Depreciation Bases of Equipments Used for Construction of Cross Country Pipelines : A Rational and Systematic Framework

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Abstract

In cross country pipeline projects, pipelines are constructed with the help of particular types of plant and machinery subject to depreciation in the process of being used for the construction work. The present study (empirical in nature) identified and selected the equipments which play a key role in construction of pipelines. The present work is based on collection of data pertaining to useful life and rate of depreciation of pipeline construction equipments from 12 equipment users in the country. The data were analyzed with the application of statistical tool and SPSS software. For pipeline construction agencies, depreciation is considered as a part of the cost of construction of projects. The present study reported that depreciation needs to be charged on pipeline construction equipments.

Keywords : **depreciation, construction, equipment, pipeline, useful life**

JEL Classification : L64, L74, L95

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Cross country pipelines are laid for transportation of natural gases and petroleum products. Pipelines are laid between two distant places (one corner of one country to another corner, or from one country to another country passing through cities, deserts, under rivers, through creaks, under railway tracks, under highways, over hills and mountains. The laying of these pipelines is decided as per the available/possible shortest routes as well as the quantities to be transported. The size and pipe material is decided as per the composition of the products that would be transported through the pipelines. The stations between the start and end point are decided as per the distance and the terrain. Pumping stations, pigging stations, and receiving stations are located as per the requirement. The initial survey in all respects is carried out for feasibility of the project. The best possible route is decided and even en-routed, if needed.

The land acquisition formalities are started by the government authorities as notices are required to be served to the land owners before the pipeline job is started. The land is normally acquired from the farmers; the owner's compensation for the crops is decided, and the formal statements are recorded; the profiles are noted so that land in the same profile and condition is handed over back to the owners/farmers after the pipeline has been laid. The pipelines are laid underground at a depth depending on the terrain and soil conditions.

The pipeline work starts with surveying and cleaning the right-of-way (ROW). The ROW is a narrow strip of land that contains the pipeline(s) and where all onsite construction activities occur. It is surveyed, cleared of

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bushes and trees, and is levelled so that the workers can use the equipment to build, inspect, and maintain the pipeline. The right-of-way (ROW) is graded to allow the movement of excavators, other pipeline equipment, and materials for carrying out pipeline construction activities. The next activity is hauling and stringing the pipes. The pipes are lined up along the right-of-way as per the alignment sheet for welding. The next activity is bending the pipes as the pipeline must cross over hills and curves around special places such as lakes and mountains. To accomplish this, the horizontal and vertical bends are required to lay the pipelines. After the laying of pipes, the welding is carried out.

The next activity is digging the trench and lowering-in of the pipeline section. This activity precedes backfilling and padding to protect the pipe coating from potential damage. Next comes hydrostatic testing of the laid section of the pipeline followed by final cleaning up. During the final cleaning of right-of-way, the temporary facilities such as camps and temporary working stations are reclaimed. The areas which were taken from the farmers are built to their original condition or are compensated.

From the above description, it is apparent that the laying of pipelines is a specialized work and for carrying out all the said activities, special pipeline construction equipments are required. Every company follows a depreciation policy of its own for its fixed assets and uses a method of its own choice for computing depreciation. In this research paper, several pipeline construction companies were consulted, who had the relevant data on improvement aspects, say, the extent of use of all these construction equipment in day to day construction, their wear and tear, and useful life of the equipment; these inputs were used for computing the depreciation of these pipeline construction equipment. The primary data for the study were collected during the time period from 2012-2013 by interviewing the project managers of different pipeline construction agencies. The present research paper was developed using these data.

For better exposition, the subject matter of this paper is divided into six sections. The Section-A contains the literature review and research methodology. The Section-B provides a short description of all the pipeline construction equipments which we included in our study, mentioning therein the technical specifications, types of equipment, name of the manufacturer, and use of the equipment. The Section-C explains, in detail, about the survey tool used for collecting data pertaining to useful life and rate of depreciation of the equipment from different equipment manufacturers. The Section-D deals with the statistical analysis of the collected data and the acceptance criteria of the data, which was ultimately used for computation of depreciation. The Section-E details the procedure followed for computing depreciation of pipeline construction equipments using diminishing balance method, which is regarded as the most appropriate as far as construction equipments are concerned. This section also contains concluding observations on the subject. The Section-F is the penultimate section, which presents the research implications, limitations of the study, and scope for further research.

Section - A

Literature Review

Depreciation is a measure of wearing out, consumption, or other loss of value of a depreciable asset arising from use, effluxion of time, or obsolescence through technology and market changes. Depreciation is allocated so as to charge a fair proportion of the depreciable amount in each accounting period during the expected useful life of the asset. Depreciation includes amortization of assets whose useful life is predetermined ("Report by expert committee on computation of depreciation on extra shift workings," 2012). The useful life is the period over which a depreciable asset is expected to be used by the enterprise. The determination of the useful life of a depreciable asset is a matter of estimation and is normally based on various factors, including experience with similar types of assets. The useful life of a depreciable asset should be estimated after considering the following factors (Accounting Standard (AS) 6., n.d.):

(1) Expected physical wear and tear,

(2) Obsolescence, and

(3) Legal or other limits on the use of the asset.

According to the Expert Advisory Committee of the Institute of Chartered Accountants, useful life is either (a) the period over which a depreciable asset is expected to be used by the enterprise, or (b) the number of production or similar units expected to be obtained from the use of the asset by the enterprise ("Report by expert committee on rates of depreciation on various assets involved in mass rapid transport system," 2007). The Indian Accounting Standard explains the term 'useful life' as follows (Accounting Standard (AS) 6. , n.d.) :

The useful life of a depreciable asset is shorter than its physical life and is:

(1) Pre-determined by legal or contractual limits, such as the expiry dates of related leases,

(2) Directly governed by extraction or consumption,

(3) Dependent on the extent of use and physical deterioration on account of wear and tear which, in turn, depends on operational factors, such as, the number of shifts for which the asset is to be used, repair and maintenance policy of the enterprise, and so forth, and

(4) Reduced by obsolescence arising from factors such as :

(a) Technological changes,

(b) Improvements in production methods,

(c) Change in market demand for the product or service output of the asset, or

(d) Legal or other restrictions.

In arriving at the rate at which depreciation should be provided, the company should consider true commercial depreciation, that is, the rate which it is adequate to write off the asset over its useful life based on the technological estimates of the management. In case, the useful life so worked out is less than the life arrived at as per the rates prescribed by the Government of India ("Rates of depreciation as per Companies Act, 1956: Schedule XIV," n.d.), the higher rate of depreciation, so arrived at, is applied. However, in case the useful life works out to be longer, that is, the rate so arrived at is lower, then the rate prescribed by the statute (the rates prescribed in the relevant statute) ("Rates of depreciation as per Companies Act, 1956: Schedule XIV," n.d.) should be applied. Charging of depreciation as per the straight line method rates, based on estimated useful lives of the assets as per the provisions of the Indian Accounting Standard (Accounting Standard (AS) 6. , n.d.) would be a proper charge, provided such rates are allowed by the Ministry of Company Affairs as per the Companies Act, 1956 ("Rates of depreciation as per Companies Act, 1956: Schedule XIV," n.d.).

