Difficulties of Explorationests in decision making under complex constraints of Technical/Economical and Geopolitical environment of risk and uncertainties

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Abstract: The ultimate objective of Explorationests and managerial head posts is to make the right decision of exploration and development plans under Technical (Engineering) , Economic and Geopolitical major environments.This decision must respond positively to the target of exaggerating the national reserve necessities and to replace that depleted or about depleted reservoirs or fields with the best efficiency. Thus, The task of a decision maker is in the beginning to evaluate the situation of the problem he has, where certainly falls in one or more of four cases: 1) Certain deterministic consequences 2)Risky of probabilistic consequences 3)Uncertainty of unknown consequence and 4)Conflict of consequences influenced by opponents. Explorationests or manager deeply has to deal with enormous numbers of unknown variables or parameters as more complex situations by more components of risk and uncertainties, particularly the 2nd and the 3rd categories. In both cases Explorationests must develop a criterion like reserve, profits as related to his objective, then applying either a simulation method or analytical approach to reduce the level of probabilities. The probability can be defined by what is called the Expected Value concept, which for Net Present value becomes (ENPV) , which in turn could be either: An event , where a product to be obtained by multiplying the occurrence(frequency)as an outcome by the condition worth value , or : As Decision Alternative , where the probability outcome that could occur, if the decision alternative is occurred . This definition hence, is the most important tool in decision making, while the most popular simulation technique to reduce probability level is what defined as Monte Carlos simulation. It tried to apply it in this work for the western flank of the Mesopotamia, where many exploratory targets of unknown variables assumed to deal with the concept of expected value EV as: a) joint, mutual exclusives probabilistic formula P(total)=P(Tech)*P(Eco)*P(Geopol), and, or: As similar case, but as a decision making alternatives, P(total)=Sum{P(Tech)+P(Eco)+P(Geopol)}.Results of this preliminary study are promising targets, but risky to some extent, thus it seems better to explore this major target, but not to develop it, at least now.

Keywords: Petroleum Exploration, Oil Exploration Constraints, Risk and Uncertainty Evaluation.

الخلاصة: الهدف النهائي من الاستكشافات ووظائف الرؤساء الإداريين هو اتخاذ القرار الصحيح لخطط الاستكشاف والتطوير في إطار البيئات الرئيسية التقنية (الهندسية) والاقتصادية والجيوسياسية. يجب أن يستجيب هذا القرار بشكل إيجابي لهدف المبالغة في ضرورات الاحتياطي الوطني والاستعاضة عن تلك المكامن أو الميادين المستنفدة بأفضل كفاءة. وبالتالي، فإن مهمة صانع القرار هي في البداية تقييم حالة المشكلة التي يواجهها، حيث تقع بالتأكيد في واحدة أو أكثر من أربع حالات: 1) بعض النتائج الحتمية 2) مخاطر العواقب الاحتمالية 3) عدم اليقين من العواقب غير المعروفة و 4) تضارب العواقب المتأثرة بالخصوم. يتعين على الاستكشافات أو المدير التعامل بعمق مع أعداد هائلة من المتغيرات أو البارامترات غير المعروفة باعتبارها مواقف أكثر تعقيدًا من خلال المزيد من مكونات المخاطر والشكوك، لا سيما الفئتين الثانية والثالثة.في كلتا الحالتين، يجب على الاستكشافات تطوير معيار مثل الاحتياطي، والأرباح فيما يتعلق بهدفه، ثم تطبيق إما طريقة محاكاة أو نهج تحليلي لتقليل مستوى الاحتمالات. يمكن تعريف الاحتمال بما يسمى مفهوم القيمة المتوقعة، والذي يصبح بالنسبة لصافي القيمة الحالية(ENPV) ، والذي بدوره يمكن أن يكون إما: حدث، حيث يتم الحصول على منتج عن طريق ضرب الحدوث (التردد) كنتيجة في الشرط قيمته، أو: كبديل للقرار، حيث النتيجة الاحتمالية التي يمكن أن تحدث، إذا حدث البديل للقرار. ومن ثم، فإن هذا التعريف هو الأداة الأكثر أهمية في صنع القرار، في حين أن تقنية المحاكاة الأكثر شيوعًا لتقليل مستوى الاحتمال هي ما تم تعريفه على أنه محاكاة مونتي كارلوس.

1. Introduction

a. Iraq is one of the main producers of hydrocarbons and for exploration, it is a promising country.

b. Different trends of comprehension of the constraint of risk and uncertainty in the exploration stage.

c. Importance of H-C treasure to Iraqi people and country (Geostrategic and geopolitics) is so great.

d. Exploration quality depends on types and needs.

e. Continuity of exploration (geostructural and stratigraphic) is so necessary.

f. Global new era of H-C needs, style, and consumption (Near a new energy break through) .

Note: All coming data are from published literature, personal experience and assumptions.

g. A question may rise, if is still there a new era for Iraqi energy sector

2. Petroleum geology of Iraq:

A. the 3-Tectonic plates are influencing the geologic folding and tectonic activity of Iraq

- Iranian (Zagros) plate
- Arabian plate
- Anadol (Turkish) plate

B. Geology, geophysics and petroleum engineering / drilling / logging / testing , evaluation and production are in successive steps and highly sensitive to technology advancements.

