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Effects of Cost Recovery Limit on Nigerian Production Sharing Contract under the Proposed 2018 PIFB

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Abstract— After identifying that the proposed Petroleum Industry Fiscal Bill (PIFB 2018) does not explicitly state a particular Cost Recovery Limit (CRL) which gives rise to speculations and uncertainty on the path of the contractor when dealing with Nigerian Production Sharing Contracts (PSCs), this research observed the impact of varying CRL on the profitability of PSCs and determined an optimal value that is beneficial to both the contractor and the host government. It achieved this by developing a cash flow model that complied with the provisions of PIFB 2018 while initially using a CRL of 80%, ran a Monte Carlo Simulation to account for uncertainties, a Sensitivity Analysis to observe the impact of the varied CRL on the PSC, and a CRL Optimization, using the Crystal Ball Software. Results from the sensitivity analysis showed the regressive effect of CRL on the contractor's Net Present Value: the higher the CRL value, the lower the NPV. The study also discovered that a CRL value of 66% not only maximizes the NPV of the contractor at a 50% certainty but also maximizes the government and contactor's take to up to 83.9% and 15.7%, respectively.

Index Terms— Cost Recovery, Profit Oil, Royalty, PIFB, Discounted Cash Flow, Net Present Value, Government take, contractor take.

1 Introduction

DEVELOPING and developed countries earn a significant amount of foreign exchange from petroleum resources, in addition to it being a source of livelihood [1]. To avoid shortchanging themselves, they formulate comprehensive tax regimes and fiscal systems that ensure maximum benefits from their resources [2]. These regimes and fiscal systems comprise the sharing formula of the earnings from oil and gas-related activities, between the host government and the contractor (typically International Oil Companies (IOCs), sometimes indigenous oil companies).

According to Mian [3], Petroleum Fiscal System (PFS) is defined as a collection of frameworks of contractual instruments, policies and taxation methodology enacted by the host government. Although, most countries, including Nigeria, operate several fiscal systems, their choice system varies, depending on their financial goals and objectives. The two major categories of PFS as described by Johnston [4] are Concessionary and Contractual Systems. In comparison, they differ in resource ownership, profit sharing, and the forms and mode of payment of different taxes and royalties [5]. Production Sharing Contract (PSC) falls under the Contractual Petroleum Fiscal System.

Iledare [5] further explained how the government has sole ownership and control of the petroleum resources in a PSC while the oil company is contracted for their exploration, development and production. The company in return gets a percentage of the recovered production. Being straightforward, the PSC arrangement usually specifies the percentage of the net production the contractor is given to recover its capital expenditure, also known as "cost oil". This cost recovery process applies to the remaining part of the total production after royalty deduction, guaranteeing profit oil immediately after the commencement of production. After the "cost oil" is deducted, the remaining part of the production is known as "profit oil," which is further shared between the host government and the contractor using a stipulated sharing formula.

The percentage of the net production set out by the PSC to recover the contractor cost is known as the cost recovery limit (CRL) or the cost recovery cap. Ashong [6] noted how this threshold in addition to royalty rates impacts the performance of oil and gas investments made under this PFS. If the cost cannot be completely recovered in a fiscal year, it can be carried forward to subsequent years. On the other hand, if it is completely recovered and there is still a remainder (typically termed excess cost recovery), the host government and contractor can further share it while complying with the agreed sharing formula.

The proposed Petroleum Industry Fiscal Bill 2018 [7] as drafted by the Nigerian Senate stipulates several provisions and fiscal instruments to guide the exploration and exploitation of Nigerian petroleum resources except for the cost recovery limit. This gives room for uncertainties, especially to contractors and investors, including the IOCs, who set aside huge amounts of money in developing petroleum resources internationally. It is also referred to as fiscal instability, which can cause adverse implications like limited petroleum-related investments into the country. Therefore, it is necessary to in addition to finding out the implications of omitting CRLs in PFS, determine the optimal CRL value that is suitable for both the host government and the contractor.

` This research aims to define the effects of varied cost recovery limits on the profitability of Nigerian PSCs while considering the fiscal instruments of the PIFB 2018. To achieve this aim, the research builds a basic PSC cash flow model that represents a hypothetical offshore oil and gas operation in Nigeria, incorporates the PIFB 2018 fiscal instruments into the model, examines the profitability of the operation by setting an initial cost recovery cap, and conducts a sensitivity analysis which will explore the effects of varied CRL on the profitability of operations and aid the determination of an optimum CRL.