Research Methodology

For computing the cost of depreciation of equipment, it is imperative to find out the useful life and rate of depreciation of the equipment. For computing the useful life and rate of depreciation of pipeline construction equipment, 12 pipeline construction agencies were contacted and information on useful life and rate of depreciation were collected from them. The data collected were analyzed with the application of Student's *t* - distribution method by using SPSS, and the accepted value of useful life and rate of depreciation of all the equipments were arrived at. Thereafter, the depreciation cost was computed using diminishing balance method (the reason is that the 'new' equipment should be subject to a higher amount of depreciation, because being more productive, with the passage of time, its productivity decreases and, therefore, an 'old' equipment should have less amount of depreciation).

Section - B

Cross Country Pipeline Equipments

The equipments which are used for construction of pipelines are listed in Exhibit 1 :

Exhibit 1 : Equipments used for construction of a pipeline :

(1) Lifting Equipment :

(a) Pipe layers (side booms), **(b)** Crawler cranes, **(c)** Hydraulic telescopic cranes

(2) Welding Equipment :

(a) Welding tractor (Pay welders), **(b)** Diesel welding machines, **(c)** Manual, semiautomatic welding machine (diesel driven or AC powered)

(3) Induction heating & stress relieving machines

(4) Hydraulic pipe bending machines

(5) Horizontal boring machines

(6) Horizontal directional drilling

(7) Hydrostatic test equipment :

(a) Pressure pumps, **(b)** Filling pumps, **(c)** Dosing pumps

(8) Air Dryers

(9) Sand blasting hopper

(10) Earth moving equipment :

(a) Hydraulic excavators back hoes, **(a)** Dozers with ripper attachments, **(c)** Motor graders, **(d)** Hydraulic and mechanical trenchers, **(e)** Rock breaker

(11) Transport Vehicles :

(a) Low bed trailers, **(a)** Flat bed trailers

(12) Dewatering Equipment :

(a) Dewatering pumps, **(b)** Mud pumps

Table 1. Capacity of Excavators of Different Makes

Manufacturer	Bucket Capacity (Cubic Meter)	Capacity of Excavator (Horse Power)
Caterpillar	0.35 - 24	17.4 - 54 - 755 - 1470
Liebherr	0.9 - 34	120 - 3000
Samsung	0.9 - 1.25	112
Kobelco	0.3 - 3.25	35 - 300
Mitsubishi	0.03 - 0.9/1.0/1.5/1.7/3.5	54 - 135 - 300

Table 2. Capacity of Bulldozers of Different Makes

Manufacturer	Capacity (Horse Power)
Caterpillar	70 - 770
Komatsu	40 - 1150
Liebherr	105 - 330

Table 3. Capacity of Backhoe Loaders of Different Makes

Manufacturer	Bucket capacity (Cubic Meter)	Capacity (Horse Power)
Marshall	0.2 - 1.2	51
Caterpillar	0.24 - 1.0	74 - 95
Gmmco	0.3 - 1.0	82
L & T Case	0.24 - 0.90	72
Escorts JCB	0.24 - 1.0	76 - 96

Table 4. Capacity of Motor Grader of Different Makes

Manufacturer	Blade capacity (Feet)	Capacity(Horse Power)
Caterpillar	12	120, 140, 165, 500
Fiat Hitachi	12	140
Volvo/Champion	12	155, 160, 170
Kamotsu	12.2	135, 155

Table 5. Capacity of Different Makes of Pipe Layers

Manufacturer	Boom length (Feet)	Capacity (Tons)
Caterpillar	18, 24	14 - 90 - 104
Komatsu	18, 24	14 - 90 - 110

Uses of Different Construction Equipment

The uses of different specialized construction equipment are described in the following section :

Earth Moving Equipment

Equipments which are used for excavation, earth filling, dumping and waste disposal, river or canal digging are designated as earth moving equipment.

➲ **Excavators :** These are mechanical and hydraulic operated with back hoes having different bucket capacities and different lengths of boom and stick one-piece (mono block) or two pieces (twin) boom and arm (stick) with different types and sizes of bucket. These are extensively used in everyday work at sites. The capacity of excavators - and that of its bucket - of different reputed makes is given in the Table 1.

➲ **Bulldozers :** This equipment has blades of different types such as straight, angle, universal, semi-universal for different uses with multi or single shank ripper attachment. Selection of the dozer is done as per the job requirement. Dozer capacity, type of blade for different applications such as U-blades, V-tree cutter blade, landfill blades, and so forth should be determined before selecting the machine. The capacity of bulldozers of different makes is given in the Table 2.

➲ **Backhoe Loaders :** Backhoe loaders are a very versatile piece of equipment for earth moving jobs. It has the versatility to handle excavation, loading, dozing, grading, grabbing, backfilling, trenching, and rock breaking. These have the ability to move on any terrain. The capacity of this equipment and of different makes is given in the Table 3.

➲ **Motor Grader :** This equipment is used for grading uneven earth surface and is used during preparation of Right-of-way (ROW). The capacity of different makes of this equipment is given in the Table 4.

Table 6. Capacity of Rock Breaker of Different Makes

Manufacturer	Oil Flow (Litre/Minute)	Impact Rate (bpm)	Rod Dia (Millimetre)	Weight (Kilogram)
Furukawa	20-Dec	900 – 1250	36	66
	16/30	900 – 1200	45	86
	25/40	850 – 1200	52	129
	32/48	750 – 1000	60	172
	42/62	700 – 900	68	225
	50/90	650 – 1050	75	365
	65/110	550 – 900	90	550
	100/130	450 – 625	105	905
	120/155	400 – 525	120	1450
	145/180	360 – 460	135	1840
	155/190	340 – 440	140	2250
	175/220	320 – 400	150	2550
	200/250	300 – 350	165	3550
	250/340	250 - 320	180	4600
Soosan Hydraulic	15/25	800 – 1200	40	72
Breakers	20/30	600 - 1000	45	100
	25/40	550 – 950	53	130
	30/45	450 – 750	68	298
	45/85	400 – 800	85	577
	80/110	450 – 630	100	890
	90/120	400 – 530	125	1303
	100/130	450 – 750	68	325
	120/155	400 – 800	85	1450
	145/180	450 – 630	100	1840
	155/190	400 – 530	125	2250
	175/220	400 – 490	140	2550
	200/250	320 – 450	155	3550
	120/150	400 – 490	140	1735
	170/240	320 – 450	155	2555
	190/250	280 – 370	165	3065
	210/290	230 - 320	175	3909

➲ **Pipe Layers (Side Booms)** : This equipment, also known as side booms, is mainly used for lowering the pipeline section inside the trench. The capacity of different makes of pipe layers is given in the Table 5.

➲ **Rock Breaker Attachments for Hydraulic Excavators :** These attachments are fixed to hydraulic excavators and have different sizes. These can be attached to various models and capacities of excavators as per the power of the excavators and requirement of the job. The capacity with respect to different makes of this equipment is provided in the Table 6.

Welding Equipment

➲ **Welding Tractor (Pay Welders) :** These are truck mounted welding machines with power generator and air compressor. The advantage of mobility of this type of welding machine finds extensive use in pipeline work as the welding machine can move along the trench of the pipeline performing weld joints of pipes. Without pay welders, pipeline construction is unthinkable.

➲ **Hydraulic Pipe Bending Machine :** The pipe bending machines are used for making cold field bends in a pipeline laying project. These machines are of different diameters and need some conversion kits to convert the machine into a particular pipe diameter and pipe wall thickness for making the bend. The accessories of the pipe bending machine consist of shoe and die set suitable for a particular pipe size.

➲ **Horizontal Boring Machine :** For pipeline crossing under highways, railway tracks, lined canals, and so forth, where no trenching or open cut of a trench is allowed, trenchless technology is used. The machines used for this purpose are either horizontal auger boring machines or horizontal directional drilling machines. The boring machines have different sizes and can be used for rocky strata as well as for any other strata of the soil.

