INVESTMENT APPRAISAL OF MECHANICAL PLANT (A case study of appraisal of D7 Bulldozer)

Anthony K. Deku[1], Boris K. Sasraku-Neequaye[2], David Amedegbe-Doe[3]

[1.] Department of Mechanical Engineering, Accra Technical University, Ghana

[2, 3] Department of Building Technology, Accra Technical University, Ghana

Abstract

This research aims at economic appraisal of a mechanical plant (D7 Bulldozer) using various economic appraisal techniques. The objectives were as follows: to determine the total ownership cost of the plant, to determine the total operating cost, to determine the running expenses, to determine the all-in-daily rate of mechanical plant and to appraise the mechanical plant economically. The various techniques of appraisal were used to assess the viability of a project involving the mechanical plant. All the key indicators were favourable. Hence any venture involving the plant is worth being undertaken.

Keywords: *Investment appraisal, Mechanical, Plant.*

INTRODUCTION

Plant is any machinery for doing work. Plant and equipment used in undertaking works are known as builder's plant or construction plant or mechanical plant.

According to Chudley (1993), items of mechanical plant ranges from small hand held power tools to larger pieces of plant such mechanical excavators and tower cranes.

Chudley (1993) attributed the following reasons for the plant. These are as follows:

(i) Increased production (ii) Reduction in overall construction costs (iii) Carry out activities which cannot be carried out by the traditional manual methods in the context of economics (iv) Eliminate heavy manual work thus reducing fatigue and as a consequence increasing productivity. (v) Replacing labour where there is a shortage of personnel with the necessary skills. (vi) Maintain the high standards required particularly in the context of structured engineering works.

Chudley(2001) and Harris & McCaffer (2006) listed economic considerations and maintenance considerations as factors to be considered before acquiring a plant.

Harris & McCaffer (2001) and Harris et al (2006), listed the methods of plant acquisition as cash or outright purchase, leasing, hiring and hire purchase. Harris & McCaffer (2001) and Harris et al (2006) argued that the decision to purchase an item of plant should be based on economic considerations because, unless it can be demonstrated that the investment will yield a satisfactory rate of return, there should be no purchase at all.

Harris et al (2006), further argued that, in practice several more factors needed to be considered before a decision is possible. They further argued that many makes of machine are available, structures the broad technical details of the products can be closely compared between different manufacturers, but often this is not possible. Intangible areas exist, such as after sales service, maintenance, delivery and payment arrangement. These are often not quantifiable and frequently take in disproportionate influence during the decision making process. Hence, all the important and complex factors involved when deciding on the purchase of an item of plant or equipment should be taken into account. Only after careful consideration of all the facts, involving many separate judgments, can a decision then be reached. Obviously, the final choice is bound to be a compromise between what the manager wants ideally, and what can be actually be obtained.

According to Harris et al (2006), the problem is been tackled in a systematic and discipline way. Kepner and Tregoe (1997) decision – making procedure developed for the design process adopted by many manufacturing Companies provides a potentially suitable method for application in construction equipment selection. Dixon (1966) described decision as follows: Decision making is compromise. The decision maker must weigh value judgment that involves economic factors, technical practicalities, scientific necessities, human and social considerations, etc. To make a "correct" decision is to choose the one alternative from among those that are available which best balances or optimizes the total value, considering all the various factors.

Chudley (1993) and Chudley et al (1996 and 2016) classified plants as excavators, transport vehicle, Hoists, Rubble chutes & Skips, Cranes, Concreting plants, etc.

All plant depreciates with age or usage. Harris et al (2006) defined depreciation as the loss of value due to usage or age. A contractor normally recovers this loss by including a sum of money equivalent to the depreciation cost in his rates for doing the work or hiring out the plant. Harris et al(2006), Chudley (1996) and Chudley et al (2006 ,2014 and 2016), listed the methods of deprecation as the straight line depreciation, declining balance depreciation, sinking fund method of depreciation, Sum of digits methods, and free depreciation. Harris and McCaffer (2001) and Harris and McCaffer (2006) listed other methods of depreciation as discounted cash flow method, the effect of inflation method and marginal costing. Chudley (1996, 1998 and 2016) also added the capital outlay method.

According to Chudley (1993) and Chudley et al(2006 and 2016), bulldozers are machines that consist of a track or wheel mounted power units with hydraulic rams. Many bulldozers have the capacity to adjust the mould blade about a central swivel point. Some bulldozers can also be fitted with rear attachments such as rollers and scarifies.

