mate/assistant to an operator amounts to 65% of cost of operator.

1/ 250 should be considered as an average, the actual figure in a given case may be somewhere between 200 and 300.

If wages data are provided, including all fringe benefits, insert directly in (6), omitting preceding calculations.

If data pertaining to (2), (3) and (4) are not adequately provided, consider (5) to be:

0.75 when labour regulations are effective or exploitation is large-scale.

0.35 when labour regulations are relaxed or exploitation is small-scale.

5.2 Effective Labourer/Crew Hours per Work Day - Labourer/Crew Cost per Effective Labourer/Crew Hour

PC 5.2

(1) Complete the following table:

OPERATION LABOURER/CREW CATEGORY	(1) Crew Cost per Work Day	(2) Work Hours (effect.) per Work Day	(3) Crew Cost per Crew Hour (effect.)
REFERENCE (CODE)	PC 5.1.1 PC 5.1.2 currency	-	(1):(2) currency
Stump Operation-Power Saw			
Off-Road Transport-Skidder			
-Crawler			
Landing - Cross Cutting	1/		
- Debarking	2/		
- Log Protection	2/		
- Scaling	3/		
Loading - Loader			
Main Transport - Truck		4/	
	CODES:	PC 5.2.1	PC 5.2.2

1/ As Stump Operation

2/ One Labourer

3/ One Foreman + Two Labourers

4/ i.e. Total Roundtrip Time per Work Day

Remarks:

(2): evaluate all data provided in the data base, relevant to working time. The data might possibly be rendered as practically experienced average values but if not, endeavour to estimate by considering total daily duty hours ("camp-to-camp") and likely time for transport, recalling that the effective crew time is the number of hours the crew is actively engaged on work performance excluding non-productive time (e.g. transport to and from work site, regular rest time), but including time for auxiliary duties(e.g. servicing of the machine).

There will invariably be substantial variations in transport distances from camp to site from year to year, however, the extremes are usually eliminated by the camp being shifted and/or through improved transport facilities. Endeavour to estimate only one average value for each operation, applicable to the entire assessment area. For general guidance and in case adequate data are not provided, practical indications are:

	Conditioning Factor PC 4.2	
	Average	Adverse
OPERATION	Effective hours per day	
Operations on the terrain	6	4
Landing	7	5
Truck Hauling	8 1/	7 1/

1/ i.e. total daily roundtrip time. Crew transport will usually be part of the roundtrip travel, and servicing, meal breaks etc., included in standing time.

6. MACHINE COST

PC 6

6.1 Machine Cost per Productive Machine Hour - POWERSAW

PC 6.1

(1)	(2)	(3)	(4)
Cost per Productive Machine Hour			
Depreciation	Fuel, Oil Lubricants	Repairs and Maintenance	Total Machine Cost
DB 5.6 Powersaw	DB 5.6 Gasoline	-	(1)+(2)+(3)
currency	currency	currency	currency

CODE PC 6.1

Remarks:

(1): total depreciation equals delivered cost; calculate depreciation per hour by dividing delivered cost by 800 hours.

(2): calculate: cost of gasoline per litre x 0.95.

(3): calculate: delivered cost x 0.75.

6.2 Machine Cost per Productive Machine Hour - SKIDDER

PC 6.2

Cost per Productive Machine Hour						
(1) Depreciation	(2) Interest	(3) Insurance Tax, etc.	(4) Tyres	(5) Repairs and Mainten.	(6) Fuel Lubricant Oil	(7) Total Machine Cost
DB 5.6 (Skidder)	DB 5.3	DB 5.4 DB 5.5	DB 5.6	DB 5.6 (Skidder)	DB 5.6 (Diesel)	(1)+(2)+(3)+(4)+(5)+(6)
currency	currency	currency	currency	currency	currency	currency

CODE: PC 6.2

Remarks:

(1): calculate by multiplying delivered cost less tyres by 0.90 thereafter dividing by:

8 000 hours if PC 4.1 is "average"
6 000 hours if PC 4.1 is "adverse"

(2): calculate by multiplying delivered cost less tyres by 0.60 and by rate of interest, expressed in decimals, thereafter dividing by:

2 000 hours if PC 4.1 is "average"
1 500 hours if PC 4.1 is "adverse"

(3): calculate by multiplying delivered cost less tyres by total rate of insurance, tax, etc., expressed in decimals, thereafter dividing by:

2 000 hours if PC 4.1 is "average"
1 500 hours if PC 4.1 is "adverse"

(4): calculate by dividing delivered cost of complete set of tyres by:

2 000 hours if PC 4.1 is "average"
1 500 hours if PC 4.1 is "adverse"

(5): calculate by multiplying delivered cost less tyres expressed in thousands of currency by: 1/

0.125 if PC 4.1 is "average"
0.167 if PC 4.1 is "adverse"

(6): calculate by multiplying cost of diesel oil per litre by 21.0 and add 0.35.

1/ assuming that the total cost of repairs and maintenance over the whole life of the machine is equal to the delivered cost less tyres.

PC 6.3

6.3 Machine Cost per Productive Machine Hour - CRAWLER

Cost per Productive Machine Hour					
(1) Depreciation	(2) Interest	(3) Insurance Tax, etc.	(4) Repairs and Mainten.	(5) Fuel Lubricant Oil	(6) Total Machine Cost
DB 5.6 (Crawler)	DB 5.3	DB 5.4 DB 5.5	DB 5.6	DB 5.6 (Diesel)	(1)+(2)+(3)+ (4)+(5)+(6)
currency	currency	currency	currency	currency	currency

CODE: PC 6.3

Remarks:

(1): calculate by multiplying delivered cost by 0.90 thereafter dividing by:
10 000 hours if PC 4.1 is "average"
8 000 hours if PC 4.1 is "adverse"

(2): calculate by multiplying delivered cost by 0.60 by rate of interest, expressed in decimals, thereafter dividing by:
2 500 hours if PC 4.1 is "average"
2 000 hours is PC 4.1 is "adverse"

(3): calculate by multiplying delivered cost by total rate of insurance, tax, etc., expressed in decimals, thereafter dividing by:
2 500 hours if PC 4.1 is "average"
2 000 hours is PC 4.1 is "adverse"

(4): calculate by mutliplying delivered cost, expressed in thousands of currency by: 1/
0.100 if PC 4.1 is "average"
0.125 if PC 4.1 is "adverse"

(5): calculate by multiplying cost of disel oil per litre by 21.6 and add 0.36.

(6): add: (1) to (5).

1/ assuming the total cost of repairs and maintenance over the whole life of the machine is equal to the delivered cost less tyres.

6.4 Machine Cost per Standing Hour and per Travelling Hour - TRUCK

PC 6.4

Cost per Standing/Travelling Hour							
(1) Depreciation	(2) Interest	(3) Insurance Tax, etc.	(4) Total Machine Cost per Stand/H.	(5) Tyres	(6) Repairs and Mainten.	(7) Fuel and Lubricants	(8) Total Machine Cost per Travel/H.
currency	currency	currency	currency	currency	currency	currency	currency
		CODE:	PC 6.4.1			CODE:	PC 6.4.2

Remarks:

(1): calculate by multiplying delivered cost less tyres by 0.90 thereafter dividing by:
15 000 hours if PC 4.1 is "average"
10 000 hours if PC 4.1 is "adverse"

(2): calculate by multiplying delivered cost less tyres by 0.60 and by rate of interest, expressed in decimals, thereafter dividing by:
3 000 hours if PC 4.1 is "average"
2 000 hours if PC 4.1 is "adverse"

(3): calculate by multiplying delivered cost less tyres by total rate of insurance, tax, etc., expressed in decimals, thereafter dividing by:
3 000 hours if PC 4.1 is "average"
2 000 hours if PC 4.1 is "adverse"

(4): add: (1) + (2) + (3)

(5): calculate by dividing delivered cost of complete set of types by:
3 500 hours if PC 4.1 is "average"
2 500 hours if PC 4.1 is "adverse"

(6): calculate by multiplying delivered cost less tyres, expressed in thousands of currency by: 1/
0.070 if PC 4.1 is "average"
0.100 if PC 4.1 is "adverse"

(7): calculate by multiplying cost of diesel oil per litre by 27 and add 0.45

(8): add (4) + (5) + (6) + (7).

