THE BEST MECHANISM FOR HANDLING TRANSMISSION POLES AT IMPREGNATION PLANT AT FIBREBOARD AFRICA LIMITED.

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ABSTRACT

Six possible mechanisms for handling logs and timber at impregnation plants have been examined in this study with the aim of determining the best option for the impregnation plant at Fibreboards Africa in Arusha. The six mechanisms denoted as alternatives were as follows: alternative one: full mechanised 4WD front end loader, alternative two: a pair of oxen and a wagon, alternative 3: a pair of sulkies and oxen, alternative four: a pair of sledges and oxen, alternative five: a farm tractor with a wagon and alternative six: a combination of a pair of sulkies and oxen plus a pair of sledges with oxen. Alternatives two to six also worked with a stationary cable line at the impregnation plant. The alternatives were subjected to costs analysis and the following indicators were calculated: internal rate of return on investment (IRR), net present values (NPV), break even point(BEP), return on investment (ROI), pay back period (PBP), and contribution margin ratio (CMR). The alternatives were then ranked according to their economic performance for each financial indicator. Alternatives four and one were found to be in the first two ranks. Using IRR as the determining financial indicator the alternatives four and one were subjected to sensitivity analysis to find out which was the best option in an unstable business environment. Alternative four which uses a pair of sledges and oxen was found to be the best. The sensitivity analysis further indicated that both alternative four and one were sensitive to price changes and less sensitive to costs of investment and changes in variable costs. It is recommended that alternative four should be adopted for handling transmission poles at the impregnation plant at Fibreboard Africa Ltd.

Keywords: *Fibreboard Africa, Eucalyptus poles, cost and sensitivity analysis, impregnation plant*

Introduction

Fibreboard Africa was a subsidiary of Tanzania Wood Industry Corporation(TWICO) until recently 1998, when it was privatised. The company is an integrated wood complex comprising of fibreboard mill, door factory, sawmill, and an impregnation plant. The main company's products are: timber, fibreboards, furniture and transmission poles.
Handling of transmission poles at Fibreboard Africa Ltd involves transportation of poles from the pole yard to the impregnation plant, feeding them in the wagon, storing treated poles and loading trucks with poles for sale. All the above operations used to be undertaken by two 4WD front-end loaders. Due to old age, one is completely grounded while the other is operating at 50% of the expected capacity.

The loaders couldn't be replaced or repaired due to financial constraints, which the company faced. Not only that, but the spares were not found locally, leave alone that they are very expensive.

Since the production activity at the plant has a direct bearing with the loader, which feeds the plant, then, there was an urgent need of looking at the alternative mechanisms to replace the loaders. It is aim of this study to come up with a solution to the problem.

MATERIALS AND METHODS

Location

The study was carried out at Fibreboards Africa Ltd, a company situated in Arusha Municipality. The company is supplied with raw materials (round wood) from Meru Forest Project which is owned by the Government through the Ministry of Natural Resources and Tourism. Apart from Meru Forest Project, the company also receives her raw material in the form of eucalyptus poles from North west Kilimanjaro Forest Project (also Govemmental owned). Logging distances range from 15 – 80 kms. The company is reached both by road and by railway, which has a station just in the neigbourhood.

The market for the transmission poles is primarily to the Tanzania electric Supply Company (TANESCO), while distribution poles are sold to TTCL and fencing poles are consumed locally in Arusha town.

Data collection

Six mechanisms for handling transmission poles at the impregnation plant were studied. The alternatives were:

- alternative one - using a 4WD front end loader,
- alternative two - using a wagon pulled by oxen,
- alternative three - using sulkies pulled by oxen,
- alternative four - using sledges pulled by oxen,
- alternative five - using a wagon pulled by a farm tractor
- alternative six - a combination of alternatives three and four as one team.

Alternatives two to six work with a stationary cable line stationed at the plant to ease loading, unloading and storing of poles at the plant.

The number of units for each alternative i.e. number of oxen, sledges and wagons, and manpower were determined to meet the plant production requirement. Also the following data were obtained:

- pole output per year 15000 pieces
- annual working days 252 days
- number of shifts per day 1
- shift length 8 hrs
- volume per pole 0.46 m^3
- density of Eucalyptus wood 670 kg/ m^3
- Pulling force of an ox 24-27% of it's weight(FAO, 1976)
- Average speed of oxen 0.8 m/s
- Efficiency of tractors 92%
- Efficiency of oxen 78%

Time study was conducted for each alternative. Time taken for loading, transportation, unloading and return trip was recorded. For alternatives two and six which work with a cable line, time for the following cable operations were recorded at Mkumbara cable line: move in and move out, chaining or chockering, and removing chockers. Other parameters for cable operation which were recorded are: load average volume, height at which the load should be lifted before is laterally moved, average distance from the plant to the stacking place, speed at which the treated poles are moved to stacking place, the speed at which the carriage moves without a load, and the speed with which the load is lifted. Cable productivity was calculated using the following formula by Mativeiko (1984):

$$P = \frac{(T - t_{move}\ ) \times h \times V_{aver}}{\frac{S}{Va} + \frac{S}{Vb} + \frac{H}{Vh} + t_c + t_{rc}}$$

Where:

P = Productivity ($m^{3)}$
T = Shift duration (hrs)
V_{aver} = Average load volume (1.38 m^3
t_{mov} = Move in and out time (s)
t_c = time for chaining or chockering (s)
t_{rc} = Time for removing chockers (s)
H = Height at which the load should be lifted before is laterally moved, (m)
S =Average distance from the plant to the stacking place (m)
V_a = Speed at which the treated poles are moved to stacking place (m/s)
V_b = the speed at which the carriage moves without a load (m/s)
V_h = the speed with which the load is lifted (m/s)
η = Mechanical advantage of the mechanism

Data analysis

Cost analysis

Costs involved in each alternative were determined. Financial indicators such as contribution margin ratio (CMR), payback period (PBP), break even point (BEP), return on investment (ROI), were calculated using the following formulae by Backman (1994):

$$CMR = \frac{CM \times 100}{Sales}\%$$

Where,
CM - Contribution margin,

$$BEP = \frac{FC \times 100}{CMR}, units$$

Where,
FC – fixed costs,
CMR – Contribution margin ratio

$$PBP = \frac{TI}{\text{Re}venue/annum}, yrs$$

Where,

TI – Total costs

$$ROI = \frac{OM}{TI + Wc}, \%$$

Where,

OM - Operating margin

Wc - Working capital

The IRR and NPV were calculated using the financial function pasted in Microsoft Excel program.

