

## Effect of Depreciation Calculation Methods on the Evaluation of Petroleum Projects

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# Effect of Depreciation Calculation Methods on the Evaluation of Petroleum Projects

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**Abstract**— The development of oil reserves requires critical decision-making due to the high investment costs involved. Given the substantial investment costs in petroleum projects, these decisions can significantly impact profitability. A key component of these costs is the depreciation, depletion, and amortization (DD&A) of assets over their useful life. This study provides guidelines for managing asset costs in petroleum projects by employing cash flow and financial models. Two cases were analyzed: Case 1 (fixed asset costs) applied S.L. and DDB, while Case 2 (production-linked costs) employed UOP. Although both models yield the same total profit, the cash flow model reflects profits only after several years, whereas the financial model accounts for profit from the first year by distributing the investment cost over the project's estimated life. The study compares the implications of these methods—Straight-Line, Double Declining Balance, and Unit of Production—on profit recognition and investment recovery.

**Keywords**— Total profit, DD&A calculation, Cash flow model, Financial model, Petroleum projects

## I. INTRODUCTION

Profit, in its simplest concept, is the excess of revenue over all implicit costs of conducting business within a specified time period [1-9, 11-17]. In the oil production business, profit is directly determined by three factors, including 1) prices, 2) costs, and 3) volume.

For petroleum projects, two models are used to estimate profit:

- A. Cash flow model
- B. Financial model

The cash flow model is an operational concept that sums all project revenues and deducts all operating expenditures, with total asset costs incurred at the project's start as shown in Figure 1.

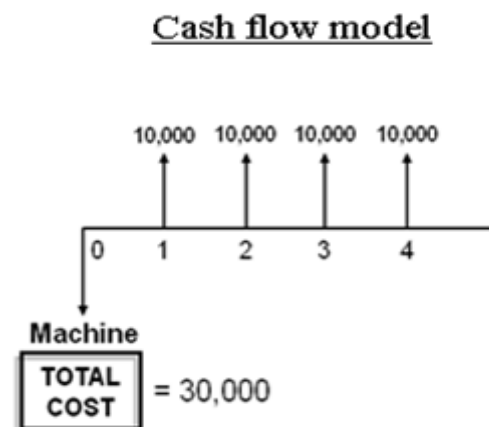


Fig. 1. Cash flow model

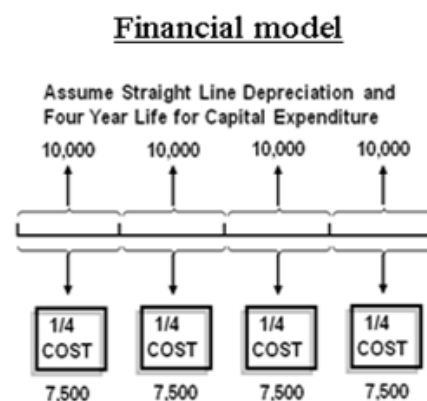


Fig. 2. Financial Model

## DEPRECIATION, DEPLETION, AND AMORTIZATION (DD&A)

DD&A is defined as the allocation of the cost of an asset over its useful life. It is important to note that these methods are calculated by subtracting the asset salvage value from its original cost.

Depreciation refers to prorating the cost of tangible assets, such as vehicles, pipelines, wellheads, and buildings, over their useful lives. For example, an office building used for

many years before being sold will have its cost spread across its expected lifespan, with a portion expensed each year. Depletion allocates the cost of natural resource assets (e.g., oil wells) over their productive lives. The initial costs are distributed over the total estimated recovery period. Amortization typically involves spreading the cost of intangible assets, such as signature bonuses, royalties, and lease acquisition costs, over their useful lives.[10] This study aims to compare the effects of three DD&A methods—straight-line, double-declining balance, and unit of production—on profit recognition in petroleum projects, evaluating the implications of using cash flow versus financial models for project valuation and decision-making. By analyzing these aspects, the research seeks to provide practical guidelines for selecting appropriate cost allocation methods based on project-specific characteristics, ensuring more accurate financial assessments and informed decision-making in the petroleum sector.