1/ assuming that the total cost of repairs and maintenance over the whole life of the truck is approximately equal to the delivered cost less tyres.

7. SUMMARIZED TIME COSTS

PC 7

7.1 Machine Time versus Crew Time

PC 7.1

Referring to manual section 2.8.3, production formulae (1) and (2), the following assumptions are to be made:

OPERATION - MACHINE	Machine Time (productive) in Percentage of Crew Time (effective)	Coefficients	
		α	β
Stump Operation - POWERSAW	40%		0,40
OffRoad Transport - SKIDDER	85%	1.20	
OffRoad Transport - CRAWLER	85%	1.20	
Landing - POWERSAW	75%		0,75
Loading - LOADER	85%	1.20	
	CODE:	PC 7.1.1	PC 7.1.2

7.2 Total Time Costs: Crew plus Machine

PC 7.2

Complete the following table:

OPERATION CREW	(1) Crew Cost per Crew/Hour (effective)	(2) Coeffic. α	(3) Crew Cost per Mach/Hour (product.)	(4) Machine Cost per Mach/Hour (product.)	(5) Coeffic. β	(6) Machine Cost per Crew/Hour (effective)	(7) Total Time Cost per Crew Hour (effective)	(8) Total Time Cost per Mach/Hour (product.)
REFERENCE CODE:	PC 5.2.2	PC 7.1.1	(1)x(2)	PC 6.2	PC 7.1.2	(4)x(5)	(1)+(6)	(3)+(4)
Stump Operation-P.SAW								
OffRoad Trans-SKIDDER								
OffRoad Trans-CRAWLER								
Landing - POWERSAW								
Loading - LOADER				1/				
						CODE:	PC 7.2.1	PC 7.2.2

1/ As Skidder

8. LOAD SIZE CALCULATIONS

PC 8

8.1 Off-road Transport (Skidder and Crawler

PC 8.1

(i) complete the following table:

ASSESSMENT UNIT	(1)	(2) (3) Skidder		(4) (5) Crawler	
	Mean Specific Gravity	Load Size in Tons	Load Size in m^3	Load Size in Tons	Load Size in m^3
REFERENCE (CODE)	DB 4.2	-	(2):(1)	-	(4) : 1
No. Terrain Code Stock Code	(Ton/m^3)	(Ton)	(m^3)	(Ton)	(m^3)
			CODE: PC 8.1.1		CODE: PC 8.1.2

Remarks:

(1): extract from the data base DB 4.2, Species Distribution, and insert for each species (spp. group) the specific gravity (green condition) as determined by means of botanical/ technical documents. Multiply for each species (spp. group) the volume per ha (DB 4.2.1)by the corresponding specific gravity, add up and divide the total of weight by the total of volume, whereby the mean specific gravity is derived.

Only a reasonable approximation is required. Therefore, if the number of species is excessive, those which make up approximately 75% of the volume will suffice for the calculation. Also, if not excessive differences in species distribution are found, consider only one specific gravity for the entire assessment area. Disregard the fact that the species distribution to volume may differ from exploitable stock to extracted stock.

(2) and (4): determine the load sizes in tons from the following indications:

(1) Terrain Class	(2) (3) Load Size in Tons (green weight)	
	Skidder	Crawler
	(tons)	(tons)
1	5.50	10.00
2	4.75	9.00
3	3.75	7.50
4	-	5.00

The indications are assumed to apply to a broad average of practically experienced loads for 175 HP skidder and crawler respectively. If other weight classes of equipment are definitely envisaged, adjust the above load sizes - plus or minus as the case may be - by:

5% per 10 HP for skidder

10% per 10 HP for crawlers

8.2 Truck Hauling

PC 8.2

(i) The standard load per roundtrip is assumed to be 25 tons corresponding to a medium-heavy pole-trailer truck of 200-225 HP. If other weight classes of trucks are definitely envisaged, use the corresponding load indications from the technical literature.

(ii) Using the load size in tons complete the following table:

ASSESSMENT UNIT	(1) Mean Specific Gravity	(2) Load Size in tons	(3) Load Size m^3
REFERENCE CODE:	PC 8.1	-	(2):(1)
No. Terrain Code Stock Code	(tons/m^3)	(tons)	(m^3)

CODE: PC 8.2

Remarks:

(1): extract from the table in PC 8.1. As in PC 8.1 disregard that the species distribution to volume may differ from exploitable stock to net yield and also, that "exploitable" includes bark.

(2): insert for all: 25 tons, unless other indications are definite (see (i) above).

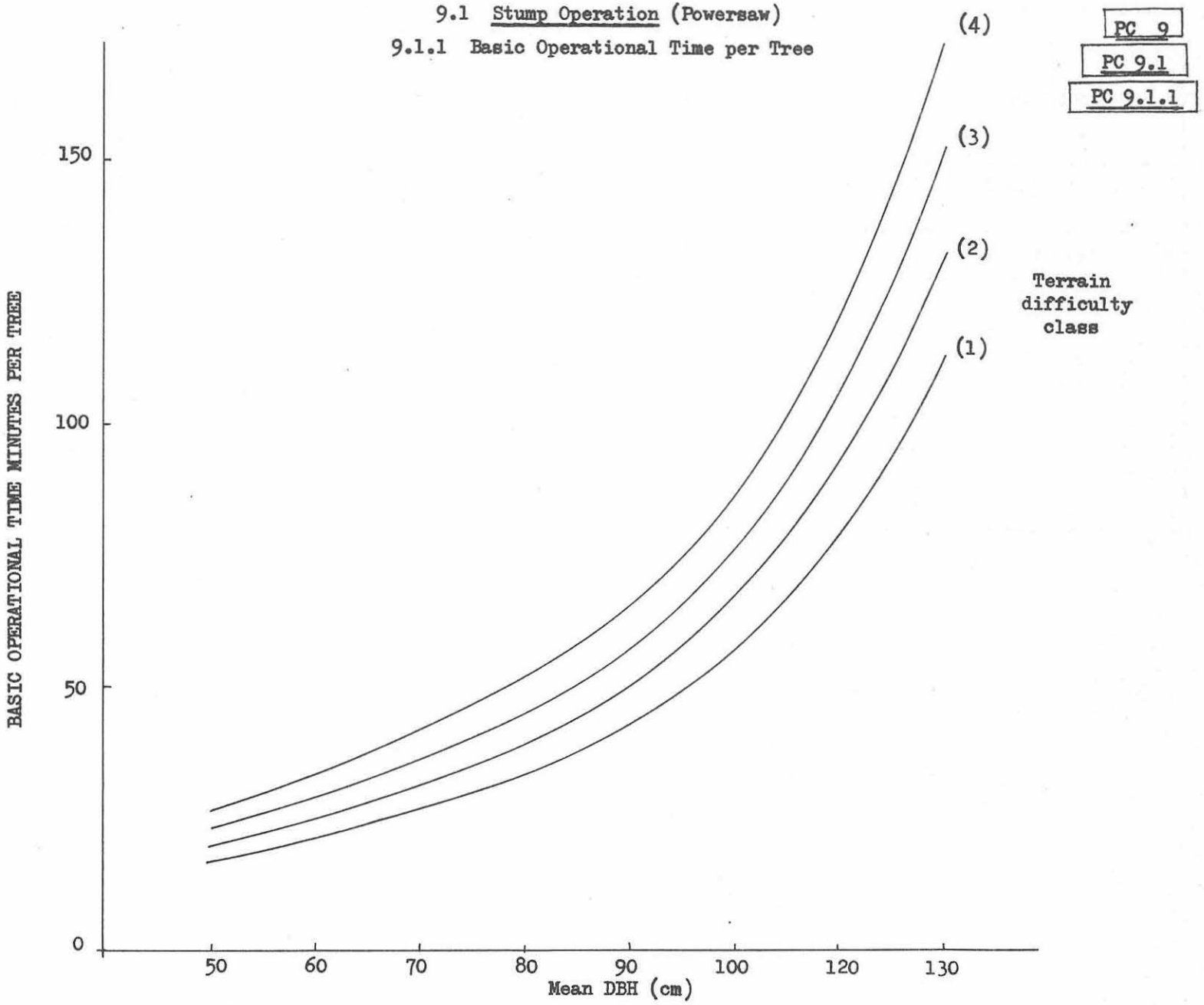
In most cases one load size, common for the entire assessment area will suffice. No adjustments due to terrain differences are required, as increased road construction costs in difficult terrain are assumed to have eliminated extreme differences in road standards and road hauling capacities.