➲ **Horizontal Directional Drilling Machine :** To reach across any difficult river, canal, sea creak, under any historic monument, modern facilities for laying of such pipelines are available, where horizontal directional drillings are used. The horizontal directional drilling machines have reduced the complicacy of the job and have eased all constraints of laying pipelines. In this method, drilling rigs of various capacities are available for use. As per the pipe size and terrain, strata of the soil becomes the basis for selecting the drilling rigs. The capacity of the rig is taken in tons (150 tons, 250 tons, 450 tons).

➲ **Hydrostatic Test Equipment :** Pipelines constructed and laid inside the trench undergo hydrostatic pressure testing before commissioning is done by using hydrostatic test equipment. The pipeline sections are cleared by air pigging and gauging of the pipeline, and this is done to check the pipeline for any damages, any dents, or any over penetration in the weld joints. The pumps are used for filling the installed pipelines with water, and gradually, some testing pressure is developed inside the pipeline and the leakage, if any, is observed and rectified.

Section - C

Useful Life and Rate of Depreciation of Equipment

The useful life of all construction equipments, as mentioned above, vary from equipment to equipment. The useful

Table 7. Useful Life of Equipment as Per Equipment Users (Users 1-6)

Equipment	Useful Life (in years)					
	User 1	User 2	User 3	User 4	User 5	User 6
Excavators	8	7.75	8	8	8.25	8
Backhoe Loaders	8.33	8.33	8	8	8	8
Motor Grade	7.75	8	8	8	8	8
Pipe Layer (Side Boom)	10	9.66	10	10	9.75	10
Rock Breaker Attachment for Hydraulic Excavator	6	6	6	6	6	6
Welding Tractor (Pay welders)	8	8.25	7.75	8	7.75	8
Hydraulic Pipe Bending Machine	9.75	10	10	10	9.75	10.25
Horizontal Boring Machine	10	9.75	9.75	10.25	10	10
Horizontal Directional Drilling Machine	10	10.25	9.75	10	10	10
Hydrostatic Test Equipment	9.75	10	9.66	10	10	10

life depends on the use of equipment on the job in a year and the expected wear and tear of the equipment. For computing the useful life and rate of depreciation of pipeline construction equipment, 12 pipeline equipment users (pipeline construction agencies) were contacted and the information on useful life and rate of depreciation was collected, which has been tabulated in Tables 7, 8, 10, and 11. Thereafter, the best fitted line was drawn (refer to Figure 1 to Figure 20) using the data collected on useful life and rate of depreciation of different equipment. The average of the observations that fell on and was very close to the best fitted line was found out and tabulated in Tables 9 and 12.

Section - D

Statistical Analysis of Collected Data and Its Acceptance

The data pertaining to useful life and rate of depreciation of equipment (Refer to Tables 7 and 8 and Tables 10 and 11) were tested by using student's *t*- test. It was observed that the data presented in Table 9 and Table 12 lies within the 95% confidence limit and, therefore, can be considered as acceptable. In operational terms, there is credence/reliability of values related to useful life of equipments listed in Table 9 as well as rates of depreciation contained in Table 12. The results of the student's *t* - test are furnished in Tables 13 to 32.

➲ ***T*-test**

/TESTVAL=0
/MISSING=ANALYSIS
/VARIABLES=Equipment users, Rate of depreciation
/CRITERIA=CI(.9500)

Table 8. Useful Life of Equipment as Per Equipment Users (Users 7-12)

Equipment	Useful Life (in years)					
	User 7	User 8	User 9	User 10	User 11	User 12
Excavators	8	8	8	7.75	8	8
Backhoe Loaders	8	7.75	8	8.25	8	8
Motor Grade	8.25	8	8.25	7.75	8	8
Pipe Layer (Side Boom)	10	10	10	10	10	10
Rock Breaker Attachment for Hydraulic Excavator	5.75	6.25	6	6	6	5.75
Welding Tractor (Pay welders)	8	8	8	8.25	8	8
Hydraulic Pipe Bending Machine	9.75	10	10	10	10	10
Horizontal Boring Machine	10	10	10	9.75	10.25	10
Horizontal Directional Drilling Machine	10	9.75	10.33	10	10	10
Hydrostatic Test Equipment	9.75	10.25	10	10	10	10

Table 9 . Useful Life Derived from Best Fitted Line

Equipment	Useful life (In years)	Equipment	Useful life(In years)
Excavators	8	Welding Tractor (Pay welders)	8
Backhoe Loaders	8	Hydraulic Pipe Bending Machine	10
Motor Grader	8	Horizontal Boring Machine	10
Pipe Layer (Side Boom)	10	Horizontal Directional Drilling Machine	10
Rock Breaker Attachments for Hydraulic Excavators	6	Hydrostatic Test Equipment	10

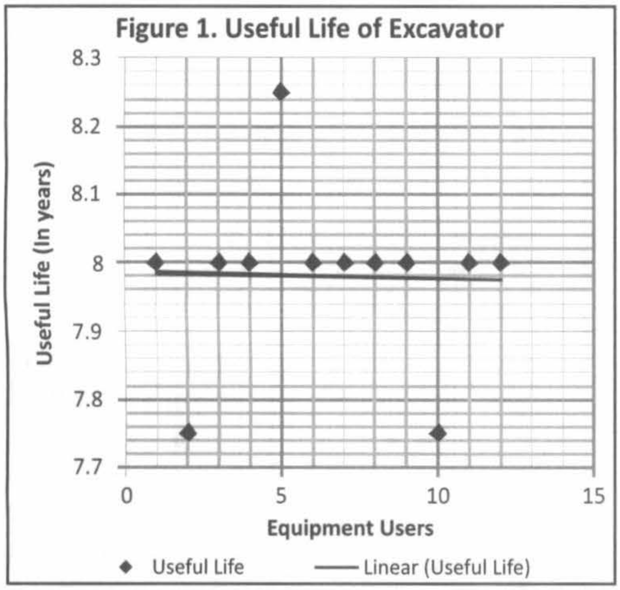


Figure 1. Useful Life of Excavator
Useful Life (In years)
8.3
8.2
8.1
8
7.9
7.8
7.7
0
5
10
15
Equipment Users
Useful Life
Linear (Useful Life)

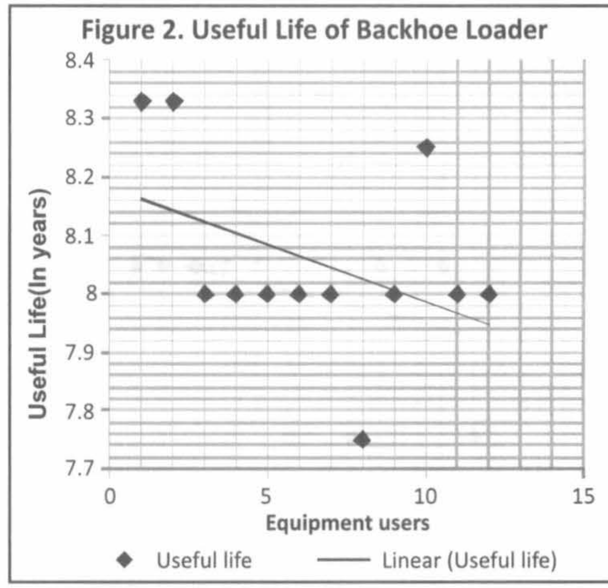


Figure 2. Useful Life of Backhoe Loader
Useful Life(In years)
8.4
8.3
8.2
8.1
8
7.9
7.8
7.7
0
5
10
15
Equipment users
Useful life
Linear (Useful life)