1.1 Summary of the Fiscal Instruments in Nigeria's PSC in the Proposed 2018 Petroleum Industry Fiscal Bill

Nigerian fiscal instruments and terms are classified into pre-discovery provisions, post-discovery provisions and profit-based provisions [8]. These classifications further clarify how government maximizes revenue from their petroleum resources, especially with regards to the PIFB, and ultimately, its PSCs. Before the discovery of the resources, contractors are obligated to remit signature bonuses and rentals. Johnston [9] notes that about 50% of countries with petroleum fiscal systems demand a token pre-discovery fee which is most times fixed and regressive to the contractor due to the possibility of the project's non-profitability. The post-discovery fee includes royalty, production bonus and crypto fees. Nigerian uses a sliding royalty payments system and are based on location, hydrocarbons types, and volume or water depth. According to Echendu et al., [10], royalty dependent on value results in great benefits to the host government, as it earns more when the price of the resources increase. Table 1 summarizes the comparison between existing and proposed PSCs water depth-related royalty schemes.

TABLE 1: PSC 1993 & 2005 Royalty Rates [10]

Water	PSC 1993	PSC 2005
0 – 200m	16.67%	-
200 – 500m	12.00%	12.00%
500 – 800m	8.00%	8.00%
800 –	4.00%	8.00%
> 1,000m	0.00%	8.00%

The existing 1993, 2000, 2003, and 2005 Nigerian PSCs use sliding royalty rates that depends on the water depth of the oil field. However, a Joint Development Zone 2003 PSC, whose royalty rate is dependent on the daily production rate is the only exception. PIFB [7] stipulates a royalty scheme dependent on daily production rate and this study incorporates it into its analysis. Table 2 summarizes the PIFB 2018 royalty scheme.

The production bonus is an avenue for the host government to maximize more value at each level of the development of its petroleum resources especially after the discovery of the resources and the beginning of their production [10]. The cost government can also impose extra levies, duties and other financial obligations, also known as crypto fees with the intent of extracting more revenue from its resources. An example is 3% of the annual capital budget that NDDC and host communities receive [7].

A key post-discovery provision in most Nigerian PFSs is the corporate income tax (CIT) which comprises a percentage of their profit from petroleum resources development-related activities. PIFB (2018) stipulates a petroleum income tax (PIT) of 40%, an additional petroleum income tax (APIT) of 0.5% for every $1 oil price increase, and an education tax of 2%.

TABLE 2: PIFB 2018 Royalty Rates [7]

Terrains	Average Daily Production Tranches (Mbpd)	Rates
Onshore	First 2.5	2.5%
	Next 7.5	7.5%
	Next 10.0	15.0%
	Above 20.0	20.0%
Shallow water	First 10.0	5.0%
	Next 10.0	10.0%
	Next 10.0	15.0%
	Above 30.0	20.0%
Deepwater	First 50.0	5.0%
	Next 50.0	7.5%
	Above 100.0	10.0%

2. Method

This work used the discounted cash flow (DCF) method to evaluate the impact of the proposed 2018 PIFB on petroleum investment in a typical offshore field in Nigeria. It achieved this by applying a spreadsheet modelling technique. The DCF method allows for the integration of the time-value of money in the modelling process, accounting for inflation which has a high chance of occurring during the lifecycle of the field. The study also observed the impact of the CRL on the profitability of the investment and sought an optimum CRL beneficial to the host government as well as the contractor using the Crystal Ball Software. The previous section has already summarized the fiscal instruments and provisions applicable in the proposed 2018 PIFB. Presented below are some useful equations used for the analyses in this work.

Recoverable costs = OPEX + CAPEX-Bonuses- Royalties (1)

Recovery Limit = CRL * (GR-Royalty) (2)

where: CRL = Cost Recovery Limit stipulated by the Fiscal Arrangement and GR = Gross Revenue

The government takes is calculated using:

$$HGT_{AIT} = Roy + Bonuses + Rentals + Taxes + Others \quad (3)$$

while the contractor take is calculated as:

$$CTAIT = Gross\ Revenue - CAPEX - OPEX - HGT_{AIT} \quad (4)$$

where: "Others" = Crypto Levies (i.e. NDDC Levy and the Education Tax).The net present value is determined using:

$$NPV = \sum_{t=1}^{k} \frac{NCF_t}{(1+r)^t} \quad (5)$$

where: NCF_t is the annual cash flows assuming end of yer cash receipts, r is the discount rate which reflects the value of alternative use of fund, t is the time in years and k is the lifetime (in years) of the project.

The internal rate of return (IRR) is can be obtained using:

$$NPV = \sum_{t=1}^{k} \frac{NCF_t}{(1 + IRR)^t} = 0 \quad (6)$$

while the profitability index is determined using:

$$PI(f,F) = 1 + \frac{NPV\ (f,F)}{PVof\ CAPEX} \quad (7)$$

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where: PI = Profitability Index, PV is Present Value and CAPEX is Capital Expenditure

From Equation 6, the Internal Rate of Return (IRR) can be evaluated by making it the subject of the equation. This work assumed the exponential production decline and the input parameters are summarized in Table 4.