9. Time Elements

9.1 Stump Operation (Powersaw)

9.1.1 Basic Operational Time per Tree

PC 9
PC 9.1
PC 9.1.1



9.1.2 Operational Time Adjustment

PC 9.1.2

ASSESSMENT UNIT	(1) Mean DBH (Felled)	(2) Buttressness Factor Value	(3) Buttressness Adjustment Coeffic.	(4) Felling Time adjust. coefficient	(5) Cross-Cutting Nos.Logs per Tree (extract)	(6) Cross-Cutting Adjustment Coeffic.	(7) Total Oper. Time Adjust. Coeffic.
REFERENCE (CODE)	DB 4.5.4	DB 4.8.1	-	DB 4.4.8	DB 4.6.4	-	(3)+(4)+(6)
No. Terrain Code Stock Code							

CODE: PC 9.1.2

Remarks:

(3): determine the adjustment coefficient corresponding to the factor value from the following indications:

Factor Value Buttressness	Adjustment Coefficient Buttressness
1	0.00
2	0.10
3	0.15

(6): determine the adjustment coefficient corresponding to the number of logs per tree and the DBH of the field tree from the following indications:

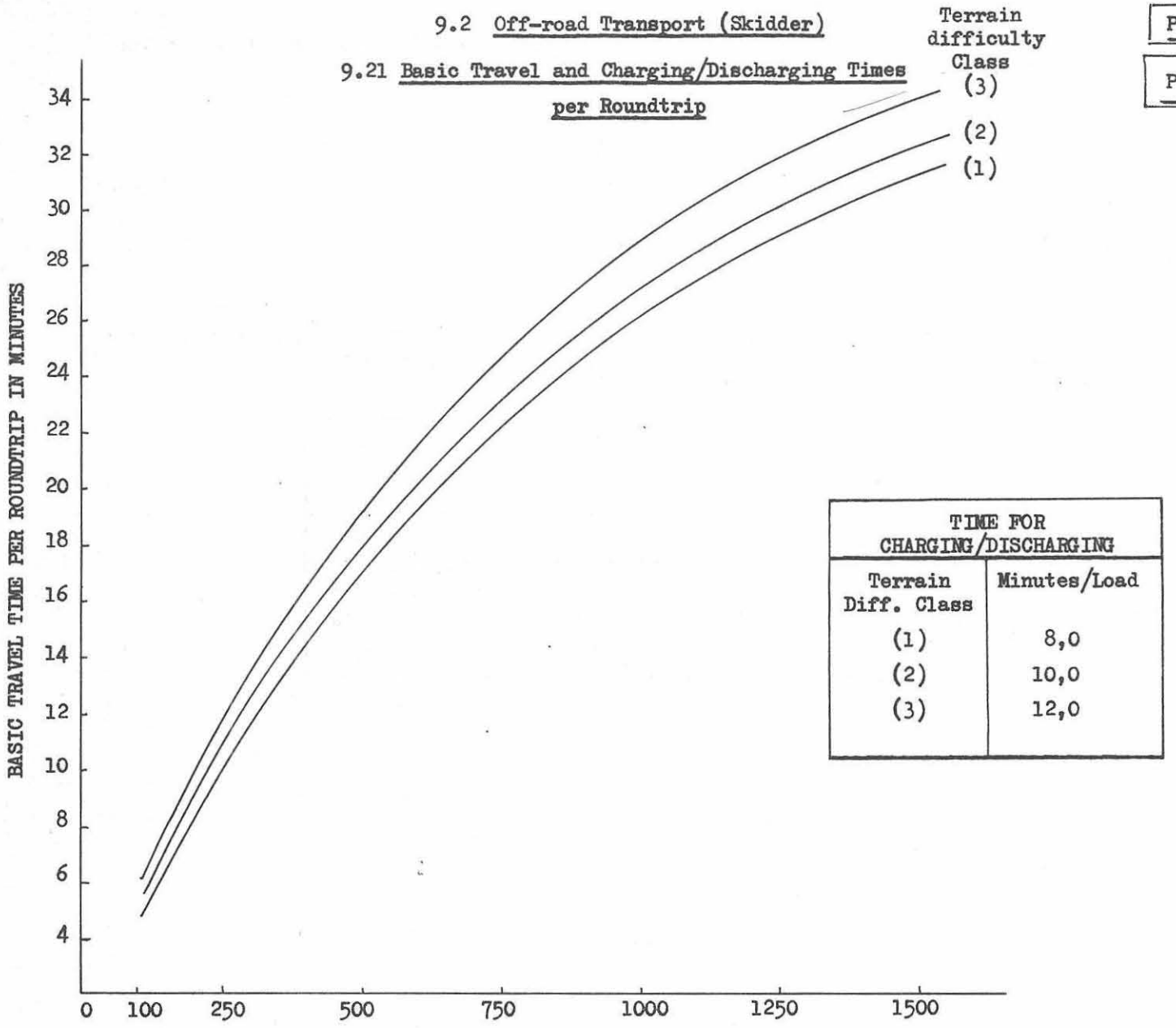
No. Logs per tree (Extracted)	(1)	(2) Mean DBH (Felled)	(3)
	< 50 cm	50–80 cm	> 80 cm
< 1.25	0.05	0.07	0.09
1.25 - 1.50	0.10	0.13	0.16
> 1.50	0.17	0.21	0.25

PC 9.2

PC 9.2.1

9.2 Off-road Transport (Skidder)

9.21 Basic Travel and Charging/Discharging Times per Roundtrip



TIME FOR CHARGING/DISCHARGING	
Terrain Diff. Class	Minutes/Load
(1)	8,0
(2)	10,0
(3)	12,0

9.2.2 Travel Time Adjustment Coefficient (Skidder)

PC 9.2.2

ASSESSMENT UNIT	(1)	(2)	(3)	(4)	(5)	(6)
	Factor Values					
	Under-Brush	Surface Evenness	Surface Obstacles	Soil Firmness	Total	Trav.Time Adjustm. Coeffic.
REFERENCE (CODE)	DB 4.8.3	DB 4.8.4	DB 4.8.5	DB 4.8.6	(1)+(2)+(3)+(4)	-
No. Terrain Code Stock Code						

CODE: PC 9.2.2

Remarks:

(6): determine the corresponding adjustment coefficients from the following indications.