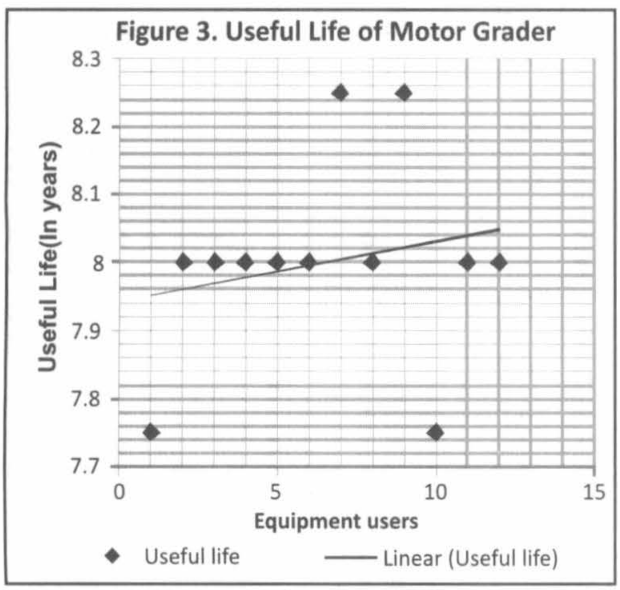


Figure 3. Useful Life of Motor Grader
Useful Life(In years)
8.3
8.2
8.1
8
7.9
7.8
7.7
0
5
10
15
Equipment users
Useful life
Linear (Useful life)

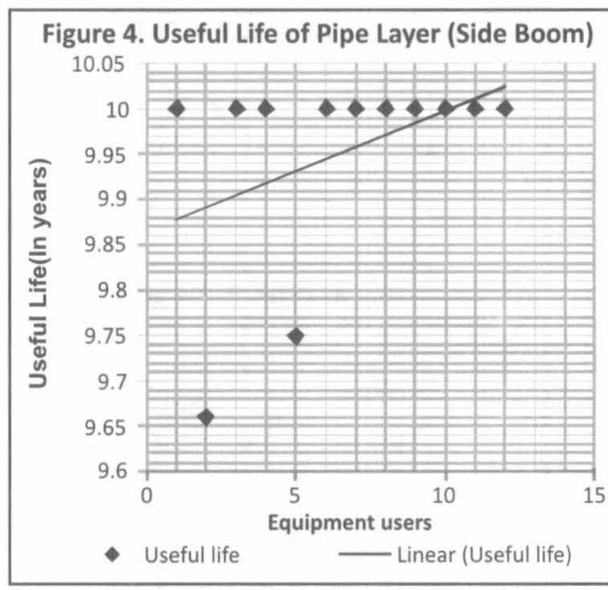


Figure 4. Useful Life of Pipe Layer (Side Boom)
Useful Life(In years)
10.05
10
9.95
9.9
9.85
9.8
9.75
9.7
9.65
9.6
0
5
10
15
Equipment users
Useful life
Linear (Useful life)

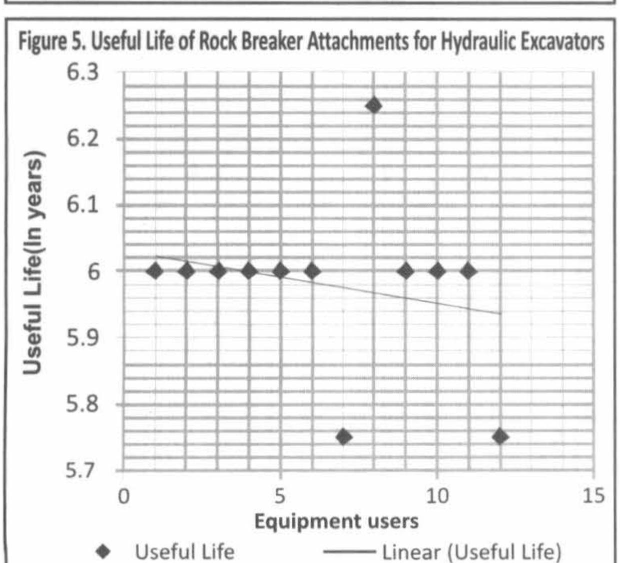


Figure 5. Useful Life of Rock Breaker Attachments for Hydraulic Excavators
Useful Life(In years)
6.3
6.2
6.1
6
5.9
5.8
5.7
0
5
10
15
Equipment users
Useful Life
Linear (Useful Life)

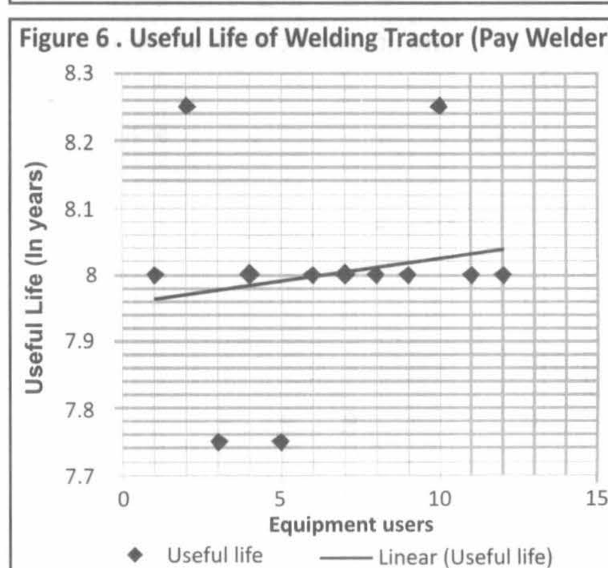


Figure 6 . Useful Life of Welding Tractor (Pay Welder)
Useful Life (In years)
8.3
8.2
8.1
8
7.9
7.8
7.7
0
5
10
15
Equipment users
Useful life
Linear (Useful life)

