DETERMINATION OF DEPRECIATION OF CONSTRUCTION LOGISTICS (A CASE STUDY OF USING VARIOUS METHODS TO DETERMINE THE DEPRECIATION OF D7 BULLDOZER)

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Abstract - This research aims at determining the depreciation of a construction logistics (D7 Bulldozer) using various methods. The methods chosen were the straight line, Sinking fund, capital outlay, sum of digits and declining balance. The objectives were as follows: to determine the total depreciation, to determine the annual depreciation, to determine the hourly depreciation, to determine the daily and weekly depreciation of the plant. The various methods were used to compute the total depreciation, annual depreciation, hourly depreciation, daily depreciation and weekly depreciation of the construction plant. The results were compared and analysed to select the best method for determining depreciation. The capital outlay method was selected as the best method.

Keywords - Depreciation, Plant, straight line method, Logistics.

I. INTRODUCTION

The Oxford Dictionary (2016) defines logistics as the branch of military science relating to procuring, maintaining and transporting material, personnel and facilities. The New Oxford American Dictionary (2016) defines logistics as the detailed coordination of a complex operation involving many people, facilities or supplies. The Oxford Dictionary Online (2017) defines logistics as the detailed organization and implementation of complex operation. The Council of Supply Chain Management Professionals (2013),also defined logistics as the process of planning, implementing, and controlling procedures for the efficient and effective transportation and storage of goods including services and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirements and includes inbound, internal and external movements. The Business Dictionary (2016), defines logistics as the planning, execution and control of procurement, movement and stationing of personnel, material and other resources to achieve the objectives of a campaign, plan, project or strategy. Logistics can further be defined as the management of inventory in motion and at rest. Dictionary.com (2016), defined logistics as the planning, implementation and coordination of the details of a business or other operation.

Logistics can be classified as inbounds and outbounds logistics. Fields of logistics include procurement logistics, distribution logistics, reverse logistics, emergency logistics, production logistics, domestic logistics, digital logistics, construction logistics, military logistics and many others. Resources managed in logistics can include physical items such as food, materials, animals, equipment, and liquids as well as abstract items, such as time and information. The logistics of physical items involves the integration of information flow, material handling, production, packaging, inventory, transportation, warehousing and often security. Resources used in construction include management expertise, capital, machinery, manpower and materials

A 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 being 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) 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), 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) also added the capital outlay method.

According to Chudley (1993) and Chudley et al(2006), bulldozers are machines that consist of a track or wheel mounted power units with a hydraulic ram. 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) listed the main functions of bulldozers as follows;

1. Shallow excavations up to 300mm deep either on level ground or sidehill cutting
2. Clearance of Shrubs and small trees
3. Clearance of trees by using raised mould blade as a pusher arm
4. Acting as a towing tractor
5. Acting as a pusher to scraper machine.

AIM: This study aims at determining the depreciation of a mechanical plant (D7 Bulldozer) using various methods of depreciation.

Objectives:

1. To determine the total depreciation of the construction plant
2. To determine the annual depreciation of the plant
3. To determine hourly depreciation of the Plant
4. To determine the daily depreciation of the Plant
5. To determine the weekly depreciation 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 analyzed using the straight line method, declining balance method, sinking fund method, sum of digits method and capital outlay method.

DATA

Cost of D7 Bulldozer = $186,000
Anticipated economic Life = 5 years

Average utilization = 1000 hours per year
Resale value = $26,000
Working hours in a day = 8 hours
Number of working days in a week = 5
Interest rate =8% p.a
Analyses of Depreciation

A. Using the straight line method

(i) Total Depreciation = Cost Price – Salvage value
Total Depreciation = $186,000 - $26,000
Total Depreciation = $160,000

(ii) $\text{Annual Depreciation} = \frac{\text{Total Depreciation}}{\text{Anticipated Economic Life}} = \frac{\$160{,}000}{5 \text{ years}}$

Annual Depreciation = $\frac{\$160{,}000}{5 \text{ years}}$ = $32,000 per year

(iii) Hourly Depreciation = $\frac{\text{Annual Depreciation}}{\text{Average utilization per year}}$