Total of Factor Values:	(1) 4 - 6	(2) 7 - 9	(3) 10 - 12	(4) 13 - 15	(5) 16 - 20
Adjustment Coefficient:	1.00	1.05	1.10	1.25	1.50

Note:

Skidder extraction is considered non-feasible if the terrain class is 4

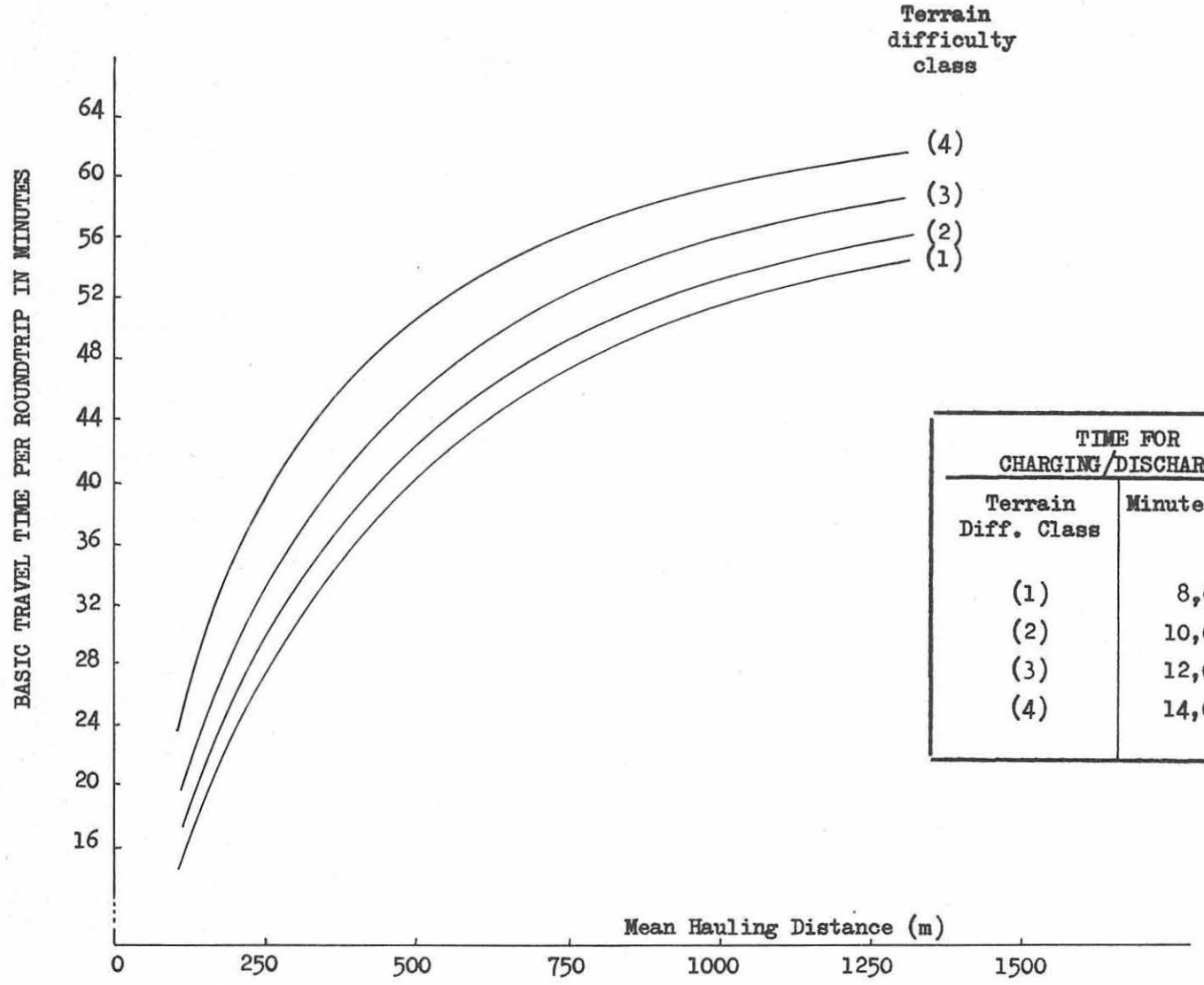
If the above coefficient is 1.50, also consider terrain class 3 non-operable for skidder and transfer the assessment unit(s) to crawler operation.

PC 9.3

PC 9.3.1

9.3 Off-road Transport (Crawler)

9.31 Basic Travel and Charging-Discharging Times



TIME FOR CHARGING/DISCHARGING	
Terrain Diff. Class	Minutes/Load
(1)	8,0
(2)	10,0
(3)	12,0
(4)	14,0

9.3.2 Operational Time Adjustment Coefficient (Crawler)

PC 9.3.2

Insert in the following table the total factor values from the table in PC 9.2.2(5) and complete the following table:

ASSESSMENT UNIT	Total Factor Value	Trav. Time Adjustment Coefficient
REFERENCE (CODE)	-	-
No. Terrain Code Stock Code		

CODE: PC 9.3.2

Remarks:

(2): determine the corresponding adjustment coefficients from the following indications:

Total of Factor Values:	(1) 4 - 6	(2) 7 - 9	(3) 10 - 12	(4) 13 - 15	(5) 16 - 20
Adjustment Coefficients:	1.00	1.00	1.05	1.10	1.25

If the above coefficient is 1.25, consider terrain class 4 non-operable for crawler. Discard effected assessment units as being non-exploitable, alternatively consider cable yarding, in which case the extracted volume per ha must exceed 60 m^3 (see DB 4.5.3) and the total area to be yarded must exceed 45 000 ha. Cable yarding cost per m^3 may exceed crawler cost in terrain class 3 by 100% or more.

(Calculation of cable yarding costs is not included in this manual).

9.4 Truck Hauling

PC 9.4

Complete the following table; if more than one delivery point applies, complete a table for each:

ASSESSMENT UNIT (Delivery Point:)	(1) Hauling Distance	(2) Hauling Distance	(3)	(4) Travel Time	(5) Travel Time	(6)	(7)	(8) Truck Time Coefficients	(9) Truck Time Coefficients	(10) Truck Time Coefficients
	on Artery Road	on Feeder Road	Standing Time per Roundtrip (ST)	on Feed.Rd per Round-trip	on Artery Rd per Round-trip	Total per Round-trip (TT)	Total Time per Round-trip (RT)	ST:RT ("s")	TT:RT ("t")	60:RT
REFERENCE (CODE)	PC 13.2	PC 13.1	-	-	-	(4)+(5)	(3)+(6)	-	-	-
No. Terrain Code Stock Code	(km)	(km)	(min)	(min)	(min)	(min)	(min)	-	-	-

CODES: PC 9.4.1 PC 9.4.2 PC 9.4.3 PC 9.4.4 PC 9.4.5 PC 9.4.6

Remarks:

(3): this time element comprises time per one roundtrip of loading and unloading plus idling time in the landing. Use following indications:

	Total Hauling Distance		
	<10 km	10–40 km	>40 km
Standing Time Minutes/Roundtrip	50	45	30

(4) and (5): calculate by multiplying (1) and (2) by the following travel times:

7 minutes per km on feeder roads (average two ways)

2.5 minutes per km on artery roads (average two ways)

(8), (9) and (10): also vide manual section 2.8.3.

10. SUMMARIZED TIME COSTS - TRUCK HAULING

PC 10

Complete the following table; if more than one delivery point applies, complete a table for each:

ASSESSMENT UNIT (Delivery Point:)	(1) Crew Cost per Hour R.Tr.	(2) Cost per Standing Hour (C_{ST})	(3) "s"	(4) Standing Cost per Hour R.Tr.	(5) Cost per TR.Hour (C_{TT})	(6) "t"	(7) Travel Cost per Hour R.Tr.	(8) Total Time Cost per Hour R.Tr.
REFERENCE (CODE)	PC 5.2.2	PC 6.4.1	PC 9.4.4	(2)x(3)	PC 6.4.2	PC 9.4.5	(5)x(6)	(1)+(4)+(7)
No. Terrain Code Stock Code	currency	currency	-	currency	currency	-	currency	currency

CODE: PC 10

For the definition of C_{ST} and C_{TT} see manual section 2.8.3. C_{ST} and C_{TT} do not include crew cost.