C. It is not easy to insure H-C prospect, thus better to have the good management approach and tool, all view is expressed in figs(1,2,3 &4) concerning geologic map, x-sectional view, fields, reservoirs layers .

D. En their deep western side of the Mesopotamia, difficult to find giant fields for many geologic limitations don't: trapping, facies , depth , age, unconformities , folding , faulting , source rocks, graben, sand stone and migration.

E. Structural and stratigraphic traps, complex migration.

F. Prospect, reservoirs, reserve, grading by volume, by H-C quality by drive, porosity and permeability.

G. Exploration ways: Surface geology / Subsurface and Remote exploration (fig.5),

H. This paper assumed two areal zones for fields distribution: the first is what called Algaziera, between Alfurat river and Tigress river and the second is the desert to the west of Alfurat river.

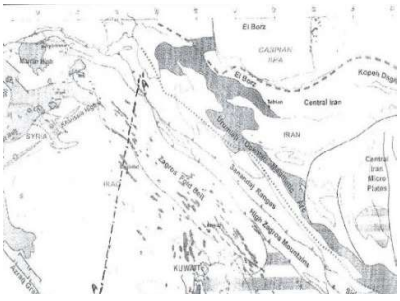

Fig .1. Techtronic elements of Iraq (Curtsey ref.9)

3: Fields and reserve considered:

More than 500 hundreds stromal traps are distributed over the map of Iraq, but we are considering only the western flank of Euphrates river or desert flank, which includes tens of fields, but we considered again only few of them to simplify the qualitative descriptive exercise(figs 3 and 4).

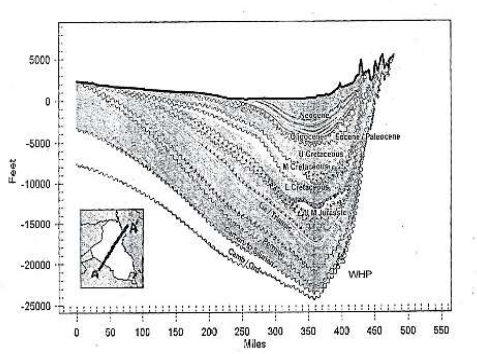

Fig .2. Geologic x-section of Iraq near Baghdad from east to west, perpendicular to Zagros folding (Curtsey of whpierceexploration.com)

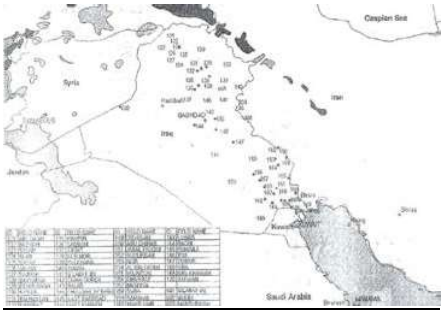

Fig .3. Showing fields in Iraq from Beydoun et al, 1991 (Curtsey of ref-10)

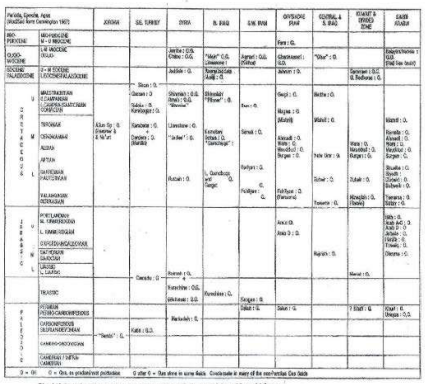
Fig.(4) Producing stratigraphic units of the Arabian Plate(After Beydoun,1991) After Ref.(10).

Fig .4. producing stratigraphic units of the Arabian Plate(Beydoun et al, 1991Curtsey of ref-10)

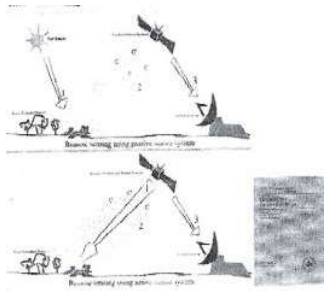

Fig .5. Remote sensing illustration (curtsey Wikipedia, after ref.10)

4. Explorationests and his responsibility in decision making:

→ Proposing and choosing geological, geophysical and remote technologies.

→ Finding Prospects

→ Reserve evaluation

- (No fixed terminology agreement but Petroleum Resources Management terminology SPE , AAPG & WPC @2007, has introduced the P-coding system (or 1P , 2P & 3P classification) as follows:

1) Proved (90% probable recovery) certain, actual recovery probability P ≥ to 1.0 P).

2) Probable (recovery probability 50% of 2+3) Risky Actual Recovery ≥2P

3) Possible (10% Recovery probability of (1+2) Uncertain (RP ≥ 3P)Scared

⟶ Explorationests responsibility comes from the importance of his role in risk and/or uncertainty evaluation and by reducing its level down to classical probability.