Hourly Depreciation = $\frac{\$32{,}000}{1000 \text{ hours}}$ = $32.00 per hour

(iv) Daily Depreciation = Hourly Depreciation x 8 hours

Daily Depreciation = $32.00 per hour x 8 hours

Daily Depreciation = $256.00

(v) Weekly Depreciation = Daily Depreciation x 5 days
= $256 x 5
= $1,280.00

B. Using Capital Outlay method
(i) Capital Cost = $186,000.00
Compound interest on capital
(8% for 5 years) = $87,295.02
= $273,295.02
Deduct resale value = $26,000.00
Total Depreciation = 247,295.02

(ii) Annual Depreciation = $\frac{\text{Total Depreciation}}{\text{Anticipated Economic Life}} = \frac{\$247{,}295.02}{5 \text{ years}}$

Annual Depreciation = $49,459.00 per year

(iii) Hourly Depreciation = $\frac{\text{Annual Depreciation}}{\text{Average utilization per annum}}$

Hourly Depreciation = $\frac{\$49{,}459.00}{1000 \text{ hours}}$ = $49.46 per hour

(iv) Daily Depreciation = Hourly Depreciation x 8 hours

Daily Depreciation = $49.46 per hour x 8 hours

Daily Depreciation = $395.68

(v) Weekly Depreciation = Daily Depreciation x 5 days
= $395.68 x 5
= $1,978.40

C. Using the Declining Balance Method

$$d = \left[\left(1 - \sqrt[n]{\frac{L}{P}}\right) * 100\right]$$ L= Salvage value d= Depreciation

P = Purchase Price

N = Life of asset

$$d = \left[\left(1 - \sqrt[5]{\frac{26000}{186000}}\right) * 100\right]$$

d = [(1 – 0.674671) x 100%]

d = 32.53%

Table 1 : Depreciation using Declining Balance Method

End of Year	Depreciation (%)	Depreciation for year $	Book Value $
0	32.53	0	186,000.00
1	32.53	60,505.80	125,494.00
2	32.53	40,823.26	84,670.94
3	32.53	27,543.46	57,127.48
4	32.53	18,543.57	38,543.91
5	32.53	12,543.91	26,000.00

Total Depreciation = $160,000

Total Depreciation = $186,000 - $26,000 = $160,000

D. Using the Sinking Fund Method

Sinking Fund Factor = $I/[(1+I)^n - 1] = 0.08/[(1.08)^5 - 1] = 0.1705$

Sinking Fund Factor= 0.1705

Table 2 : Depreciation Using the Sinking Fund Factor

Year	Payment $	Interest $	Depreciation $	Book value
1	27,280	0	27,280	158,720
2	27,280	2,182.40	29,462.40	129,257.10
3	27,280	4,539.39	31,819.39	97.438.21
4	27,280	7,084.94	34,364.94	63,114.14
5	27,280	9,834.14	37.114.14	26,000.00

Total Depreciation = $160,040.87

E. Using the Sum of Digits Method

Number of Years = 5 years

Sum of Digits = 1 +2 +3 + 4 + 5

Table 3: Depreciation Using the Sum of Digits Method

Year	Factor	Depreciation $	Book Value
1	5/15	53,333.33	132,66.67
2	4/15	42,666.67	90,000.00
3	2/15	32,000.00	58,000.00
4	2/15	21,333.33	36,666.67
5	1/15	10,666.67	26,000.00

Total Depreciation = $160,000.00

COMMENTS

(a) ANALYSIS USING THE DECLINING BALANCE METHOD

Using the Declining Balance method the following results were obtained;

(i) Total Depreciation = $186,000 - $26,000 = $160,000.00

(ii) Annual Depreciation for year 1 = $60,505.80

(iii) Hourly Deprecation for Year 1 = $\frac{\$60,505.80}{1000 \text{ hours}}$ = $60.57/hour

iv)Daily Depreciation for Year 1 = $60.57/ hour x 8 hours

= $484.08

v) Weekly Depreciation for year 1 = $484.08 x 5
= $2420.40

Since the depreciation varies for the various years, the annual, hourly, daily and weekly depreciation will also vary for the subsequent years. Table One (1) can be used to get the total depreciations for the respective years.