11. ARTERY ROADS

PC 11

11.1 Artery Road Net - Sketch Plan

PC 11.1

(i) Based on map indications of optional delivery points, entry points and existing (potential) roads and other pertinent data from the data base, final selection of (a) delivery point(s) and (b) entry point(s) were made in pre-calculation PC 1;

(ii) on a skeleton map endeavour to sketch a network of artery roads which would by and large drain the entire area. The coverage intensity should be approximately 1.5 to 2.0 km per 1 000 ha, i.e. parallel roads would be spaced approximately 5 km apart;

(iii) branches of the road net should pass through the approximate centre of gravity of each assessment unit and should terminate approximately 2 km from the exterior borderline;

(iv) endeavour to follow the contour lines of the map to the extent possible, definitely avoiding excessive crossing of narrowly spaced lines. If a dominant river system exists, the major stretches of the road net should follow the river course;

(v) adjust the road net to incorporate possibly existing suitable roads. Mark all existing bridges and indicate where additional bridges appear to be required.

(vi) The sketched road net only serves the purpose of giving indications of the magnitude of the required road net in order to estimate construction requirements and hauling distances. It is most unlikely that the sketch will have more than a superficial resemblance to a properly planned, practically feasible road net.

(vii) The map is termed the "Road Map".

11.2 Artery Roads: Average Construction and Maintenance Costs per km

PC 11.2

(i) complete the following table:

TERRAIN CLASS	(1) Tract. Time Required (Clearing Formation) per km	(2) Total Tractor Cost per km	(3) Total Road Cost per km	(4) Total Road Length	(5) Reduct-ions	(6) Total Construct. Require-ments	(7) Total Road Cost
REFERENCE (CODE)	-	-	-	PC 11.1	-	(4)-(5)	(6)x(3)
Terrain Code	(hours/km	currency	currency	(km)	(km)	(km)	currency
1	135						
2	175						
3	225						
4	300						
			TOTAL:			TOTAL:	
			CODE: PC 11.2.1			CODE:	PC 11.2.2

AVERAGE TOTAL ARTERY ROAD COSTS/KM :

CODE: PC 11.2.3

Remarks:

(2): extract data PC 7.2.2 total time cost (crawler team) and multiply by (1).

(3): adjust the calculated tractor costs by multiplying (2) by 1.50 in order to include cost of inforced surfacing, ditching, culverts, maintenance, etc.

(4): measure on the map by sections located in different terrain class areas the total length of the artery road net, terrain class by terrain class, multiply the measured distances by a road winding factor of 1.15 if class 1 or 2 and 1.30 if class 3 or 4 and insert the summarized values in the table.

(5): determine from the map and pertinent data from the data base, whether any part of the total road length (a) does exist in fully operational condition, (b) does exist, but requires improvement or (c) the construction cost may be shared with outsiders.

Estimate potential reductions of construction requirements by means of the following indications:

	REDUCTION
Road exists, fully operational	Total length of existing section
Road exists, but improvement required	50% of length of existing section
Road costs can be shared	25% of length of section in question

(6): deduct (5) from (4)

(7): multiply (6) by (3) and add up; divide the sum by total of (4) to obtain average total road cost per km of roads. (PC 11.2.3).

If the data base provides adequate indications of practically experienced, locally applicable road costs per km, use such indications and omit separate cost calculations as above.

The assumed road standard is an all-weather, gravel or laterite surfaced trunkroad, approximately 8 - 10 m between shoulders and cleared for major vegetation on both sides in 10 m wide strips, measured from the road shoulders.

11.3 Bridges: Average Construction Cost per km of Artery Road

PC 11.3

(1) Bridge Type (Length)	(2) Number of Bridges Required	(3) Cost per Bridge	(4) Total Bridge Cost
(m)	(nos)	currency	(2)x(3) currency
< 10			
10–25			
> 25			
		TOTAL	

CODE: PC 11.3.1

AVERAGE BRIDGE COST PER KM ROAD :

CODE: PC 11.3.2

Remarks:

(1) and (2): estimate from the map and pertinent data from the data base how many bridges are required of various types and sizes, as indicated roughly in (1): <10 m (simple log construction), 10 - 24 m (heavy log construction possibly supported between terminal points) and > 25 m (proper bridge-engineering construction in concrete and steel).

(3): assume - if better indications are not rendered by the data base - the following unit costs:

Bridge length	Bridge Construction Cost per Unit equals:
< 10 m	50% of average artery road costs per km (PC 11.2.3)
10 - 25 m	100% of average artery road costs per km
> 24 m	500% of average artery road costs per km

(4): multiply (2) x (3) and add up; divide the sum by total operational road length (PC 11.2.1) to obtain average bridge cost per km road.

If the data base provides adequate indications of practically experienced, locally applicable bridge construction costs, use such indications and admit separate cost calculations as above.

12. FEEDER ROADS

PC 12

12.1 Feeder Roads: Construction Costs per km

PC 12.1

TERRAIN CLASS	(1) Tractor Time Required (Clearing, Formation) per km	(2) Tractor Cost per Machine/ Hour	(3) Total Tractor Cost per km	(4) Total Road Construct. Cost per km
REFERENCE (CODE)	-	PC 7.2.2	(1) x (2)	-
Terrain Code	hours/km	currency	currency	currency
1	90			
2	110			
3	140			
4	210			

CODE: PC 12.1

Remarks:

(4): adjust the calculated tractor cost by multiplying (3) by 1.25 (in order to include cost of grading, culverts etc.).

If the data base provides adequate indications of practically experienced, locally applicable road costs, use such indications and omit separate calculations as above.

The assumed road standard is a 6 - 8 m wide, dirt-road permitting heavy duty truck passage, except during heavy or prolonged rain periods.

12.2 Feeder Road Density - Feeder Road Cost per m^3 (extracted)

PC 12.2

PC 12.2.1

TABLE (I)

ASSESSMENT UNIT	(1) Off-road Transport: Total Time Cost 1/	(2) Off-road Transport: Load Size 1/	(3) Feeder Road Cost per km	(4) Volume per ha (Extract)
REFERENCE (CODE)	PC 7.2.2	PC 8.1	PC 12.1	DB 4.6.2
No. Terrain Code Stock Code	currency	(m^3)	currency	(m^3)

1/ skidder or crawler, as the case may be.

Using the values from Table (I), complete for each assessment unit a table as follows:

PC 12.2.2.

TABLE (II)

ASSESSMENT UNIT No..... Mean Off-road Hauling Distance	(1) Trav.Time per Roundtrip	(2) No. of Roundtrips per hour	(3) Volume per Hour	(4) Travel Cost per m^3	(5) Feeder Road Density	(6) Feeder Road Cost per ha	(7) Feeder Road Cost per m3
REFERENCE (CODE)	PC 9.2.1/2 or PC 9.3.1/2	60: (1)	Load Size x (2)	Time Cost : (3)	-	ER.Cost : 1000 x (5)	(6) : Vol/ha
(m)	(min)	(nos)	(m3)	currency	(m/ha)	currency	currency
200							
250							
300							
350							
400							
450							
500							
750							
1 000							
1 250							