**DD&A CALCULATION**

The straight-line method (S.L.), the double declining balance (DDB) method, and the unit-of-production (UOP) method are the most commonly used approaches for DD&A calculations. Each requires the following parameters: (a) asset cost, (b) useful life, and (c) salvage.

*A. Straight line method (S.L.):*

It is the most common method used in the industry. It assumes that the value of an asset decreases at a constant rate over time. The depreciation is computed by dividing the depreciable amount of the asset by the expected number of accounting periods of its useful life, as shown in Equation 1. Useful economic life is not equal to physical life, but it is the period over which the present owner intends to use the asset [10, 14].

$$D_{SL} = \frac{C - S}{t_L} \text{----- (1)}$$

Where:

- $D_{SL}$  = Straight line depreciation per year
- C = Cost
- S = Salvage value at the end of the life of the project
- $t_L$  = Depreciation life

*B. Double decline balance method (DDB):*

This method of depreciation is also known as 200% decline balance, and it is a form of accelerated depreciation. Compared to other methods, the depreciation will vary by year, but the total amount will still remain the same. Essentially, the double-decline balance means double the rate of straight line. However, the double-decline balance method ignores salvage value [10, 14]. For the first year, Equation 2 is used for calculating DDB1:

$$DDB_1 = (C - S) \times \left(\frac{M}{t_L}\right) \text{----- (2)}$$

While Equation 3 is used to estimate DDB for any year (n):

$$DDB_n = DDB_{n-1} \times \left[1 - \left(\frac{M}{t_L}\right)\right] \text{----- (3)}$$

To fully depreciate a capital cost by the end of its life using the double-declining balance method, a switch to the straight-line method is required. The year at which this is made can be determined using Equation 4:

$$N = t_L - \left(\frac{t_L}{M}\right) + 1 \text{----- (4)}$$

*C. Unit of production method (UOP):*

This method is more suitable for production assets. Thus, another piece of information that will be needed is the number of units produced each year. In this case, the useful life of an asset is related more directly to units of work performed by the asset than to the passage of time. In such a case, depreciation can be calculated at the same rate for each unit of output. Equation 5 is used for determining UOP. [10, 14].

$$UOP = (C - S) \times \left(\frac{Q_n}{U}\right) \text{----- (5)}$$

Where:

- $Q_n$  = Annual production of year n
- U = Reserves or ultimate recovery
- n = Depreciation year

**II. DATA DESCRIPTION**

The two cases were chosen to demonstrate the application of different depreciation calculation methods (DD&A) in petroleum projects and to highlight their practical relevance in financial decision-making. The first case compares Straight-Line (S.L.) and Double Declining Balance (DDB) for time-based depreciation, relevant for long-lived assets like pipelines. S.L. spreads costs evenly, while DDB front-loads expenses for faster cost recovery, switching to S.L. in year 9 to meet regulatory timelines. The second case uses the Unit-of-Production (UOP) method, tying depreciation to extraction rates—crucial for oil and gas fields where asset utility declines with reserves. DD&A calculations were used to evaluate the investment, and then the total profit was determined using the cash flow and financial models. Tables 1 and 2 presented input data for each case.

TABLE 1. Input Data for Case 1

Investment = \$ 5 × 10 <sup>9</sup>					
Year	Cost (MM\$)	Income (MM\$)	Year	Cost (MM\$)	Income (M\$)
1	150	1280	9	150	1200
2	150	1280	10	150	1150
3	150	1280	11	150	1100
4	150	1280	12	150	1040
5	150	1280	13	150	980
6	150	1280	14	150	930
7	150	1280	15	150	840
8	150	1280	16	150	745