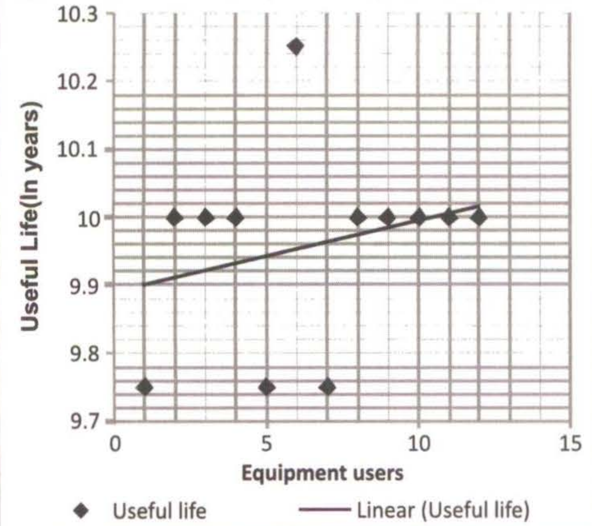


Figure 7. Useful Life of Hydraulic Pipe Bending Machine

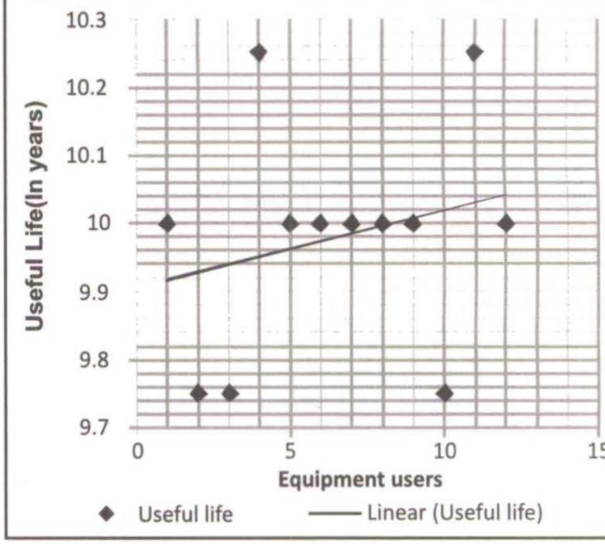


Figure 8. Useful Life of Horizontal Boring Machine

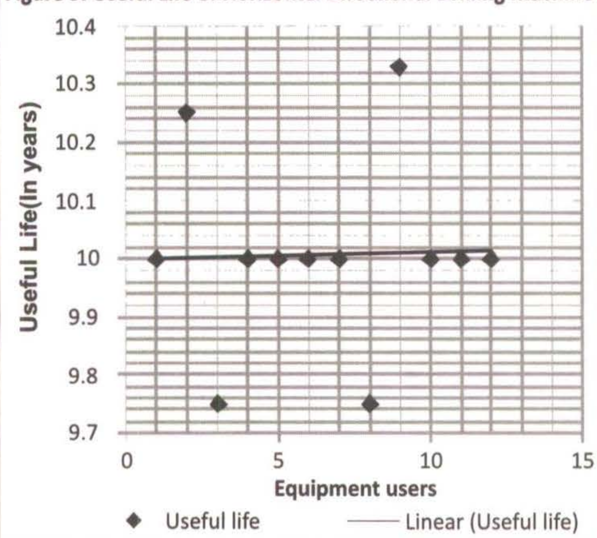


Figure 9. Useful Life of Horizontal Directional Drilling Machine

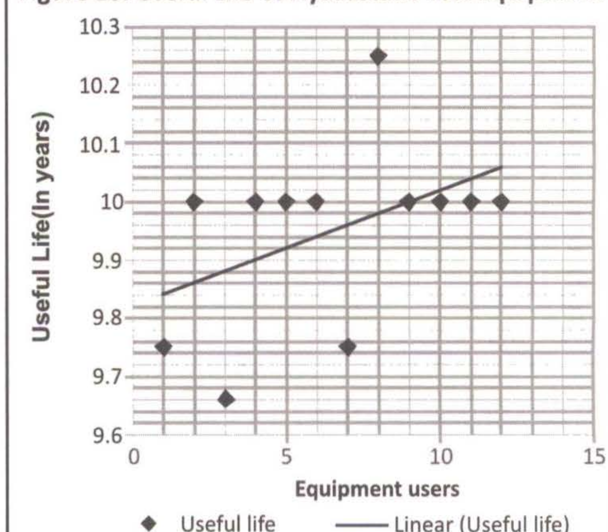


Figure 10. Useful Life of Hydrostatic Test Equipment

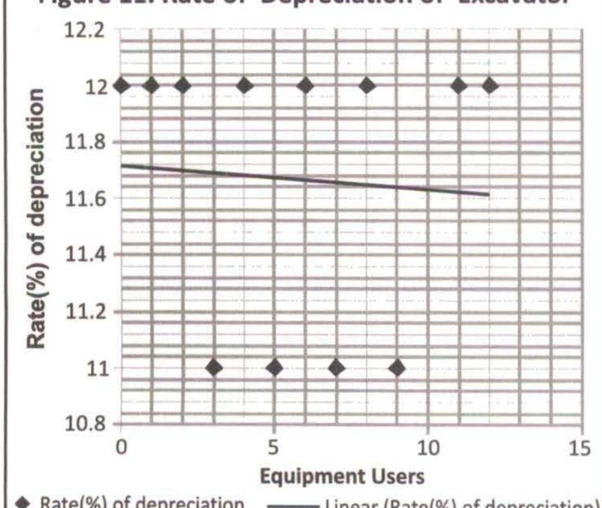


Figure 11. Rate of Depreciation of Excavator

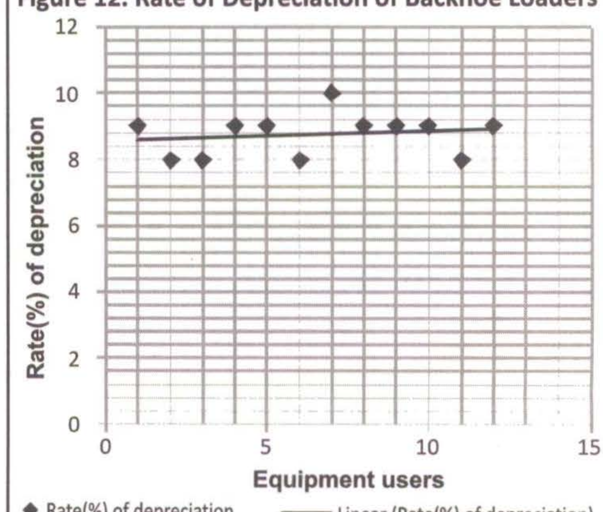


Figure 12. Rate of Depreciation of Backhoe Loaders

Figure 13. Rate of Depreciation of Motor Grader

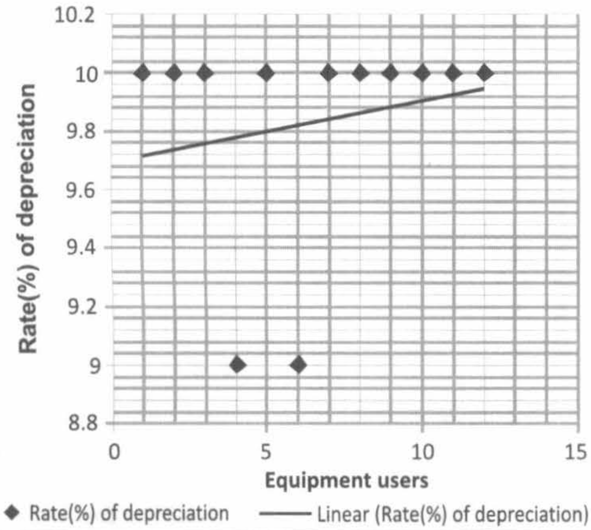


Figure 14. Rate of Depreciation of Pipe Layer (Side Boom)