CODE: PC 12.2.2

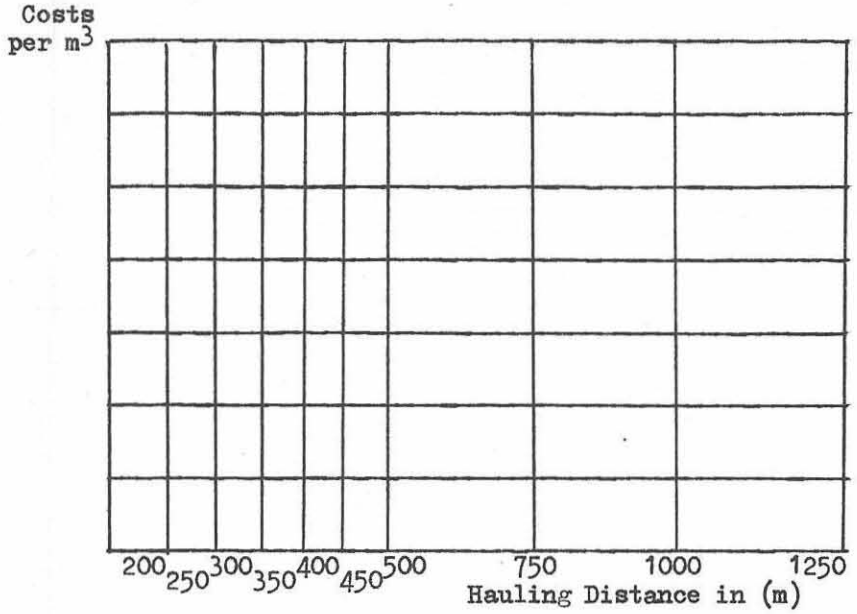
Remarks:

(5): determine from the following table:

(1) Mean off-road hauling distance	(2)	(3)	(4)	(5)
	Road Densities (m/ha)			
	Terrain Class 1	Terrain Class 2	Terrain Class 3	Terrain Class 4
(m)	(m/ha)	(m/ha)	(m/ha)	(m/ha)
200	20.0	22.5	30.0	40.0
250	15.0	18.0	24.0	31.0
300	13.5	15.0	20.0	26.5
350	11.5	13.0	17.0	23.0
400	10.0	11.0	15.0	20.0
450	9.0	10.0	13.0	18.0
500	8.0	9.0	12.0	16.0
750	5.5	6.0	8.0	10.5
1 000	4.0	4.5	6.0	8.0
1 250	3.0	3.5	5.0	6.5

For each assessment unit use from Table (II) the values of (4) travel cost per m^3 and (7) feeder road cost per m^3 to draw the two representative curves on the following graph:

PC 12.2.3



PC 12.2.4

The distance corresponding to the point where the two lines intercept is the optimum off-road transport distance. Round to nearest 50 m and insert in the following table:

ASSESSMENT UNIT	(1) Optimum Off-road Hauling Distance	(2) Optimum Feeder Road Density	(3) Correspond. Road Spacing	(4) Feeder Road Cost per m^3 (Extract.)
REFERENCE (CODE)	-	-	-	PC 11.2.3
No. Terrain Code Stock Code	(m)	(m/ha)	(m)	currency
CODE:	PC 12.2.4	PC 12.2.5	PC 12.2.6	PC 12.2.7

(1): extract from above graph and round to nearest 50 m.

(2): extract from table PC 12.2.2(5).

(3): road spacing (m) = $\frac{10\ 000}{\text{road density (m/ha)}}$

(4): calculate by dividing feeder road cost per ha (see PC 12.2.2) by value per ha (Extract.) (see: Table (I)).

13. ROAD HAULING DISTANCES

PC 13

Road Hauling Distances: to Centre of Assessment Unit

(i) Mark on the road map the approximate centre of areal gravity of each assessment unit;

(ii) in each centre-point, draw straight lines north/south, east/west, north-west/south-east and north-east/south west and extend all the lines to intercept with the border line of the assessment unit;

(iii) multiply the 8 measured distances from border to centre, divide the total by 8, i.e. the average distance from border to centre is obtained;

(iv) multiply the average distance by 0.65 and consider this distance to be the average road hauling distance to the centre; 1/

(v) insert the findings in the table.

Road Hauling Distance: from Centre of Assessment Units to Delivery Point(s)

(i) On the road map trace and measure the road distance from the centre of each assessment unit to the delivery point or to each delivery point if two or more are considered;

(ii) multiply each of the calculated distances by a road winding factor of 1.30 and consider these distances to be the average hauling distances from the centres of the assessment units to the delivery points. Insert the findings in the table and complete the table.

ASSESSMENT UNIT	(1) Average Road Haul Distance to Centre	(2) (3) (4) (5) Average Road Hauling Distance from Centre to Delivery Points				(6) (7) (8) (9) Total Average Road Hauling Distance to Delivery Points			
		A1	A2	A3	A4	A1	A2	A3	A4
No. Terrain Code Stock Code									
CODE:	PC 13.1	←	PC 13.2	→		PC 13.3	→		

1/ i.e. applying a road winding factor of 1.30 to half of the average distance from border to centre.

14. PRODUCTION (PERFORMANCE) CALCULATIONS

PC 14

14.1 Stump Operation (Powersaw)

PC 14.1

ASSESSMENT UNIT	(1) Mean DBH (Felled)	(2) Basic Operat-ional Time per Tree	(3) Operat-ional Time Adjust-ment Coeffic.	(4) Total Operat-ional Time per Tree	(5) Nos. Tree per Hour	(6) Volume per Tree (Extract.)	(7) Basic Volume per Hour	(8) Volume per Hour Adjusted for Climatic Influence
REFERENCE (CODE)	DB 4.5.4	PC 9.1.1	PC 9.1.2	(2)x(3)	60:(4)	DB 4.6.3	(5)x(6)	-
No. Terrain Code Stock Code	(cm)	(min)	-	(min)	(nos)	(m^3)	(m^3)	(m^3)

CODE: PC 14.1

Remarks:

(8): adjust the calculated hourly production volume by multiplying (7) by 0.90 if PC 4.3 "Strain on Labourers" coefficient is "adverse" (i.e. the work efficiency is assumed to be reduced by 10%. No adjustment is required if PC 4.3 is "average").

14.2 Off-road Transport

PC 14.2

14.2.1 Skidder

PC 14.2.1

In the following table, initially discard all assessment units, where the terrain class code is 4 (non-operable for skidder);

Determine from PC 9.2.2 (travel time adjustment coefficient) whether any assessment unit, coded as belonging to terrain class 3, has an adjustment coefficient of 1.50. If so, also discard such assessment unit(s) as being non-operable for skidders.

ASSESSMENT UNIT	(1) Mean Hauling Distance	(2) Basic Travel Time per Round-trip	(3) Trav.Time Adjustment Coeffic.	(4) Adjusted Travel Time per Round-trip	(5) Time for Charg/ Disch. per Round-trip	(6) Total Round-trip Time	(7) Nos. Round-trips per Hour	(8) Load Size	(9) Basic Volume per Hour	(10) Volume per Hour Adjusted for Climatic Influence
REFERENCE (CODE)	PC 12.2.4	PC 9.2.1	PC 9.2.2	(2)x(3)	PC 9.2.1	(4)+(5)	60: (6)	PC 8.1.1	(7)x(8)	-
No. Terrain Code Stock Code	(m)	(min)	-	(min)	(min)	(min)	-	(m^3)	(m^3)	(m^3)

CODE: PC 14.2.1

Remarks:

(1): adjust the calculated hourly production volume by multiplying (9) by 0.90 if PC 4.3 "Strain on Labourers" coefficient is "adverse" (i.e. the work performance is reduced by 10%. No adjustment is required if PC 4.3 is "average").

14.2.2 Crawler

PC 14.2.2

Determine from PC 14.2.6 (travel time adjustment coefficient) whether any assessment unit, coded as belonging to terrain class 4, has an adjustment coefficient of 1.25. If so, discard such assessment unit(s) as being non-operable for crawlers.