TABLE 2. Input Data for Case 2

Investment = 4000 M\$ Reserves = 8000 BSCF			
Year	q (BSCF/Y)	Cost (MM\$)	Income (MM\$)
1	585	120	1025
2	585	120	1025
3	585	120	1025
4	585	120	1025
5	585	120	1025
6	585	120	1025
7	585	120	1025
8	585	120	1025
9	555	120	960
10	530	120	920
11	500	120	880
12	480	120	830
13	450	120	780
14	425	120	750
15	380	120	670

In Tables 1 & 2:

**M\$** : A thousand dollars, **MM\$** : One million dollars , **q** : Flow rate

### III. RESULT AND DISCUSSION

In Case 1, both the straight-line and the double-declining balance methods were applied to allocate investment costs over the project's estimated lifespan, while the unit-of-

production method was used in Case 2. Table 3 summarizes the DD&A calculations for Case 1, indicating when it is necessary to transition from DDB to the straight-line method, while Table 4 summarizes the DD&A calculations for Case 2. Tables 5 and 6 and Figures

TABLE 3. DD&A calculation for Case 1

Year	Investment (MM\$)	DS.L (MM\$)	DDB (MM\$)	DDB & S.L (MM\$)
0	5000			
1		312.5	625	625
2		312.5	546.875	546.875
3		312.5	478.515625	478.515625
4		312.5	418.7011719	418.701172
5		312.5	366.3635254	366.363525
6		312.5	320.5680847	320.568085
7		312.5	280.4970741	280.497074
8		312.5	245.4349399	245.43494
9		312.5	214.7555724	214.755572
10		312.5	187.9111258	214.755572
11		312.5	164.4222351	214.755572
12		312.5	143.8694557	214.755572
13		312.5	125.8857738	214.755572
14		312.5	110.150052	214.755572
15		312.5	96.38129553	214.755572
16		312.5	84.33363359	214.755572

<b>Total (MMS)</b>		5000	4409.664565	5000
TABLE 4. DD&A calculation for Case 2				
<b>Year</b>	<b>Investment (MMS)</b>	<b>q (BSCF/Y)</b>		<b>UOP (MMS)</b>
<b>0</b>	5000			
<b>1</b>		585		365.625
<b>2</b>		585		365.625
<b>3</b>		585		365.625
<b>4</b>		585		365.625
<b>5</b>		585		365.625
<b>6</b>		585		365.625
<b>7</b>		585		365.625
<b>8</b>		585		365.625
<b>9</b>		555		346.875
<b>10</b>		530		331.25
<b>11</b>		500		312.5
<b>12</b>		480		300
<b>13</b>		450		281.25
<b>14</b>		425		265.625
<b>15</b>		380		237.5
<b>Total (MMS)</b>		8000		5000

TABLE 5. Summary of the results of Case 1

<b>Year</b>	<b>Cash Flow Model</b>			<b>Financial Model</b>		
	<b>Cost (MMS)</b>	<b>Income (MMS)</b>	<b>NCF (MMS)</b>	<b>Cum. NCF (MMS)</b>	<b>NCF (MMS) [S.L]</b>	<b>NCF (MMS) [DDB &amp; S.L]</b>
<b>0</b>	5000		-5000	-5000		
<b>1</b>	150	1280	1130	-3870	817.5	505
<b>2</b>	150	1280	1130	-2740	817.5	583.125
<b>3</b>	150	1280	1130	-1610	817.5	651.484375
<b>4</b>	150	1280	1130	-480	817.5	711.2988281
<b>5</b>	150	1280	1130	650	817.5	763.6364746
<b>6</b>	150	1280	1130	1780	817.5	809.4319153
<b>7</b>	150	1280	1130	2910	817.5	849.5029259
<b>8</b>	150	1280	1130	4040	817.5	884.5650601
<b>9</b>	150	1200	1050	5090	737.5	835.2444276
<b>10</b>	150	1150	1000	6090	687.5	785.2444276
<b>11</b>	150	1100	950	7040	637.5	735.2444276
<b>12</b>	150	1040	890	7930	577.5	675.2444276
<b>13</b>	150	980	830	8760	517.5	615.2444276
<b>14</b>	150	930	780	9540	467.5	565.2444276
<b>15</b>	150	870	720	10260	407.5	505.2444276
<b>16</b>	150	745	595	10855	282.5	380.2444276
<b>Total Profit (MMS)</b>			10,855		10,855	10,855