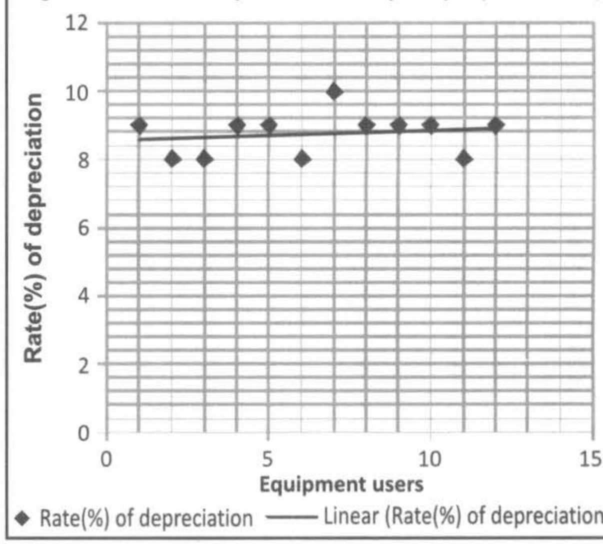


Figure 15. Rate of Depreciation of Rock Breaker

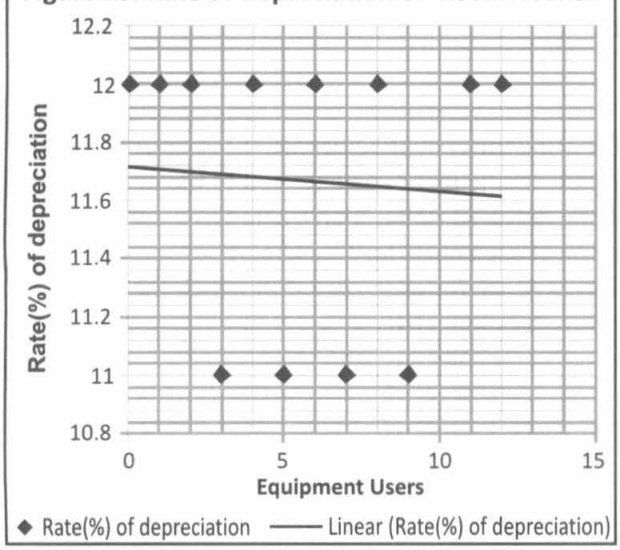


Figure 16 . Rate of Depreciation of Welding Tractor (Pay Loader)

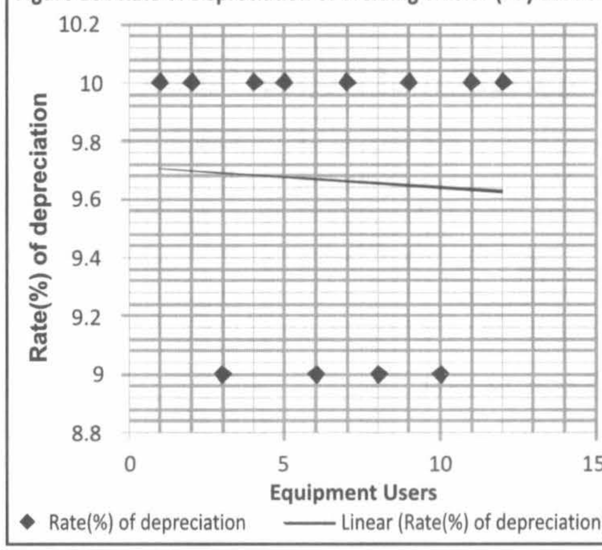


Figure 17. Rate of Depreciation of Hydraulic Pipe Bending Machine

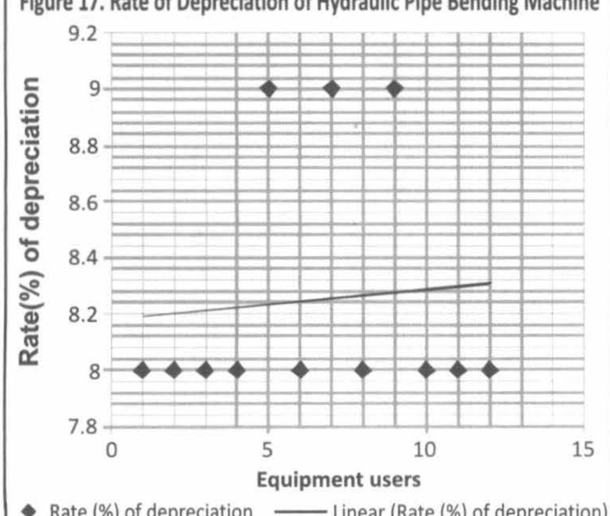
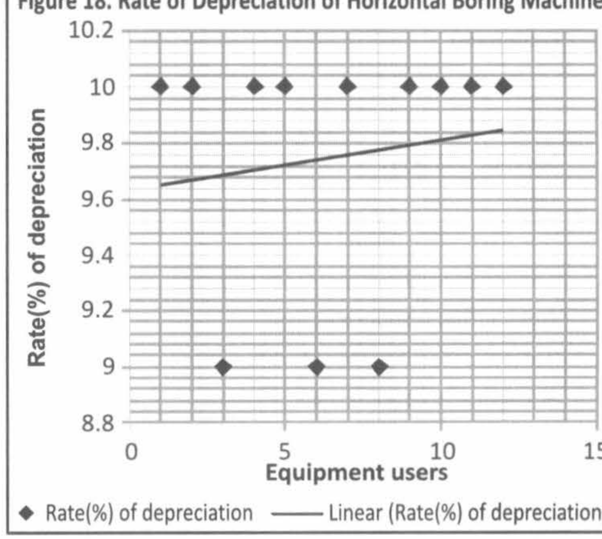
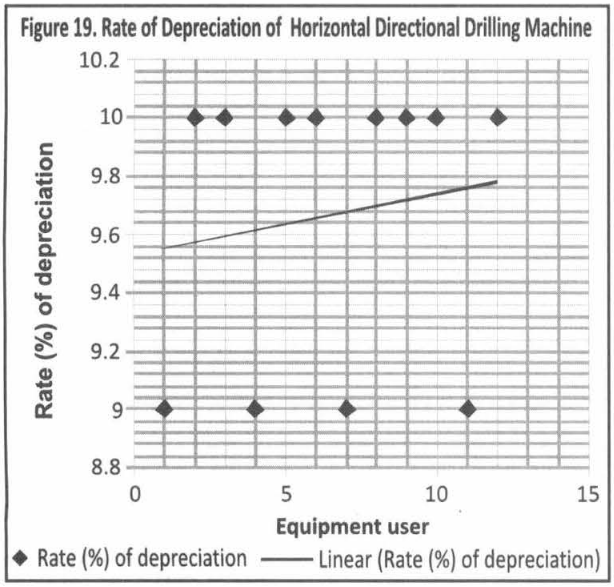
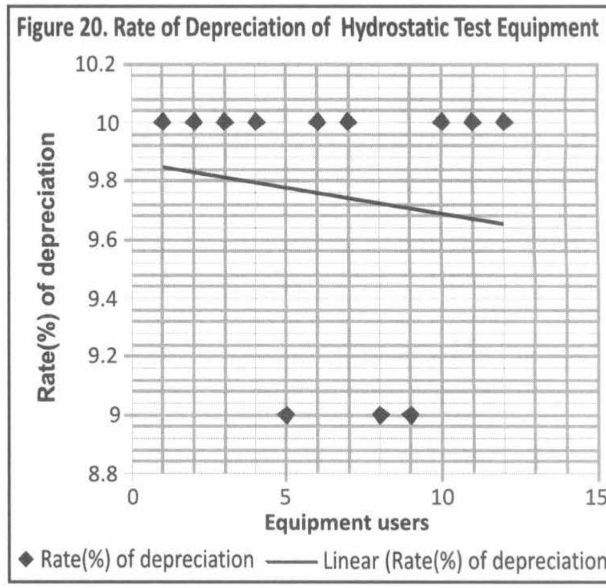


Figure 18. Rate of Depreciation of Horizontal Boring Machine







Section - E

Computation of Depreciation Cost

Depreciation is the process of computing expenses from allocating the cost of equipment over its expected useful lives. Any business or income producing activity using tangible assets incur costs related to those assets. Where the assets produce benefits in future periods, the costs must be deferred rather than treated as a current expense. The business then records depreciation expense as an allocation of such costs for financial reporting. The costs are allocated in a rational and systematic manner as depreciation expense for each period in which the asset is used, beginning when the asset is placed in service. Generally, this involves four criteria :

(1) Cost of the asset,

(2) Expected salvage value, also known as residual value of the asset,

(3) Estimated useful life of the asset, and

(4) A method of appropriating the cost over such life.