(b) ANALYSIS USING THE SINKING FUND METHOD (FROM TABLE 2)

i) Total Depreciation = $186,000 - $26,000 = $160,000.00

ii) Annual Depreciation for year 1 = $ 29,462.40 (from table 2)

iii) Hourly Depreciation for year 1 = $\frac{\$29,462.40}{1000 \text{ hours}}$
= $ 29.46/hour

iv) Daily Depreciation for year 1 = $29.46/hour x 8 hours
= $235.68

v) Weekly Depreciation for year 1 = $235.68 x 5
= $1,178.40

From the calculations, the annual depreciations varies for all the years. Hence the annual, hourly, daily and weekly depreciations will also vary for the subsequent years.Table Two (2) can be used to get the total depreciations for the respective years.

(c) ANALYSIS USING THE SUM OF DIGITS
From Table Three (3)

i) Total Depreciation = $186,000 - $26,000 = $160,000.00

ii) Annual Depreciation for year 1 = $53,333.33

iii) Hourly Depreciation for year 1 = $\frac{\$53,333.33}{1000 \text{ hours}}$
= $53.33/hour

iv) Daily Depreciation for year 1 = 53.33/hours x 8 hours
= $426.64

From the calculation, the depreciation for the various years are different. The depreciation varies for the various years, hence their respective hourly, daily and weekly depreciation will also vary. Table Three (3) can be used to get the total depreciations for the respective years.

RESULTS

1. Using the straight line method the following results were obtained;

(a) The total depreciation was $160,000
(b) The annual depreciation was $32,000
(c) The hourly deprecation was $32.00
(d) The daily depreciation was $256.00
(e) The weekly depreciation was $1,280

These findings affirm earlier findings by Deku, Sasraku-Neequaye and Amedegbe-Doe (2017).

2. Using the Capital outlay method the following results were obtained;

a) The total depreciation was $273,295.02
b) The annual depreciation was $49,459.00 per annum
c) The hourly depreciation was $49.46 per hour
d) The daily depreciation was $395.68
e) The weekly depreciation as $1,978.40

These findings affirm earlier findings by Deku, Sasraku-Neequaye and Amedegbe-Doe (2017)

3. Using the declining balance method;

a) The total depreciation was $160,000.00
b) The annual depreciation ranges from $60,505.80 in the year one to $12,543.91 in the five. Hence the corresponding hourly, daily and weekly depreciations will also vary. The deprecation is highest in year one and very low in year five.

4. Using the Sinking fund method;

a) The total depreciation was $160,040.87 instead of $160,000. The difference was due to approximation using the sinking fund factor.
b) The annual depreciation ranges from $27,280 in year one to $37,114.14 in year five. Hence the corresponding daily, weekly and hourly depreciation for the various years will also vary.
c) The depreciation is lowest in year one and rises gradual to the highest in year five.

5. Using the sum of digits;

a) The annual depreciation is $160,000.00
b) The annual depreciation for the various years varies from $53,333.33 in year one to $10,666.67 in year five. The depreciation is highest in year one and reduces gradually to $10,666.67 in year five.

CONCLUSION

Irrespective of the method chosen, the total depreciation was $160,000 over the lifespan of the Plant.

1. Annual depreciation for the plant is dependent on the method of depreciation chosen. The annual depreciation varied based on the method used. The annual depreciation for the plant was not uniform it varies from a low of $10,666.67 using the sum of digits method to a high of $60,505.50 using the declining balance method.
2. The daily, hourly and weekly depreciation will also vary depending on the method of depreciation used.
3. The Capital outlay and the Straight line methods gives a simplistic and ease methods of determining depreciation.

Though all the various methods of depreciation have their merits and demerits, the Capital outlay method is simple, easier to use, more reliable and accurate.And thus have an edge over other methods based on this study.

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