Chudley (1993 and 1998) and Chudley et al (2016) listed the main functions of bulldozers as follows;

(i) Shallow excavations up to 300mm deep either on level ground or sidehill cutting
(ii) Clearance of Shrubs and small trees
(iii) Clearance of trees by using raised mould blade as a pusher arm
(iv) Acting as a towing tractor
(v) Acting as a pusher to scraper machine.

According to The Association for Project Management (APM) (2016), Investment appraisal is a collection of techniques used to identify the attractiveness of an investment. The purpose of investment appraisal is to assess the viability of project, programme or portfolio decisions and the value they generate. In the context of a business case, the primary objective of investment appraisal is to place a value on benefits so that the costs are justified.

According to the APM (2016), there are many factors that can form part of an appraisal. These include:

- financial – this is the most commonly assessed factor;
- legal – the value of an investment may be in it enabling an organisation to meet current or future legislation;
- environmental – the impact of the work on the environment is increasingly a factor when considering an investment;
- social – for charitable organisations, return on investment could be measured in terms of 'quality of life' or even 'lives saved';
- operational – benefits may be expressed in terms of 'increased customer satisfaction', 'higher staff morale' or 'competitive advantage';

- risk – all organisations are subject to business and operational risk. An investment decision may be justified because it reduces risk.

A financial appraisal is the most easily quantifiable approach but it can only be applied to benefits that produce financial returns.

The simplest financial appraisal technique is the payback method. The payback period is the time it takes for net cash inflow to equal the cash investment. This is a relatively crude assessment and is often used simply as an initial screening process.

A better way of comparing alternative investments is the accounting rate of return (ARR) which expresses the 'profit' as a percentage of the costs. However, this has the disadvantage of not taking into account the timing of income and expenditure. This makes a significant difference on all but the shortest and most capital-intensive of projects.

In most cases, discounted cash flow techniques such as net present value (NPV) or internal rate of return (IRR) are appropriate to evaluate the value of benefits and alternative ways of delivering them. NPV calculates the present value of cash flows associated with an investment; the higher the NPV the better. This calculation uses a discount rate to show how the value of money decreases with time. The discount rate that gives an investment a NPV value of zero is called the IRR. NPV and IRR can be compared for a number of options.

Appraisal of capital-intensive projects and programmes should take into account the whole-life costs across the complete product life cycle as there may be significant termination costs. In the case of the public sector, where income is usually zero, it is common practice to identify the option with the lowest whole-life cost as the option that offers the best value for money.

The appraisal on less tangible and non-financial factors is more subjective. In some cases, a financial value may be calculated by applying a series of assumptions. For example, work that improved staff morale may lead to lower staff turnover and reduce recruitment costs. A financial appraisal of this benefit would have to include assumptions about the numerical impact of increased morale on staff turnover and the estimated costs of recruitment.

Where benefits cannot be quantified then scoring methods may be used to compare the subjective value of benefits. This research seeks to appraise the economic viability of a project involving a mechanical plant (D7 Bulldozer)

AIM: The research aims at appraising a business venture involving a mechanical plant (D7 Bulldozer) using various investment appraisal techniques.

Objectives:

(i) To determine the total ownership cost of the plant per day
(ii) To determine the operating cost of the plant per day
(iii) To determine the running cost of the plant per day
(iv) To determine the all-in-daily rate of the plant
(v) To determine the purchase factor of the plant
(vi) To carry out investment appraisal of the plant

Methodology: Primary and Secondary sources of data were employed. This was achieved through informal interview with suppliers of plant and equipment, financiers, literature review of previous theses, journals and textbooks. The data collected were then analysed using investment appraisal methods, like the simple payback method, discounted payback method, profitability index, present worth and net present values. The results were then analysed and conclusions drawn.

Data

Initial cost: $186,000.00

Anticipated economic life = 5 years, Average utilization of plant in a year = 100 days

Resale value = $26,000

Working hours in a day = 8 hours

Interest rate = 30% p.a.

Exchange rate = US$ 1.00 = GHS4.50

Overhead expenses = 10%

Operator's wage = GHS 100 per day

Banksman's wages = GHS40 per day

Repairs and Renewals - 25%

Transport to and from site = GHS1,500.00

Number of sites visited a year = 5

Fuel and Lubricants at 30%

Insurance at 10%

A. Ownership Cost per day

Purchase Price = $186,000

Resale value = $26,000

(i) Total Depreciation $186,000 - $26,000

Total Depreciation = $160,000

(ii) Total Depreciation in Ghana cedis = $160,000 x GHS 4.50
= GHS720,000

(iii) Depreciation per day = $\frac{\text{GHS 720,000}}{5 \times 100}$ = GHS1,440.00