ASSESSMENT UNIT	(1) Mean Hauling Distance	(2) Basic Travel Time per Round-trip	(3) Trav.Time Adjustment Coeffic.	(4) Adjusted Travel Time per Round-trip	(5) Time for Charg/ Disch. per Round-trip	(6) Total Round-trip Time	(7) Nos. Round-trips per Hour	(8) Load Size	(9) Basic Volume per Hour	(10) Volume per Hour Adjusted for Climatic Influence
REFERENCE (CODE)	PC 12.2.4	PC 9.3.1	PC 9.3.2	(2)x(3)	PC 9.3.1	(4)+(5)	60: (6)	PC 8.1.2	(7)x(8)	-
No. Terrain Code Stock Code										

CODE: PC 14.2.2

Remarks:

(10): adjust the calculated hourly production volume by multiplying (9) by 0.90 if PC 4.3 "Strain on Labourers" coefficient is "adverse" (i.e. the work performance is reduced by 10%. No adjustment is required if PC 4.3 is "average").

14.3 Landing

PC 14.3

14.3.1 Cross-cutting by Powersaw

PC 14.3.1

ASSESSMENT UNIT	(1) Nos.Logs Yielded per Log.Extr.	(2) Mean Diameter per Log.Extr.	(3) Average Time Required per Log.Extr.	(4) Mean Volume per Log.Extr.	(5) Basic Volume Cross Cut per Hour	(6) Volume per Hour Adjusted for Climatic Influence
REFERENCE (CODE)	DB 4.7.1	DB 4.6.7	-	DB 4.6.6	-	-
No. Terrain Code Stock Code	(nos)	(cm)	(min)	(m^3)	(m^3)	(m^3)

CODE: PC 14.3.1

Remarks:

(3): determine from the following indications:

MEAN DIAMETER LOGS EXTRACTED	Average Time required per Log (extracted) (effective crew time)				
	40 cm	40 - 59 cm	60 - 79 cm	80 - 100 cm	100 cm
Nos. Logs Yielded per Logs Extracted	(min)	(min)	(min)	(min)	(min)
1.25	5	8	10	12	15
1.25 - 1.99	7	10	14	18	22
1.50 - 1.75	10	15	20	25	30
1.75	17	27	37	47	57

(5): divide (4) by (3), thereafter multiply by 60.

(6): adjust the calculated hourly production volume by multiplying (5) by 0.90 if PC 4.3 "Strain on Labourers" coefficient is "adverse" (i.e. the work efficiency is assumed to be reduced by 10%. No adjustment is required if PC 4.3 is "average").

14.3.2 De-barking (manually) PC 14.3.2

(i) Complete the following table:

ASSESSMENT UNIT	(1) Mean Diameter per Log (extract)	(2) Mean Length per Log (extract)	(3) Surface De-barked	(4) Debark-ing Time per m^2	(5) Average Time per Log Actually Debarked	(6) Factor Value Debark-ing Require-ment	(7) Average Time per Log (extract)	(8) Volume per Log (extr.)	(9) Basic Volume (extr.) Handled per Man-Hr (effect.)	(10) Volume per Man-Hr (effect.) Adjusted for Climatic Influence
REFERENCE (CODE)	DB 4.6.7	DB 4.6.8	-	-	(3)x(4)	DB 4.8.2	(5)x(6)	DB 4.6.6	(8):(7)	-
No. Terrain Code Stock Code	(cm)	(m)	(m^2)	(effect-ive man-hr)	(effect-ive man-hr)	-	(effect-ive man-hr)	(m^3)	(m^3)	(m^3)

Remarks: CODE: PC 14.3.2

(3): calculate by multiplying (1) by (2) by 3.14.

(4): determine from the following indications:

Mean Diameter per Log (Extracted)	Debarking Time per m^2
(cm)	(effective man-hour)
40	0.08
40 - 80	0.07
80	0.03

(10): adjust the calculated hourly production volume by multiplying (9) by 0.90 if PC 4.3 "Strain on Labourers" coefficient is "adverse" (i.e. the work efficiency is assumed to be reduced by 10%. No adjustment is required is PC 4.3 is "average").

14.3.3 Log Protective Measures

PC 14.3.3

Assume that 10 m^3 (extracted volume) is handled per one man hour (effective).

14.3.4 Scaling, Log Marking, Recording, etc.

PC 14.3.4

Assume that 20 m^3 (extracted volume) is handled per crew hour (effective), composed of effective time of 1 foreman plus 2 labourers.

14.4 Loading

PC 14.4

As a matter of simplification consider the work performance per productive machine hour of the loader to equal one truck load as calculated in PC 8.2.

14.5 Main Transport: Truck Hauling

PC 14.5

For each delivery point, complete the following table: 1/

ASSESSMENT UNIT	(1) Load Size in m^3	(2) Number of Roundtrips per hour "r"	(3) Volume Carried per Roundtrip Hour
REFERENCE (CODE)	PC 8.2	PC 9.4.6	(1)x(2)
No. Terrain Code Stock Code	(m^3)		(m^3)

CODE: PC 14.5

1/ Load size should in most cases be the same, as already mentioned in Section PC 8.2. However, "r" values are generally different and a separate calculation is, therefore, needed for each assessment unit.

Chapter 6

COST ASSESSMENT

The worksheets of this section are to be filled in with the data from "data Base" and "Precalculations" following the indications of the Reference (Code). Thereafter the worksheets are to be completed by calculations as also indicated under "Remarks". All data derived from the assessment calculations are coded, the code number being preceded by "CA".

INDEX TO COST ASSESSMENT

1. LOG ASSEMBLY COSTS

CA 1

1.1 Stump Operation

CA 1.1

ASSESSMENT UNIT	(1) Time Cost per Crew Hour (effective)	(2) Volume (produced) per Crew Hour (effective)	(3) Production Cost per m^3 (extract)	(4) Total Volume (extracted)	(5) Total Cost
REFERENCE (CODE)	PC 7.2.1	PC 14.1	(1):(2)	PC 2.2	(3)x(4)
No. Terrain Code Stock Code	(currency)	(m^3)	(currency)	(m^3)	(currency)
			TOTAL		
			Average Cost per m^3 (extracted) :		

CODE : CA 1.1

1.2 Off-Road Transport Operation

CA 1.2

ASSESSMENT UNIT	SKIDDER (1) Time Cost per Mach. Hour (prod.)	SKIDDER (2) Volume (extr.) per Mach. Hour (prod.)	SKIDDER (3) Extr. Cost per m^3 (extr.)	SKIDDER (4) Total Volume (extr. by skidder)	SKIDDER (5) Total Cost (skidder)	CRAWLER (6) Time Cost per Mach. Hour (prod.)	CRAWLER (7) Volume (extr.) per Mach. Hour	CRAWLER (8) Extr. Cost per m^3 (extr.)	CRAWLER (9) Total Volume (extr. by Crawler)	CRAWLER (10) Total Cost (Crawler)	AVERAGE OPERATION (11) Total (4)+(9)	AVERAGE OPERATION (12) Total (5)+(10)
REFERENCE (CODE)	PC 7.2.2	PC 14.2.1	(1):(2)	PC 3.2	(3)x(4)	PC 7.2.2	PC 14.2.2	(6):(7)	PC 2.2	(8)x(9)		
No. Terrain Code Stock Code	(curr.)	(m^3)	(curr.)	(m^3)	(curr.)	(curr.)	(m^3)	(curr.)	(m^3)	(curr.)		
TOTAL						TOTAL						
Average Cost per m^3						Average Cost per m^3						
CODE:					CA 1.2.1	CODE:				CA 1.2.2	CODE:	CA 1.2.3
					(13)					(14)		(15)

Remarks:

(13) : divide (5) by (4)
(14) : divide (10) by (9)
(15) : divide (12) by (11)

1.3 Landing Operation

CA 1.3

1.3.1 Cross-cutting and Debarking

CA 1.3.1

ASSESSMENT UNIT	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Cross-cutting			Debarking					Sub-Total
	Time Cost per Crew Hour (effect.)	Volume (prod.) per Crew Hour (effect.)	Cost of cross-cutting per m^3 (extr.)	Time Cost per Man Hour (effect.)	Volume (debarked) per Man/Hour (effect.)	Cost of Debarking per m^3 (extr.)	Cost of Tools	Total Cost of Debarking	Cost of Cross-cutting Debarking
REFERENCE (CODE)	PC 5.2	PC 14.3.1	(1):(2)	PC 5.2	PC 14.3.2	(4):(5)	10% of 6	(6)+(7)	(3)+(8)
No. Terrain Code Stock Code	(curr.)	(m^3)	(curr.)	(curr.)	(m^3)	(curr.)	(curr)	(curr.)	(curr.)