TABLE 6. Summary of the results of Case 2

Year	Cash Flow Model			Financial Model	
	Cost (MM\$)	Income (MM\$)	NCF (MM\$)	Cum. NCF (MM\$)	NCF (MM\$)
0	5000		-5000	-5000	
1	120	1025	905	-4095	539.375
2	120	1025	905	-3190	539.375
3	120	1025	905	-2285	539.375
4	120	1025	905	-1380	539.375
5	120	1025	905	-475	539.375
6	120	1025	905	430	539.375
7	120	1025	905	1335	539.375
8	120	1025	905	2240	539.375
9	120	960	840	3080	493.125
10	120	920	800	3880	468.75
11	120	880	760	4640	447.5
12	120	830	710	5350	410
13	120	780	660	6010	378.75
14	120	750	630	6640	364.375
15	120	670	550	7190	312.5
<b>Total Profit (MMS)</b>			7190		7190

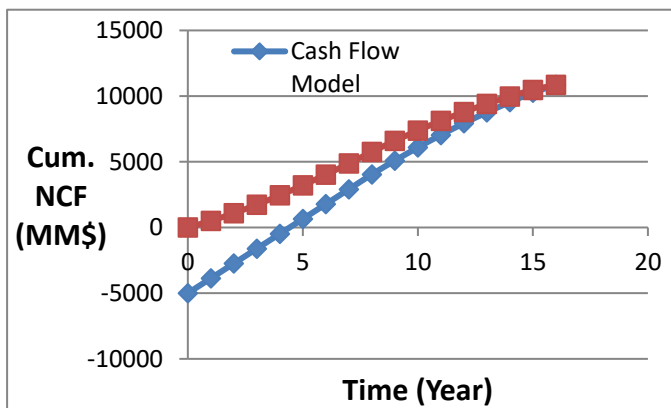


Fig. 3. Total profit calculation for case 1

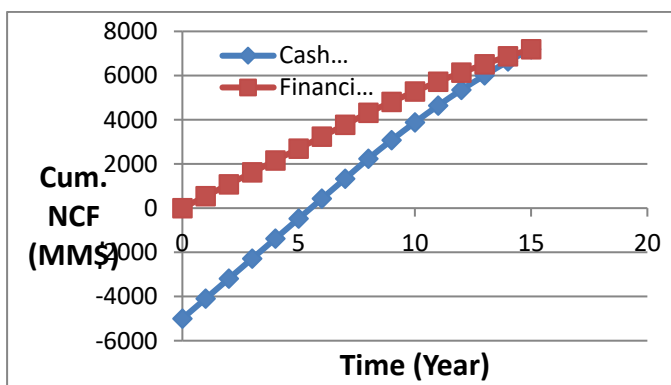


Fig. 4. Total profit calculation for case 2

#### IV. CONCLUSIONS

Based on the evaluation of the two cases, the following conclusions are drawn:

- Both cash flow and financial models can be used to accurately calculate total profit in petroleum projects.
- DD&A methods effectively allocate investment costs over the estimated project lifespan.
- While both models result in the same total profit, the cash flow model recognizes profit only after several years, whereas the financial model allows for profit recognition from the project's first year due to the distributed allocation of investment costs.

#### RECOMMENDATIONS

To optimize financial and operational outcomes, recommendations should align with project goals. DDB or UOP methods can show early profitability, appealing to short-term investors, while cash flow models suit long-term planning. Depreciation choice depends on asset type: UOP fits high-output assets; S.L. suits stable, long-life ones. DDB offers early tax deferral, and hybrid methods (e.g., DDB then S.L.) can balance benefits. Dynamic models can automate switches and integrate forecasts. Future research should assess tax impacts, risk, ESG alignment (e.g., UOP for carbon tracking), and advanced tools like machine learning and sector-specific applications.