Sensitivity Analysis

Two alternatives with highest IRR (from 2.3.1) were subjected to sensitivity analysis of IRR as described by Jaako Poury (1979) in order to test the behaviour of these alternatives in an unstable business environment i.e. change in price for products, variable costs and investment.

RESULTS AND DISCUSSION

Number of Units, Manpower Requirement and Transportation Cycle

Alternative One

Number of grabber loader 1 unit
Manpower requirements 17 people
One transportation cycle took a total of 20 minutes (loading 3 minutes, transportation 10 minutes, unloading 2 minutes and return trip 5 minutes)

Alternative Two

For this alternative oxen work in a team of four as one unit and hence manpower, oxen and wagon requirements to meet daily production were as follows:

Number of oxen 6 units
Number of wagons 12
Manpower requirement 36 people

One transportation cycle took a total of 23 minutes (loading 5 min., transportation 10 min., unloading 3 min. and return trip 5 minutes.

Alternative Three

For this alternative oxen work in a team of two as one unit and hence manpower, oxen and wagon requirements to meet daily production were as follows:

Number of oxen	6 units
Number of wagon	12
Manpower requirement	30 people

One transportation cycle took a total of 23 minutes (loading 3 min., transportation 10 min., unloading 5 min. and return trip 5 minutes.

Alternative Four

For this alternative oxen work in a team of two as one unit and hence manpower, oxen and wagon requirements to meet daily production were as follows:

Number of oxen	5 units
Number of sledges	12
Manpower requirement	27 people

One transportation cycle took a total of 21 minutes (loading 3 min., transportation 10 min., unloading 3 min. and return trip 5 minutes.

Alternative Five

This alternative uses a farm tractor and requires 16 people
One transportation cycle took a total of 25 minutes (loading 10 min., transportation 5 min., unloading 5 min. and return trip 5 minutes.

Alternative Six

In this alternative oxen work in a team of two as one unit and hence manpower, oxen and wagon requirements to meet daily production were as follows:

Number of oxen	6 units
Number of wagon	12
Number of sledges	12
Manpower requirement	30 people

One transportation cycle took a total of 23 minutes (loading 3 min., transportation 10 min., unloading 5 min. and return trip 5 minutes.

The number of units, manpower requirement and transportation cycles for each alternative were calculated or adopted from the study by Kantola and Harstel (1986).

Financial Indicators

Table 1 summarizes the results of cost analysis for the six alternatives using the six financial indicators. It can be observed in the table that alternatives four and one were in first and second rank respectively.

Alternative four has more advantages that it creates the much needed employment to the local community, sledges can be locally manufactured, the quality of the treated poles is better than in alternative one, it is more environmental friendly, it can easily be adopted, and that the

required manpower can easily be trained as indicated by the on going ox-skidding project at SUA Training forest Project (Abel 1994).

Table 1: Summary of cost analysis for the six alternatives using six financial indicators.

Alternatives	FINANCIAL INDICATORS						
	CMR	PBP, yrs	BEP,mil, tsh	ROI,%	NPV, mil tsh	IRR, %	Average rank
One	43.5 (1)	1.7 (4)	229.2 (1)	41.3 (2)	46.0 (3)	52 (2)	**2.17**
Two	43.1 (3)	2.2 (6)	273.7 (5)	31.4 (6)	22.4 (6)	35 (6)	5.33
Three	43.1 (3)	1.84 (5)	259.8 (4)	35.9 (5)	42.7 (4)	44 (4)	4.17
Four	42.7 (4)	1.58 (1)	255.3 (2)	41.7 (1)	68.2 (2)	54 (1)	**1.83**
Five	43.2 (2)	1.6 (2)	292.7 (6)	40.9 (3)	68.7 (1)	48 (3)	2.83
Six	42.9 (5)	1.65 (3)	258.3 (3)	40.0 (4)	31.2 (5)	42 (5)	4.17

NB: number in bracket is the rank of the alternative in that particular financial indicator, rank 1 as the best alternative and 6 the least appropriate alternative.

Sensitivity Analysis

Figure 1 and 2 present results of the sensitivity analysis of IRR with changes in sales price, variable costs and investments for alternatives four and one respectively. The figures indicate that sales prices are the most critical factor affecting profitability. This means that a slight change in product price will result into higher changes in IRR. If the change is positive this will be very health to the company but if it is negative then profits will decrease tremendously. It can further be observed from the two figures that alternative four was more economically viable.

CONCLUSION AND RECOMMENDATIONS

It was found that alternative four followed by alternative one were the best options for handling transmission poles at the impregnation plant at Fibreboard Africa Ltd. It was further found that alternative four was more economically viable compared to alternative one.

It is recommended that alternative four which uses oxen and sledges should be adopted for handling transmission poles at the impregnation plant at Fibreboard Africa Ltd. Further, Fibreboard Africa should conduct a marketing survey and adopt marketing strategies which will help to control product prices to her advantage.

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