TABLE 4: SUMMARY OF THE ASSUMED PRODUCTION AND ECONOMIC INPUT PARAMETERS

Production Profile (Day per Yr)	**365**	
Build-Up Phase (Exponential)		
Start Year	2012	
Production *(BOPD)*	9,000	
Plataeu Phase		
Start Year	2015	
Capacity *(BOPD)*	120,000	
Decline Phase		
Start Year	2023	
Effective Decline Rate	12.50%	
Economic Limit (*BOPD*)	18505.21	
Project Life	2036	
Products Price Forecast		
Crude Oil ($/Bbl)	$55.21	
Price Inflation	1.5%	
Escalation Rate (%)	2.0%	
CAPEX (million USD)		
Exploration and Appraisal cost for	3	M
The development cost for 2010	3	M
The development cost for 2011	3	M
Production Facility and Infrastruc-	1	M
TOTAL CAPEX	1	M
Discount Rate	12.0%	

In this work, 24-year field economic life was assumed. The 12% discount rate was assumed because it is within the range generally applied by most Nigerian financial institutions and investors in petroleum assets valuation [11]. The next stage after forecasting the production of oil from the field was the determination of exploration and development technical costs which were depreciated using the straight-line depreciation method while considering the cost recovery option stipulated in the PSC arrangement [12]. The recoverable cost is estimated before the calculation of profit oil. Contractors are then allowed to recoup this cost. This work assumed 80% CRL for its initial analysis, which was later varied using a sensitivity analysis tool to observe its impact on the profitability of the PSC. It also assumed a negotiable 70%, 30% profit oil split between the host government and contractor, in favor of the former. The profitability indicators considered for this analyses were the NPV, IRR, PI, Discounted Government Take and Discounted Contractor Take respectively..

The Crystal Ball software was used for the sensitivity analysis to determine the impact of varying CRL on the profitability indicators i.e. the profitability of the investment under the proposed PIFB 2018. To determine the optimal CRL value beneficial to the host government (Nigeria) and the contractors under this proposed bill, this work used the OptQuest tool in the Crystal Ball software. The tool found an optimal CRL value between 20% and 90% by meeting the following requirements:

i. P90 of IRR ≥ 12% (because a 12% discount rate was assumed by the project)
ii. P90 of PI ≥ 1 (a requirement for acceptable investment in petroleum industry decision making)
iii. P90 of Government Take ≥ 70% (fair value for government take)
iv. P90 of Contractor Take ≥ 10% (fair value for contractor take)

3 RESULTS AND DISCUSSION

Deterministic Results

The deterministic results from the analyses are shown in Table 5 for before income tax (BIT) and after income tax (AIT). From Table 5, it can be inferred that at 80% cost recovery cap, the proposed PIFB 2018 is valuable to both the host government and the contractor, with a positive NPV for both. This implies that similar projects are worth embarking on under the proposed bill. Similar trends were observed on other profitability indicators like the IRR which is greater than the assumed 12% discount rate and the PI which is greater than 1, meeting the requirements for acceptable investments in economic decision making [8].

TABLE 5: SUMMARY OF DETERMINISTIC RESULTS

	Host-Govt. BIT($M	**Contractor BIT($MM)**	**Host Govt. AIT**	**Contractor AIT ($MM)**
NPV @ 12%	5,395.02	1,825.04	6,195.45	1,024.61
Internal Rate of Return		53.5%		43.8%
Present Value Ratio		2.89		1.62
Profitability Index		3.89		2.62
Undiscounted Take Statistics	73.6%	26.4%	84.9%	15.1%
Discounted Take Statistics	74.7%	25.3%	85.8%	14.2%

The present value ratio of 1.62 for the contractor further shows how profitable investments under the PIFB 2018 with a net gain of 1.62 for each invested dollar while a profitability index of 2.62 assure investors that their investments must be recovered. The host government and contractor take of 85.8% and 14.2%, respectively are fair to both parties.

Stochastic Results

Stochastically, there is a very good chance that the contractor will always add value to his investment under the proposed PIFB. From Figure 1 below, there is 50% certainty that the NPV of the contractor will range from 825.26 to 1,493.27 MM$ with a P90 of 554.85 MM$ and a P10 of 1,829.51 MM$. Since 90% of the estimates will exceed the P90 NPV of 554.85 MM$, the chances of investment remaining valuable to the investor under the proposed bill are high.

With a P90 and P10 of 53.1% and 37.3%, respectively, the

IRR of the investment indicates that it remains acceptable amidst uncertainties as shown in Figure 2.