Interest rate = 30% of GHS 1440 = = GHS 432.00

Insurance a 10 of GHS 1440 = = GHS144.00

Wages of Operator &Banksman to be

GHS (100 + 40) = GHS 140.00

Total ownership cost per day = **GHS 2,156.00**

B. Operating Cost per day

(i) Repairs & renewals at 25% of GHS 1440 = GHS 360.00

(ii) Transport to and from site at 5 sites per

Year @ GHS 1500 = $\frac{\text{GHS 1500 x 5}}{100}$ = GHS75.00

Operating Cost per day = **GHS 435.00**

C. Running Expenses

Fuel and Lubricant at 30% of GHS1440 = GHS 432.00

Total cost per day = Ownership + Operating + Running

Cost per day Cost per day Expenses

Total cost per day = GHS 2,156+GHS 435.00 +GHS 4.32 = GHS 3,023.00

Overhead = 10% of GHS3,073.00 = GHS302.30

All – in = daily rate = GHS 3023.00 +GHS302.30 = GHS3,325.30

D. Purchase Price Factor (PPF)

$$P.P.F = \frac{\text{All} - \text{in} = \text{daily rate}}{Purchase\ Price\ (P)} = \frac{GHS\ 3325.30}{\$186000 * 4.5}$$

$$P.P.F = \frac{\text{All} - \text{in} = \text{daily rate}}{Purchase\ Price\ (P)} = 0.003973$$

P.P.F. = 0.003973

All – in – daily rate = 0.003973 x Purchase price

All – in – daily rate = **0.003973P**

INVESTMENT APPRAISAL OF THE MECHANICAL PLANT

Using the appraisal methods proposed by Steven (2008),Scarlett (2009),APM (2006,2008,2012 and 2016) and Gotze et al (2015). The following results were obtained.

(a) Purchase Price = $186,000 x GHS 4.50 = GHS837,000.00

(b)Annual revenue per day = hire rate per day x number of working days per year

= GHS 3,325.30 x 100

= GHS 332,530.00

(i) INVESTMENT APPRAISAL USING SIMPLE PAY BACK METHOD

$$Pay\ back\ period = \frac{Initial\ Investment}{Annual\ Rturns} = \frac{GHS\ 837{,}000}{GHS\ 332{,}530}$$

Payback period = **2.517 years**

(ii) APPRAISAL USING DISCOUNTED PAYBACK METHOD (D.C.F.)
(Interest rate = 30% p.a.) Table 1

Year 0	Returns (GHS)	D.C.F.	NPV GHS	Cumulative NPV GHS
0	(837,000)	1.00000	(837,000)	(837,000)
1	332,530	0.76923	255,792.05	(581.207.95)
2	332,530	0.59172	196,764.65	(384,442.30)
3	332,530	0.45517	151,357.68	(233,085.62)
4	332,530	0.3013	116,428.73	(116,656.89)
5	332,530	0.26933	89,560.30	(27,096.89)
6	332,530	0.20718	68,893.57	41,796.68

Payback Period (Time) = 5 years + (27,096.9 x 12 months)
68,893.57

Payback Period = 5 year 4.72 months

Payback Period = **5 years 5 months**

(iii) Net Present Value (NPV)

∑PV = Summation of Present Values

$$\sum PV = \sum_{i=1}^{6} \frac{1}{1.30^{i}} = \frac{1}{1.30^{1}} + \frac{1}{1.30^{2}} + \frac{1}{1.30^{3}} + \frac{1}{1.30^{4}} + \frac{1}{1.30^{5}} + \frac{1}{1.30^{6}}$$

∑PV = 2.64276

Total NPV = Gross Present value – Initial Investment

= [(2.64276) (GHS 332,530)] – [GHS 837,000]

= GHS 878,796.98 – GHS837,000.00

= GHS 41,796.98

(iv) Average Rate of Return (A.R.R.)

A.R.R. = Average returns x 100%
Initial investment

A.R.R = GHS 332,530 x 100%
GHS 837,000

A.R.R. = 39.729%

(V) **Profitability Index (P.I)** = ∑ Benefits
∑ Initial Investment

P.I = GHS 878,796.98
GHS 837,000.00

P. I = 1.0499 = **1.05**

(VI) **Present Worth (PW)**

Present Worth = Initial Cost + Present value of all maintenance over 5 years

Maintenance Cost per year = 25% of Annual revenue

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= 25% of GHS 332,530.00
= GHS 83,132.50

Present Worth = GHS 837,000.00 + [(2.64276) (GHS 83,132.50]

PW = GHS 837,000.00 + GHS 219,699.25

PW = **GHS 1,056,699.25**

COMMENTS AND ANALYSIS

(I) Ownership Cost: Amoa-Mensah (1995) and Amoa-Mensah (2016), stated that ownership cost comprises capital cost and interest, deprecation cost, insurance and licenses and operator's wages.Analysis of these gave a total ownership cost of GHS 2,156.00. This constitutes 64.84% of the all – in – daily rate.