#### REFERENCES

- [1] K. Aldhaferi, "Challenges of estimating future liabilities of asset retirement obligations in upstream oil and gas: A literature review," *SPE J.*, vol. 30, no. 3, pp. 1449–1456, 2025, doi: 10.2118/224407-PA.
- [2] D. Alakoum and K. Ghorayeb, "Pipeline inner diameter optimization towards reducing cost and minimizing emissions in oil and gas field development projects," presented at the

SPE Advances in Integrated Reservoir Modelling and Field Development Conf. Exhib., June 2–4, 2025, Paper SPE-225402-MS, doi: 10.2118/225402-MS.

[3] A. D. Ameyaw, W. Ampomah, and A. Morgan, "Techno-economic and life cycle assessments of integrated carbon capture and storage in blue hydrogen production," presented at the SPE Western Regional Meeting, Apr. 27–May 1, 2025, Paper SPE-224206-MS, doi: 10.2118/224206-MS.

[4] B. R. Barry, *The Management of International Oil Operations*. Tulsa, OK, USA: Pennwell Publishing Company, 1993.

[5] L. A. Burke, "Taking the mystery out of intuitive decision making," *Acad. Manag. Exec.*, vol. 13, no. 4, pp. 91–99, 1999.

[6] L. Ekenberg, "The logic of conflicts between decision making agents," *J. Logic Comput.*, vol. 10, no. 4, pp. 583–602, 2000.

[7] B. Gunn, "Decisions, decisions, decisions," *Strateg. Finance*, vol. 81, no. 8, p. 1, Feb. 2000.

[8] W. A. Hailey, E. J. Ryan, C. W. Barnes, and C. K. Woodruff, "Strategic resources allocation processes and the use of quantitative methods in evaluation of plays in oil and gas exploration," *PAFMJ*, vol. 11, pp. 78–95, 1992.

[9] I. Glukhikh, M. Pisarev, and K. Nonieva, "Developing an automated system for assessing an innovative project's economic efficiency for an oil and gas industry case," in \*2020 Int. Multi-Conf. Ind. Eng. Mod. Technol. (FarEastCon)\*, 2020, pp. 1–5.

[10] K. S. Ba-Jaalah and A. A. Aldambi, "Evaluation of petroleum project by using economic decision tools," *AIP Conf. Proc.*, vol. 2443, no. 1, p. 030051, Jul. 2022, doi: 10.1063/5.0095497.

[11] S. Mahruqi, "The influence of project assurance governance in partnership models," presented at the ADIPEC, Nov. 4–7, 2024, Paper SPE-223059-MS, doi: 10.2118/223059-MS.

[12] P. C. Nutt, "Surprising but true: Half the decisions in organizations fail," *Acad. Manag. Perspect.*, vol. 13, no. 2, pp. 75–90, 1999.

[13] V. M. Papadakis, "Strategic investment decision processes and organizational performance," *Brit. J. Manage.*, vol. 9, no. 2, pp. 133–148, 1998.

[14] Petrosol, *Petroleum Economic Decision Tools*, 2018, pp. 1–40.

[15] A. N. Quick, *Strategic Planning for Exploration Management*. Boston, MA, USA: D. Reidel Publishing, 1983.

[16] S. M. Sprague and W. J. Lee, "PUD reserves converted in practice: Impact of the SEC's final rule," presented at the SPE Annu. Tech. Conf. Exhib., Sept. 23–25, 2024, Paper SPE-220797-MS, doi: 10.2118/220797-MS.

[17] B. Waters and D. Ilk, "Evaluation of the benefit of optionality in petroleum investment performance under price

uncertainty — Delaware Basin case study," presented at the SPE/AAPG/SEG Unconventional Resources Technol. Conf., June 9–11, 2025, Paper URTEC-4264738-MS, doi: 10.15530/urtec-2025-4264738.