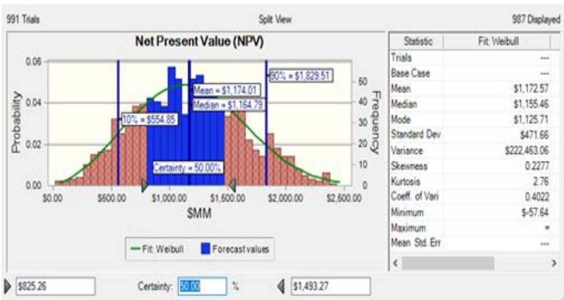

Fig. 1: Contractor's NPV Stochastic Result

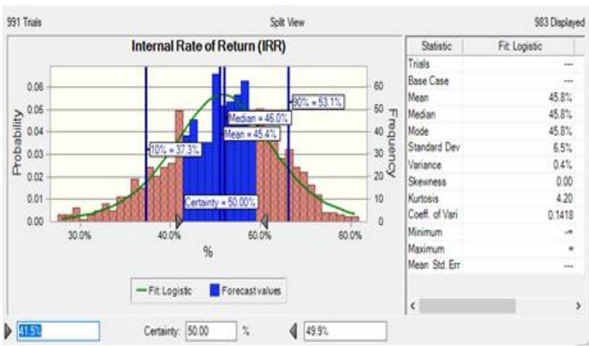

Fig. 2: Contractor's IRR Stochastic Result

It was also observed similar trends for the remaining profitability indicators considered (PI, Host Government Take, and Contractor Take. This trend, therefore, implies that investments under the proposed fiscal bill are worth embarking on, as they remain profitable even under uncertainties.

Sensitivity Analysis Results

A sensitivity analyses was also carried out to investigate the range of profitability limits and how parameter influences the investment as shown in Figure 3. From the results of the sensitivity analysis, it was observed that the Cost Recovery Limit impacts petroleum investments. Figure 3 shows a mild but regressive impact of CRL on the NPV of the contractor.

Similar trend was also observed for other indicators except the discounted government take. The CRL exhibits a progressive impact on the government take as shown Figure 4. The impact of the cost recovery on the investment under the proposed bill further emphasizes the need for the evaluation of an optimal value well suited for the contractor and the host government. The succeeding section sets out to achieve that.

CRL Optimization

The OptQuest tool in the Crystal Ball software estimated optimal values at P90, P50, and P10. These values maximize the NPV of the contractor and also ensures an IRR that is greater than the assumed discount rate. More so, it makes sure the PI is greater than 1, which further results in government and contractor takes that are fair for both parties. Figures 5, 6 and 7 present the results of the optimization process after 500 simulations.

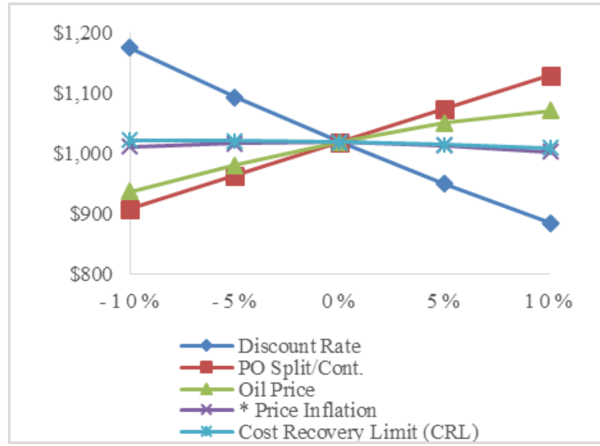

Figure 3: Sensitivity Analysis on Contractor's Net Present Value (NPV)

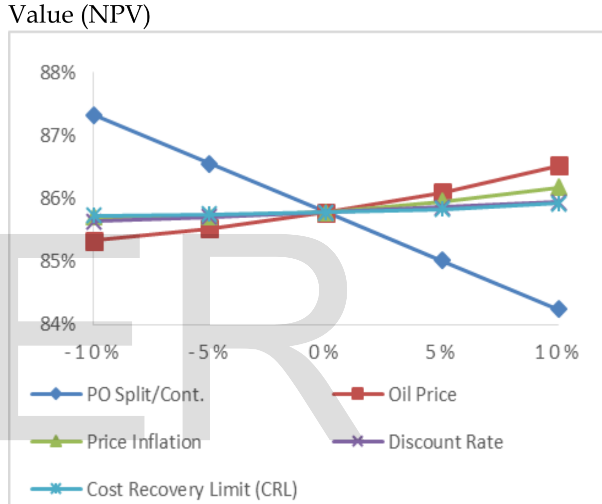

Fig. 4: Sensitivity Analysis on Host Government's Take (GTake)