(II) Operating Cost: According to Amoa-Mensah (1995) and (2016), operating cost comprises renewals and repairs,transportation of plant to and from site as well as installation and utilization during its economic life. Harris and McCaffer (2001) and Harris et al (2006), stated that operating cost comprises running and repair cost, licenses and insurance cost and overhead. From the analysis operating cost per day was GHS 435.00 which is the sum of repairs and renewals at twenty-five per cent (25%) of the depreciation and cost of transportation. This constitutes 13.05 % of the all – in – daily rate.

(III) Running Costs: According to Amoa-Mensah (1995) and (2016), running expenses include consumables like fuel, resale value and overhead expenses. Harris et al (2001) and Harris et al (2006), stated that running costs include fuel and lubricants. Futher, the cost of fuel and lubricants varies with size, type and age of the equipment. From Calculations based on the West African Estimating manual, the running expenses per day was GHS 432.00 This constitutes 12.99% of the all – in – daily rate.

Breakdown of all – in – daily rate: Table Two (2)

Item	Cost Component	Amount GHS	Percentage of Total
1	Ownership cost	2,156.00	64.84
2	Operating cost	435.00	13.08
3	Running Cost	432.00	12.99
4	Overhead	302.30	9.09
5	Total Cost	3,125.30	100.00

Results

(i) The ownership cost per day for the plant is GHS 2156.00

(ii) The operating cost per day is GHS 435.00

(iii) The running Cost per day is GHS 432.00

(iv) The total cost per day for the plant is GHS 3023.00

(v) The all – In – daily rate for the plant is GHS 3,325.30

(vi) Using the simple payback method, the payback period is 2.517 years

(vii) Using the Discounted cash flow method, the payback period is 5 years 5 months

(viii) The total net present value for the plant is GHS 41,796.99 which confirms a similar figure of GHS 41,796.68 obtained from Table 1

(ix) The average rate of return is 39.729%

(x) The Profitability index is 1.05

(xi) The present worth of the plant is GHS 1,056,699.25

Conclusion:

From the results and investment appraisal methods, the project involving the plant is economically viable or feasible. Since all the indicators such as the Net Present Value and the profitability index are favourable.

From these data the plant venture will be profitable and feasible.

REFERENCES

[1] Amoa-Mensah (1995) Building Estimating Manual for West Africa,2nd Edition, Parcom Ghana Ltd, Kumasi

[2] Amoa-Mensah (2016) Building Estimating Manual for West Africa,3rdEdition, Construction Exchange, Accra

[3] APM (2006) Book of Knowledge, 5thEdn, APM, Wycombe, UK

[4] APM (2012) Book of Knowledge, 6thEdn, APM, Wycombe, UK

[5] APM (2006) Introduction to Programme Management,2ndEdn, APM, Wycombe, UK

[6] APM (2008) Introduction to Project Planning, APM, Princes Risborough, Buckinghamshire.

[7] Chudley, R. (1993) Construction Technology Volume 4. Longman Comp. Ltd, Harlow, Essex.

[8] Chudley, R (1996) Construction Technology Handbook, 2nd Edn, Butterworth – Heinemann, London.

[9] Chudley, R (1998) Construction Technology Handbook, 3rdEdn, Butterworth – Heinemann, London

[10] Chudley, R (2001) Construction, Technology Handbook, 4thEdn, Elsevier, London

[11] Chudley, R. and Greeno, R (2006) Construction Technology Handbook, 7thEdn, Elsevier, London

[12] Chudley, R. and Greeno, R (2016) Construction Technology Handbook, 11thEdn, Elsevier, London

[13] Dixon, J.R (1966) Design Engineering – Inventiveness Analysis and Decision making McGraw –Hill, New York.

[14] Gotze et al (2015) Investment Appraisal Methods and Models,Springer,Berlin.

[15] Harris, F and McCaffer, R. (2001) Modern Construction Management 5thEdn, Blackwell Publishing, Oxford.

[16] Harris, F and McCaffer, R (2006), Modern Construction Management, 6thEdn,Blackwell Publishing, Oxford.

[17] Kepner, CH &Tregoe, B.B (1997) The New Rational Manager – An updated Edition for a New World, Kepner-Tregoe, Princeton, NJ

[18] Scarlett,B (2009) The Official CIMA Learning System-Performance Operation, CIMA Publishing

[19] Steven,G (2008)''Management Accounting-Decision Management", Financial Management, March 2008.