Table 10. Rate of Depreciation as per Equipment Users (Users 1-6)

Equipment	Rate (%) of depreciation					
	User 1	User 2	User 3	User 4	User 5	User 6
Excavators	12	12	11	12	11	12
Backhoe Loaders	9	8	8	9	9	8
Motor Grader	10	10	10	9	10	9
Pipe Layer(Side Boom)	9	8	8	9	9	8
Rock Breaker Attachments for Hydraulic Excavators	12	12	11	12	11	12
Welding Tractor(Pay welders)	10	10	9	10	10	9
Hydraulic Pipe Bending Machine	8	8	8	8	9	8
Horizontal Boring Machine	10	10	9	10	10	9
Horizontal Directional Drilling Machine	9	10	10	9	10	10
Hydrostatic Test Equipment	10	10	10	10	9	10

Table 11. Rate of Depreciation as per Equipment Users (Users 7-12)

Equipment	Rate(%) of depreciation					
	User 7	User 8	User 9	User 10	User 11	User 12
Excavators	11	11	11	12	12	12
Backhoe Loaders	10	9	9	9	8	9
Motor Grader	10	10	10	10	10	10
Pipe Layer (Side Boom)	10	9	9	9	8	9
Rock Breaker Attachments for Hydraulic Excavators	11	12	11	12	12	12
Welding Tractor (Pay welders)	10	9	10	9	10	10
Hydraulic Pipe Bending Machine	9	8	9	8	8	8
Horizontal Boring Machine	10	9	10	10	10	10
Horizontal Directional Drilling Machine	9	10	10	10	9	10
Hydrostatic Test Equipment	10	9	9	10	10	10

Table 12. Rate of Depreciation Derived from Best Fitted Line

Equipment	Rate of depreciation(%)	Equipment	Rate of depreciation(%)
Excavators	12	Welding Tractor(Pay welders)	10
Backhoe Loaders	9	Hydraulic Pipe Bending Machine	8
Motor Grader	10	Horizontal Boring Machine	10
Pipe Layer(Side Boom)	9	Horizontal Directional Drilling Machine	10
Rock Breaker Attachments for Hydraulic Excavators	12	Hydrostatic Test Equipment	10

Table 13. One-Sample Test for Excavator

	Test Value = 0					
	t	*df*	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Useful life	214.714	11	.000	7.97917	7.8974	8.0610

Table 14. One-Sample Test for Backhoe Loader

	Test Value = 0					
	t	*df*	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Useful life	167.162	11	.000	8.05500	7.9489	8.1611

Table 15. One-Sample Test for Motor Grader

	Test Value = 0					
	t	*df*	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Useful life	183.826	11	.000	8.00000	7.9042	8.0958

Table 16. One-Sample Test for Pipe Layer (Side Boom)

	Test Value = 0					
	t	*df*	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Useful life	296.087	11	.000	9.95083	9.8769	10.0248

Table 17. One-Sample Test for Rock Breaker Attachment

	Test Value = 0					
	t	*df*	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Useful life	160.896	11	.000	5.97917	5.8974	6.0610

Table 18. One-Sample Test for Welding Tractor

	Test Value = 0					
	t	*df*	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Useful life	183.826	11	.000	8.00000	7.9042	8.0958

Table 19. One-Sample Test for Hydraulic Pipe Bending Machine

	Test Value = 0					
	t	*df*	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Useful life	239.000	11	.000	9.95833	9.8666	10.0500

Table 20. One-Sample Test for Horizontal Boring Machine

	Test Value = 0					
	t	*df*	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Useful life	206.826	11	.000	9.97917	9.8730	10.0854

Table 21. One-Sample Test for Horizontal Directional Drilling Machine

	Test Value = 0					
	t	*df*	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Useful life	211.363	11	.000	10.00667	9.9025	10.1109

Table 22. One-Sample Test Hydrostatic Test Equipment

	Test Value = 0					
	t	*df*	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Useful life	218.373	11	.000	9.95083	9.8505	10.0511

Table 23. One-Sample Test for Excavator

	Test Value = 0					
	t	*df*	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Rate of depreciation	65.666	11	.000	11.66667	11.2756	12.0577

Table 24. One-Sample Test for Backhoe Loader

	Test Value = 0					
	t	*df*	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Rate of depreciation	48.764	11	.000	8.75000	8.3551	9.1449

Table 25. One-Sample Test for Motor Grader

	Test Value = 0					
	t	*df*	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Rate of depreciation	87.511	11	.000	9.83333	9.5860	10.0807

Table 26. One-Sample Test for Pipe Layer (Side Boom)

	Test Value = 0					
	t	*df*	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Rate of depreciation	48.764	11	.000	8.75000	8.3551	9.1449

Table 27. One-Sample Test for Rock Breaker Attachment

	Test Value = 0					
	t	*df*	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Rate of depreciation	60.018	11	.000	11.58333	11.1586	12.0081

Table 28. One-Sample Test for Welding Tractor

	Test Value = 0					
	t	*df*	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Rate of depreciation	45.800	11	.000	9.54167	9.0831	10.0002

Table 29. One-Sample Test for Hydraulic Pipe Bending Machine

	Test Value = 0					
	t	*df*	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Rate of depreciation	63.190	11	.000	8.25000	7.9626	8.5374

Table 30. One-Sample Test for Horizontal Boring Machine

	Test Value = 0					
	t	*df*	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Rate of depreciation	74.679	11	.000	9.75000	9.4626	10.0374

Table 31. One-Sample Test for Horizontal Directional Drilling Machine

	Test Value = 0					
	t	*df*	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Rate of depreciation	45.800	11	.000	9.54167	9.0831	10.0002

Table 32. One-Sample Test for Hydrostatic Test Equipment

	Test Value = 0					
	t	*df*	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Rate of depreciation	74.679	11	.000	9.75000	9.4626	10.0374

Table 33. Cost of Acquisition of Construction Equipment

Equipment	Cost of Acquisition of the Equipment (Amount in US $)
Excavators	94,340.00
Backhoe Loaders	37,736.00
Motor Grader	94,345.00
Pipe Layer (Side Boom)	1,88,676.00
Rock Breaker Attachments for Hydraulic Excavators	28,300.00
Welding Tractor (Pay welders)	84,905.00
Hydraulic Pipe Bending Machine	2,07,547.00
Horizontal Boring Machine	84,898.00
Horizontal Directional Drilling Machine	6,60,377.00
Hydrostatic Test Equipment	66,037.00
Equipment	Cost of acquisition of the equipment (Amount in US $)

Table 34. Computation of Depreciation of Excavator

Year(Useful life)	Book value (in US $)	Rate of depreciation	Amount of depreciation(In US $)
1	94,340.00	12%	11,320.80
2	94,340.00 - 11,320.80 = 83,019.20	12%	9,962.30
3	83,019.20 - 9,962.30 = 73,056.90	12%	8,766.82
4	73,056.90 - 8,766.82 = 64,290.08	12%	7,714.80
5	64,290.08 - 7,714.80 = 56,575.28	12%	6,789.03
6	56,575.28 - 6,789.03 = 49,786.25	12%	5,974.35
7	49,786.25 - 5,974.35 = 43,811.90	12%	5,257.42
8	43,811.90 - 5,257.42 = 38,554.48	12%	38,554.48