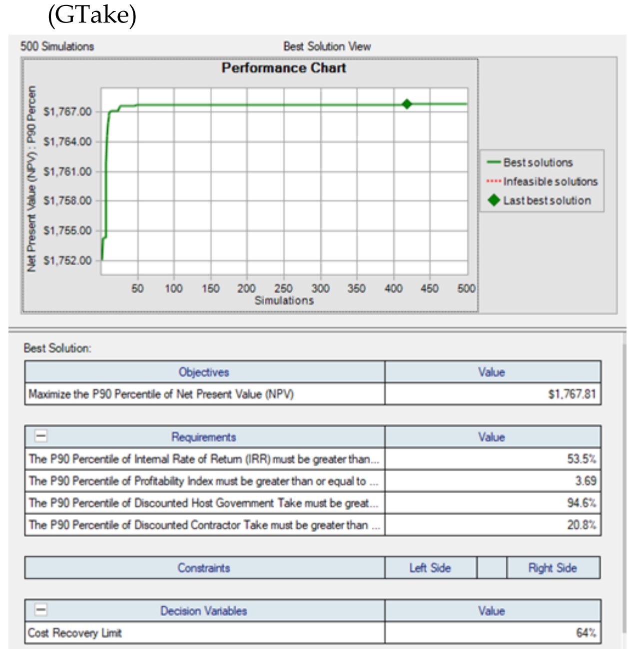

Fig. 5: Result of CRL Optimization @ P90

The optimal values of CRL that met the stipulated requirements were 64%, 66%, and 69%. From Figure 5, at P90, the optimal CRL value with the best solution to the optimization objectives and requirements is 64%, which maximises the P90 percentile of the NPV to up to a positive value of 1,767.81 MM$, and the host government and contractor's take to up to 94.6% and 20.9%, respectively, which are acceptable outcomes for the investment.

From Figure 6, at P50, the resulting optimal CRL value of 66% and maximizes the NPV to up to a positive value of 1,274.96 MM$, government and contactor's take to 83.9% and 15.7%, respectively. However, the contractor's take maximises 6.7% as shown in Figure 7, for an optimal CRL value of 69% at P10, which is not a fair take for the contractor. This work accepts the optimal CRL value of 66% since it does not only give added value to the portfolio of the contractor but also gives the host government and contractor a fair share of the proceeds.

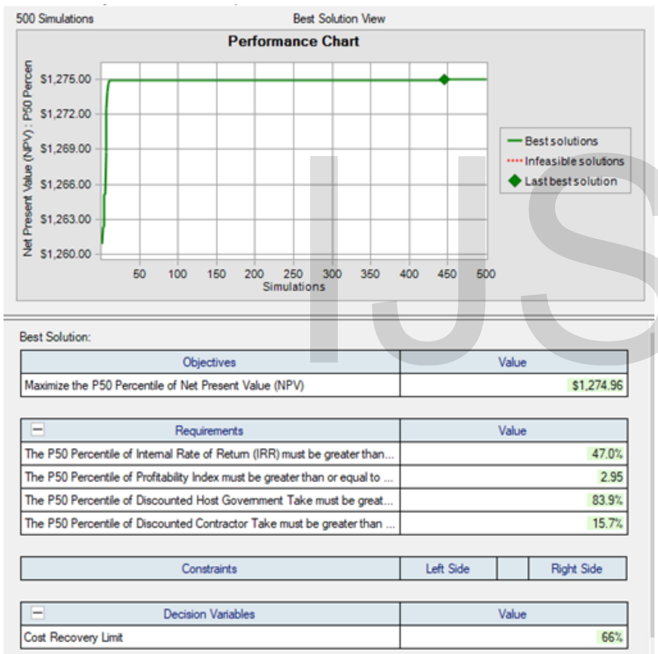

Fig. 6: Result of CRL Optimization @ P50

CONCLUSION

This work exhaustively analyzed a project under the proposed 2018 PIFB to observe the impact of CRL on Nigerian PSCs and ultimately, estimated an optimal value for CRL that is beneficial to both the host government and the contractor with regards to the fiscal instruments of the bill. It first sought the profitability of the bill using the discounted cash flow model, used the Crystal Ball software to perform sensitivity analyses showing the impact of various variables, especially the CRL on the project's profitability, and then estimated an optimal CRL value for the proposed bill which meets several requirements using an OptQuest tool. Because the cash flow model generated an NPV of 1019.27 MM$, a 43.7% IRR, PI of 2.61, and host government and contractor's take of 85.8% and 14.2% respectively, it can be inferred that projects under the proposed PIFB 2018 for Nigerian offshore PSCs are profitable. Amidst the various rent extractions and taxes from the contractor, it can still have a 14.2% take from the project after cost recovery, which is a strong indication of an overall beneficial fiscal regime. After the CRL optimization, an optimal value of 66% was estimated for the proposed PIFB 2018, which maximizes the profitability of the project and gives a fair share to the government and the contractor.