CODE: CA 1.3.1

1.3.2 Log Protection and Scaling, Marking, Recording

CA 1.3.2

ASSESSMENT UNIT	(1) Time Cost per Man/Hour (effect.)	(2) Cost per m^3 (extr.) (10%) of (1)	(3) Cost per m^3 (extract.) Adjusted	(4) Time Cost per m^3 (extr.)	(5) Cost per m^3 (extr.) (5%) of (4)	(6) Cost per m^3 (extract) Adjusted	(7) Cost of Protect. and Scaling per m^3 (extract.)
REFERENCE (CODE)	PC 5.2	PC 14.3.3	-	PC 5.2	PC 14.3.4	-	(3)+(6)
No. Terrain Code Stock Code	(curr.)	(curr.)	(curr.)	(curr.)	(curr.)	(curr.)	(curr.)

CODE: CA 1.3.2

Remarks:

(3): multiply (2) by 1,35 to provide for materials consumed and cost of tools.

(6): multiply (5) by 1,15 to provide for materials consumed and cost of tools.

1.3.3 Total Landing Operation Cost

CA 1.3.3

ASSESSMENT UNIT	(1) Cross-cutting and Debarking Cost per m^3 (extract.)	(2) Log Protect. and Scaling per m^3 (extract.)	(3) Total Landing Cost per m^3 (extract.)	(4) Total Volume (extract.)	(5) Total Cost
REFERENCE (CODE)	CA 1.3.1	CA 1.3.2	(1)+(2)	PC 2.2	(3)x(4)
No. Terrain Code Stock Code	(curr.)	(curr.)	(curr.)	(m^3)	(curr.)
			TOTAL		
			Average Cost per m^3 (extracted) :		

CODE: CA 1.3.3

Remarks:

(6): divide total of (5) by total of (4).

1.4 Total Log Assembly Costs per m^3

CA 1.4

(Extracted Volume and Net Yield)

ASSESSMENT UNIT	(1) Total Log Assembly Costs per m^3 (extracted) Stump Operation	(2) Off-road Transport	(3) Landing Operation	(4) Feeder Road Costs	(5) Total	(6) Total Volume (extract.)	(7) Total Cost of Log Assembly	(8) Cost/ Volume Adjustment Coeffic.	(9) Cost of Log Assembly per m^3 Net Yield
REFERENCE (CODE)	CA 1.1	CA 1.2.3	CA 1.3.3	PC 12.2.7	(1)+(2)+(3)+(4)	PC 2.2	(5)x(6)	DB 4.4.9	(5)x(8)
No. Terrain Code Stock Code	(curr.)	(curr.)	(curr.)	(curr.)	(curr.)	(m^3)	(curr.)	-	(curr.)
					TOTAL			CODE:	CA 1.4.1
					Average Cost per m^3: (extracted)		(10)		
					CODE:	CA 1.4.2			

Remarks:

(10): divide total of (7) by total of (6).

(11): divide total of (7) by total "net yield" (PC 2.3).

Average Cost per m^3 (net yield) (11)

CODE: CA 1.4.3

2. MAIN TRANSPORT COSTS

CA 2

2.1 Artery Roads and Bridges

CA 2.1

As a matter of simplification it is assumed that the artery road and bridge costs are equally distributed to net yield.

(1) Total Cost of Artery Roads	(2) Total Cost of Bridges	(3) Total Road/Bridge Cost	(4) Total Net Yield	(5) Average Road/Bridge Cost per m^3 (net yield)
PC 11.2.2	PC 11.3	(1)+(2)	PC 2.3	(3) : (4)
(currency)	(currency)	(currency)	(m^3)	(currency)

CODE: CA 2.1

2.2 Loading/Unloading

CA 2.2

ASSESSMENT UNIT	Loading			Unloading	Loading/ Unloading
	(1) Total Time Cost per Mach/Hour (product.)	(2) Total Volume (loaded) per Mach/Hour (product.)	(3) Total Cost of Loading per m^3 (net yield)	(4) Total Cost of Unloading per m^3	(5) Loading and Unloading Cost per m^3 (net yield)
REFERENCE (CODE)	PC 7.2.2	PC 14.4 PC 8.2	(1) : (2)	-	(3) + (4)
No. Terrain Code Stock Code	(currency)	(m^3)	(currency)	(currency)	(currency)
		CODE:	CA 2.2.1	CA 2.2.2	CA 2.2.3

Remarks:

(4): cost of unloading is assumed to be equal to 75% of the cost of loading (see manual section 2.8.2).

2.4 Total Main Transport Costs per m^3

CA 2.4

ASSESSMENT UNIT	(1) Average Road/ Bridge Cost per m^3 (net yield)	(2) Load/ Unload Cost per m^3 (net yield)	(3) Average Truck Hauling Cost per m^3 (net yield)	(4) Total Main Transport Cost per m^3 (net yield)	(5) Total Volume (net yield)	(6) Total Main Transport Cost
REFERENCE (CODE)	CA 2.1	CA 2.2.3	CA 2.3.2	(1)+(2)+(3)	PC 2.3	(4) x (5)
No. Terrain Code Stock Code	(currency)	(currency)	(currency)	(currency)	(m^3)	(currency)

CODE: CA 2.4.1

TOTAL:		
Average Cost per m^3 (net yield) : (7) :		

CODE: CA 2.4.2

Remark:

(7): divide total of (6) by total of (5).

3. TOTAL LOGGING COSTS (LESS OVERHEADS)

CA 3

ASSESSMENT UNIT	(1) Total Log Assembly Costs per m^3 (net yield)	(2) Total Main Trans. Costs per m^3 (net yield)	(3) Total Logging Costs per m^3 (net yield)	(4) Total net Yield	(5) Total Logging Cost
REFERENCE (CODE)	CA 1.4.1	CA 2.4.1	(1)+(2)	PC 2.3	(3)x(4)
No. Terrain Code Stock Code	(currency)	(currency)	(currency)	(m^3)	(currency)
			TOTAL:		
			Average Cost per m^3 (net yield) : (6) :		
				CODE:	CA 3

Remark:

(6): divide the total of (5) by the total of (4).

4. OVERHEAD COSTS

CA 4

Unless very comprehensive data are supplied, it shall not be feasible to make a valid estimation of overhead costs.

The overhead costs will comprise all such expenses which are not already included in the various operational costs. Even some of these can only be estimated very roughly (e.g. labour housing, medical transport costs, etc.).

Major expenditures, which have not been included in the operational costs are:

planning, survey, inventory costs, taxes, concession fees, royalties, management, general supervision, office expenses.

In estimating the overhead costs it is necessary to consider especially the scale of the operation and the general organization of the entire exploitation.

If no better indication can be obtained on the basis of data supplied, it may be advisable:

(i) to omit overhead costs, i.e. to enable only a calculation of "contribution toward overhead costs";

(ii) to assume overhead costs per m^3 to equal:

- 35% of average total logging costs per m^3 if the exploitation is large-scale

and

- 20% of average total logging costs per m^3 if the exploitation is small-scale.