Table 35. Computation of Depreciation of Backhoe Loader

Year(Useful life)	Book value (in US $)	Rate of Depreciation	Amount of Depreciation(In US $)
1	37,736	9%	3,396.24
2	34,339.76	9%	3,090.57
3	31,249.18	9%	2,812.42
4	28,436.75	9%	3,396.24
5	25,877.44	9%	3,090.57
6	23,548.47	9%	2,119.36
7	21,429.11	9%	1,928.62
8	19,500.49	9%	1,755.04

Table 36. Computation of Depreciation of Motor Grader

Year(Useful life)	Book value (in US $)	Rate of depreciation	Amount of depreciation(In US $)
1	94,345	10%	9,434.5
72	84,910.5	10%	8,491.05
3	76,419.45	10%	7,641.94
4	68,777.50	10%	6,877.75
5	61,899.75	10%	6,189.97
6	55,709.77	10%	5,570.97
7	50,138.80	10%	5,013.88
8	45,124.92	10%	4,512.49

Table 37. Computation of Depreciation of Pipe Layer

Year(Useful life)	Book value (in US $)	Rate of Depreciation	Amount Table 5D : Computation of depreciation of pipe layer of depreciation(In US $)
1	18,8676	9%	16,980.84
2	1,71,695.16	9%	15,452.56
3	1,56,242.59	9%	14,061.83
4	1,42,180.76	9%	12,796.26
5	1,29,384.49	9%	11,644.60
6	1,17,739.88	9%	10,596.59
7	1,07,143.29	9%	9,642.89
8	97,500.40	9%	8,775.03
9	88,725.36	9%	7,985.28
10	80,740.08	9%	7,266.60

Table 38. Computation of Depreciation of Rock Breaker

Year (Useful life)	Book value (in US $)	Rate of depreciation	Amount of depreciation(In US $)
1	28,300	12%	3,396
2	24,904	12%	2,988.48
3	21,915.52	12%	2,629.86
4	19,285.65	12%	2,314.27
5	16,971.37	12%	2,036.56
6	14,934.81	12%	1,792.17

Table 39. Computation of Depreciation of Welding Tractor

Year(Useful life)	Book value (in US $)	Rate of depreciation	Amount of depreciation(In US $)
1	84,905	10%	8,490.5
2	76,414.5	10%	7,641.45
3	68,773.05	10%	6,877.30
4	61,895.74	10%	6,189.57
5	55,706.17	10%	5,570.61
6	50,135.55	10%	5,013.55
7	45,121.99	10%	4,512.19
8	40,609.79	10%	4,060.97

Table 40. Computation of Depreciation of Hydraulic Pipe Bending Machine

Year(Useful life)	Book value (in US $)	Rate of depreciation	Amount of depreciation(In US $)
1	2,07,547	8%	16,603.76
2	1,90,943.24	8%	15,275.45
3	1,75,667.78	8%	14,053.42
4	1,61,614.35	8%	12,929.14
5	1,48,685.20	8%	11,894.81
6	1,36,790.39	8%	10,943.23
7	1,25,847.16	8%	10,067.77
8	1,15,779.38	8%	9,262.35
9	1,06,517.03	8%	8,521.36
10	97,995.67	8%	7,839.65

Table 41. Computation of Depreciation of Horizontal Boring Machine

Year(Useful life)	Book value (in US $)	Rate of depreciation	Amount of depreciation(In US $)
1	84,899	10%	8489.9
2	76,409.1	10%	7640.91
3	68,768.19	10%	6,876.81
4	61,891.37	10%	6,189.13
5	55,702.23	10%	5,570.22
6	50,132.01	10%	5,013.20
7	45,118.80	10%	4,511.88
8	40,606.92	10%	4,060.69
9	36,546.23	10%	3,654.62
10	32,891.61	10%	3,289.16

Construction equipments are depreciated in a different manner than road equipments such as cars and pickups. The useful life and rate of depreciation of different equipments deduced from the data collected from equipment users are given in the Tables 9 and 12. The cost of acquisition of different construction equipment collected from equipment users are furnished in the Table 33.

Diminishing balance method of depreciation is the most appropriate for plant and machinery (the reason is the equipment is more productive in the initial years),where additions and extensions take place so often and where the question of repairs is also very important. The depreciation may be expressed as follows :

Table 42. Computation of Depreciation of Horizontal Directional Drilling Machine

Year (Useful life)	Book value (in US $)	Rate of depreciation	Amount of depreciation (In US $)
1	66,0377	10%	66,037.7
2	5,94,339.3	10%	59,433.93
3	5,34,905.37	10%	53,490.53
4	4,81,414.83	10%	48,141.48
5	4,33,273.34	10%	43,327.33
6	3,89,946.01	10%	38,994.60
7	3,50,951.41	10%	35,095.14
8	3,15,856.27	10%	31,585.62
9	2,84,270.64	10%	28,427.06
10	2,55,843.58	10%	25,584.35

Table 43. Computation of Depreciation of Hydrostatic Test Equipment

Year (Useful life)	Book value (in US $)	Rate of Depreciation	Amount of Depreciation(In US $)
1	66037	10%	6603.7
2	59433.3	10%	5943.33
3	53489.97	10%	5348.99
4	48140.97	10%	4814.09
5	43326.87	10%	4332.68
6	38994.18	10%	3899.41
7	35094.76	10%	3509.47
8	31585.29	10%	3158.52
9	28426.76	10%	2842.67
10	25584.08	10%	2558.40

Depreciation = Book value x Depreciation rate (1)

Book value = Cost - Accumulated depreciation (2)

Using the above bases, we computed the depreciation of the construction equipments by using the useful life and rate of depreciation of the equipment (as computed and furnished in Tables 9 and12) . The process of computation of the amount of depreciation of construction equipment is shown in the Tables 34, 35, 36, 37, 38, 39, 40, 41, 42, and 43.

Concluding Observations

The present research paper identified and considered mainly 10 types of construction equipments, which play a vital role in the construction of pipelines. Out of the selected categories of equipment, various capacities of one particular equipment were considered for information only as the computed depreciation for a particular type of equipment is supposed to remain the same, irrespective of different capacities of the same equipment. It was observed that the useful life of a particular equipment, as reported by different equipment users, was in conformance with others and there was not much divergence, irrespective of different makes of equipments used by them. The study revealed that the average useful life of all the said pipeline construction equipment lies between 8 and 9 years. From the data collected on rate of depreciation from the equipment users, it was observed that excavators and rock breakers attract the maximum rate of depreciation while motor grader, welding tractor, horizontal boring machine, and hydrostatic test equipment are subject to a lower amount of depreciation.

On a methodological level, the present study has demonstrated the use of the non-parametric significance test to check the validity and acceptance of data pertaining to useful life and rate of depreciation collected from equipment users. The outcome of this research paper is the determination of depreciation rates virtually on all major construction equipments. These rates can be useful benchmarks for the construction agencies to compute depreciation charges.

Section - F

Research Implications

This research work provides very useful data on the rate of depreciation of pipeline construction equipment which are manufactured by different manufacturers. The construction material also varies in terms of quality from manufacturer to manufacturer. Since the present research was conducted based on primary data collected from different equipment users, therefore, a common platform has been worked out by us using mixed data for determining depreciation rates on all major construction equipment, irrespective of their makes.

Limitations of the Study and Scope for Further Research

The research work was conducted based on data collected from different equipment users, as in a practical sense, it is the users who can comment appropriately on the amount of depreciation the equipment undergoes after a particular period. Future studies can incorporate the comments of particular equipment manufacturers for calculating the depreciation rate of different equipments. Moreover, for one type of equipment, the rate of depreciation of different capacities of the same equipment may also be computed to see the difference, if any.

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