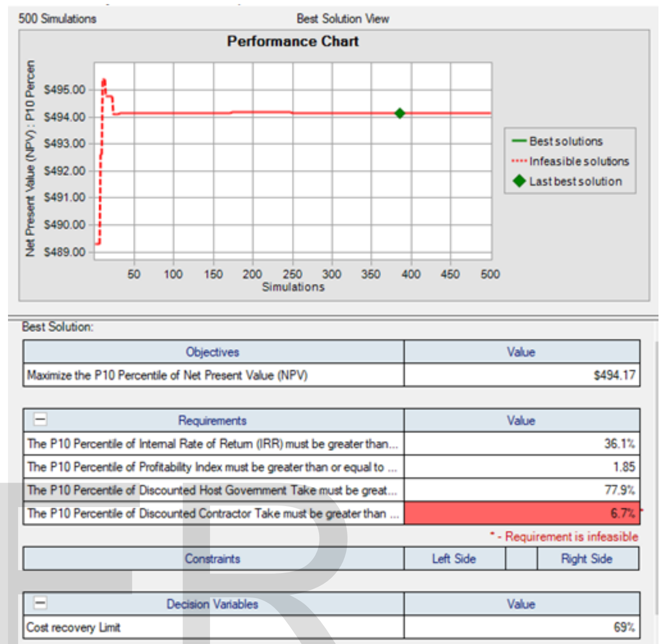

Fig. 7: Result of CRL Optimization @ P10

References

[1] Z.A Elum, K. Mopipi, A. "Henri-Ukoha. Oil exploitation and its socioeconomic effects on the Niger Delta region of Nigeria". *Envir. Sci. and Poll Res.*, 2016, *23*(13), 12880–12889, 2016.

[2] A.J. Blake, M.C. Roberts. "Comparing petroleum fiscal regimes under oil price uncertainty". *Resources Policy*, *31*(2), 95–105, 2006

[3] M.A. Mian. "Project Economics and Decision Analysis, Vol I: Deterministic Models", PennWell Books, 2002

[4] D.Johnston D. "International Petroleum Fiscal Systems-PSCs", PennWell Books, 1994

[5] O. Iledare. "Profitability in Offshore Petroleum Leases: Empirical Evidence From the US Gulf of Mexico Deep water Region" 2008. https://doi.org/10.2118/116602-MS

[6] M. Ashong. "Cost recovery in production sharing con tracts: opportunity for striking it rich or just another risk not worth bearing?" EPMLP Annual Review, University of Dundee 2010.

[7] The Petroleum Industry Fiscal Bill 2018. Retrieved on August 10, 2021, from: http://www.petroleumindustrybill.com/wp-content/uploads/2018/04/PIFB.pdf

[8] O. Iledare. Advanced Petroleum Economics, Lecture

ISSN 2229-5518

notes. African University of Science & Technology, Abu ja 2011.

[9] D. Johnston. "International exploration economics, risk, and contract analysis", PennWell Books. 2003

[10] J.C. Echendu, E.I. Onwuka, O. Iledare. Spreadsheet modelling and simulation analysis of production sharing contract terms and instruments in Nigeria. *SPE Nigeria Annual International Conference and Exhibition 2014*.

[11] K. Ojukwu. Estimating Fair Market Value of Ni gerian Petroleum Assets: A Risk-Based Approach 2020. *Retrieved on August 10, 2021, from: https://ssrn.com/abstract=3671521*

[12] O. Iledare O. Petroleum Economics, Lecture notes. Uni versity of Port Harcourt, Port Harcourt 2018.

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Place figure captions below the figures; place table titles above the tables. If your figure has two parts, include the labels "(a)" and "(b)" as part of the artwork. Please verify that the figures and tables you mention in the text actually exist. Figures and tables should be called out in the order they are to appear in the paper. For example, avoid referring to figure "8" in the first paragraph of the article unless figure 8 will again be referred to after the reference to figure 7. **Please do not include figure captions as part of the figure. Do not put captions in "text boxes" linked to the figures. Do not put borders around the outside of your figures.** Per IJSER, please use the abbreviation "Fig." even at the beginning of a sentence. Do not abbreviate "Table." Tables are numbered numerically.

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Figures (graphs, charts, drawing or tables) should be named fig1.eps, fig2.ps, etc. If your figure has multiple parts, please submit as a single figure. Please do not give them descriptive names. Author photograph files should be named after the author's LAST name. Please avoid naming files with the author's first name or an abbreviated version of either name to avoid confusion. If a graphic is to appear in print as black and white, it should be saved and submitted as a black and white file (grayscale or bitmap.) If a graphic is to appear in color, it should be submitted as an RGB color file.

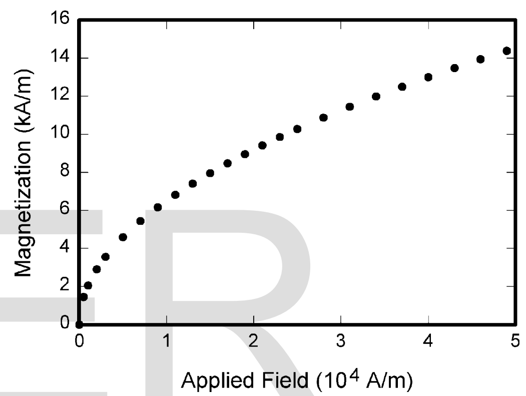

Fig. 1. Magnetization as a function of applied field. Note that "Fig." is abbreviated. There is a period after the figure number, followed by one space. It is good practice to briefly explain the significance of the figure in the caption.

Figure axis labels are often a source of confusion. Use words rather than symbols. As an example, write the quantity "Magnetization," or "Magnetization *M*," not just "*M*." Put units in parentheses. Do not label axes only with units. As in Fig. 1, for example, write "Magnetization (A/m)" or "Magnetization ($A \cdot m^{-1}$)," not just "A/m." Do not label axes with a ratio of quantities and units. For example, write "Temperature (K)," not "Temperature/K." Table 1 shows some examples of units of measure.

Multipliers can be especially confusing. Write "Magnetization (kA/m)" or "Magnetization (103 A/m)." Do not write "Magnetization (A/m) × 1,000" because the reader would not know whether the top axis label in Fig. 1 meant 16,000 A/m or 0.016 A/m. Figure labels should be legible, approximately 8 to 12 point type. When creating your graphics, especially in complex graphs and charts, please ensure that line weights are thick enough that when reproduced at print size, they will still be legible. We suggest at least 1 point.

6.3 Footnotes

Number footnotes separately in superscripts (Insert | Footnote)[1].

[1]It is recommended that footnotes be avoided (except for the unnumbered footnote with the receipt date on the first page). Instead, try to integrate the

Place the actual footnote at the bottom of the column in which it is cited; do not put footnotes in the reference list (endnotes). Use letters for table footnotes (see Table 1). Please do not include footnotes in the abstract and avoid using a footnote in the first column of the article. This will cause it to appear of the affiliation box, making the layout look confusing.

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The IJSER style is to create displayed lists if the number of items in the list is longer than three. For example, within the text lists would appear 1) using a number, 2) followed by a close parenthesis. However, longer lists will be formatted so that:

1. Items will be set outside of the paragraphs.
2. Items will be punctuated as sentences where it is appropriate.
3. Items will be numbered, followed by a period.

6.5 Theorems and Proofs

Theorems and related structures, such as axioms corollaries, and lemmas, are formatted using a hanging indent paragraph. They begin with a title and are followed by the text, in italics.

Theorem 1. *Theorems, corollaries, lemmas, and related structures follow this format. They do not need to be numbered, but are generally numbered sequentially.*

Proofs are formatted using the same hanging indent format. However, they are not italicized.

Proof. The same format should be used for structures such as remarks, examples, and solutions (though these would not have a Q.E.D. box at the end as a proof does).

TABLE 1
UNITS FOR MAGENTIC PROPERTIES

Symbol	Quantity	Conversion from Gaussian and CGS EMU to SI [a]
Φ	magnetic flux	1 Mx → 10^{-8} Wb = 10^{-8} V·s
B	magnetic flux density, magnetic induction	1 G → 10^{-4} T = 10^{-4} Wb/m^2
H	magnetic field strength	1 Oe → $10^3/(4\pi)$ A/m
m	magnetic moment	1 erg/G = 1 emu → 10^{-3} A·m^2 = 10^{-3} J/T
M	magnetization	1 erg/(G·cm^3) = 1 emu/cm^3 → 10^3 A/m
$4\pi M$	magnetization	1 G → $10^3/(4\pi)$ A/m
σ	specific magnetization	1 erg/(G·g) = 1 emu/g → 1 A·m^2/kg
j	magnetic dipole moment	1 erg/G = 1 emu → $4\pi \times 10^{-10}$ Wb·m
J	magnetic polarization	1 erg/(G·cm^3) = 1 emu/cm^3 → $4\pi \times 10^{-4}$ T
χ, κ	susceptibility	1 → 4π
χ_ρ	mass susceptibility	1 cm^3/g → $4\pi \times 10^{-3}$ m^3/kg
μ	permeability	1 → $4\pi \times 10^{-7}$ H/m = $4\pi \times 10^{-7}$ Wb/(A·m)
μ_r	relative permeability	$\mu \rightarrow \mu_r$
w, W	energy density	1 erg/cm^3 → 10^{-1} J/m^3
N, D	demagnetizing factor	1 → $1/(4\pi)$

Statements that serve as captions for the entire table do not need footnote letters.
[a]*Gaussian units are the same as cgs emu for magnetostatics; Mx = maxwell, G = gauss, Oe = oersted; Wb = weber, V = volt, s = second, T = tesla, m = meter, A = ampere, J = joule, kg = kilogram, H = henry.*

7 END SECTIONS

7.1 Appendices

Appendixes, if needed, appear before the acknowledgment. In the event multiple appendices are required, they will be labeled “Appendix A,” “Appendix B, “ etc. If an article does not meet submission length requirements, authors are strongly encouraged to make their appendices supplemental material.

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7.2 Acknowledgments

The preferred spelling of the word “acknowledgment” in American English is without an “e” after the “g.” Use the singular heading even if you have many acknowledgments. Avoid expressions such as “One of us (S.B.A.) would like to thank ... .” Instead, write “F. A. Author thanks ... .” Sponsor and financial support acknowledgments are included in the acknowledgment section. For example: This work was supported in part by the US Department of Commerce under Grant BS123456 (sponsor and financial support acknowledgment goes here). Researchers that contributed information or assistance to the article should also be acknowledged in this section.

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References

[1] J.S. Bridle, "Probabilistic Interpretation of Feedforward Classification Network Outputs, with Relationships to Statistical Pattern Recognition," *Neurocomputing—Algorithms, Architectures and Applications,* F. Fogelman-Soulie and J. Herault, eds., NATO ASI Series F68, Berlin: Springer-Verlag, pp. 227-236, 1989. (Book style with paper title and editor)

[2] W.-K. Chen, *Linear Networks and Systems.* Belmont, Calif.: Wadsworth, pp. 123-135, 1993. (Book style)

[3] H. Poor, "A Hypertext History of Multiuser Dimensions," *MUD History,* http://www.ccs.neu.edu/home/pb/mud-history.html. 1986. (URL link *include year)

[4] K. Elissa, "An Overview of Decision Theory," unpublished. (Unplublished manuscript)

[5] R. Nicole, "The Last Word on Decision Theory," *J. Computer Vision,* submitted for publication. (Pending publication)

[6] C. J. Kaufman, Rocky Mountain Research Laboratories, Boulder, Colo., personal communication, 1992. (Personal communication)

[7] D.S. Coming and O.G. Staadt, "Velocity-Aligned Discrete Oriented Polytopes for Dynamic Collision Detection," *IEEE Trans. Visualization and Computer Graphics*, vol. 14, no. 1, pp. 1-12, Jan/Feb 2008, doi:10.1109/TVCG.2007.70405. (IEEE Transactions)

[8] S.P. Bingulac, "On the Compatibility of Adaptive Controllers," *Proc. Fourth Ann. Allerton Conf. Circuits and Systems Theory*, pp. 8-16, 1994. (Conference proceedings)

[9] H. Goto, Y. Hasegawa, and M. Tanaka, "Efficient Scheduling Focusing on the Duality of MPL Representation," *Proc. IEEE Symp. Computational Intelligence in Scheduling (SCIS '07)*, pp. 57-64, Apr. 2007, doi:10.1109/SCIS.2007.367670. (Conference proceedings)

[10] J. Williams, "Narrow-Band Analyzer," PhD dissertation, Dept. of Electrical Eng., Harvard Univ., Cambridge, Mass., 1993. (Thesis or dissertation)

[11] E.E. Reber, R.L. Michell, and C.J. Carter, "Oxygen Absorption in the Earth's Atmosphere," Technical Report TR-0200 (420-46)-3, Aerospace Corp., Los Angeles, Calif., Nov. 1988. (Technical report with report number)

[12] L. Hubert and P. Arabie, "Comparing Partitions," *J. Classification,* vol. 2, no. 4, pp. 193-218, Apr. 1985. (Journal or magazine citation)

[13] R.J. Vidmar, "On the Use of Atmospheric Plasmas as Electromagnetic Reflectors," *IEEE Trans. Plasma Science*, vol. 21, no. 3, pp. 876-880, available at http://www.halcyon.com/pub/journals/21ps03-vidmar, Aug. 1992. (URL for Transaction, journal, or magzine)

[14] J.M.P. Martinez, R.B. Llavori, M.J.A. Cabo, and T.B. Pedersen, "Integrating Data Warehouses with Web Data: A Survey," *IEEE Trans. Knowledge and Data Eng.*, preprint, 21 Dec. 2007, doi:10.1109/TKDE.2007.190746.(PrePrint)