- Open nature of exploration

a. Classical probability ⟶ Use close system or well defined event.

b. Event probability ⟶ Frequency of Occurrence

c. Subjective probability ⟶ Experience &Efficiency.

- Also , formulation probabilities:

a. Probability (success) = P(generation) * P(migration) * P(trapping)

* P (reservoir) * P (seal)

b. Ultimate Recovery Probability =

Gross Recovery Volume = P (Ø)* P (h) * P (S0) * P $(\frac{1}{Bo})$ * P (R_f)

- Knowledge of all analysis approaches :

a. Quantitative, Qualitative and sensed.

b. Scientifically capacity : training + basic science

c. Best decision alternatives preparations.

d. Economic considerations.

e. Efficiency& experience to treat enormous variables simultaneously by (objective, subjective, gradual influence).

- Estimations and ranging (by subjective, prior to development capacity.
- Blending of variables
- Estimations of reserve before production,while and after production with the cooptation with the petroleum engineering.

5. The variety of H-C exploration formulas of risk and uncertainty:

a. Many point of views

- Geologic considerations (very old technical)
- Geologic + economic consideration (old technical)
- Geologic + economic + geologist personal considerate (levorsen A.L)
- Geologic + prices
- Political + geological + price + supply & dealt + cost in companies (1)

b. The point of view of this paper is P (total) = Technical (geologic & engineering) + Economical (profit) + Geopolitical (Prices).

, Where in any of constraint group there is a lot of variables has certain level of uncertainty of that factor i.e., from 100% probability to zero value, on the

Standard deviation curve, so probability value is a factor ranging between zero and one.

6. The formulation of Proposed model for the Iraqi case, at least:

6A - Before formulations of the model, better to detail in constrains of each one of the 3-main groups of constraints.

a. Direct volume of treasure Np = Billion bbl / Area are: Porosity Ø, reservoir thickness h, Oil saturation (S_o) = (1 – SW) , Recovery factor R_f = fraction and shrinkage factor $\frac{1}{Bo}$= fraction .

- We note that the volume can be expressed indirectly as a fraction or certain volume per well or per field e.g.: through the frequency distribution and cumulative frequency for each constraint or factor.

b. Probability fraction of economic factors are: reserve estimations, price, geologic and geophysical, lease cost, appraisal well drilling, production depletion cost, tax position and other sub factors.

- We note that all those factors can be expressed influence by a fraction of cumulative frequency.

c-Geopolitical factors : Also they can be expressed as fractions, according to their sub factors influences (via cumulative frequency), some of them are : demand & supply ; crises , clean energy evolution, evolution of world overall demand , USA strategic storage , Basins Depletions, Oil Petroleum Exporting Countries (OPEC) and others

We note here that any of these factors can be treated as individual factors or as collected in one single factor, which is marked here as the price (in both cases as a fraction value on the probability departing from the corresponding S shape curve.

6B – Now for reducing the level of uncertainty applying probability terminologies, grades level and rules, it needs to use Monte Carlo simulation tool to evaluate each sub factor in direct value of influence by a fraction of assigned confidential value for example.

a. For applying the Monte Carlo approach we need to construct the S-shape curve or based on the standard deviation concept or

applying frequency variation for each variable (frequency cumulative curve).

b. It is based on choosing random value from random number table for hand calculate or choose computer no generator to select cumulative frequency (for computer user) then to use it on S-curve to set in associated fraction of volume or frequency of occurrence.

c. For each experiment we select the value for each independent variable in case of technical $P_{(T)}$, or economical $P_{(E)}$ and geopolitical or prices $P_{(P)}$.

6C – Applying probability rules on proposed model Of the triple component $P_{(T)}$, $P_{(E)}$ and $P_{(P)}$.

1. $P_{(TEP)} = P_{(T)} * P_{(E)} * P_{(P)}$

As for each probability Event a single value – Law of multiplication.

2. $P_{(TEP)} = P_{(T+E+P)}$ as alternative decision making probability-Law of adding...

3. For More conditional rules of application for independent factors and non-independent (Joint) conditional event relationships can be summarized as follows :

*We note here that we can work on single compound by neglecting any term of them – also we mention here , we neglect the baye's formula for simplicity , also that formulation as for decision alternative making

7. Preliminary exercise of application:

For a practice example it was noted that we need to construct the frequency distribution of all assumed playing factors or even to start from some or sub factors. But in our case we start from the main factors of reserve, economy and prices of H-C expected. For reason of limitation of data, we did a lot of assumptions for example we assumed that number of fields under consideration are about 50 fields or reservoirs along the two proposed zones of the western flank of Iraq, We propose they can be sub divided in about 10 categories or groups classified as : Null, very poor, poor, fair, very faire, good, very good, giant, super giant, according to other sub factors of field size, closure, petroleum quality and so on.

Case 6d: What type of fraction of distribution can be used to represent 50% of the occurrence of the influence?

If either treated as event valued variable or alternative choice of decision making. Values for the mean of the major triple factor function fraction.

Is it the mean value? Is it the weighted average? Or other assigned average? Nothing that successive factor influence is conserved as cumulative range level on the abscissa, while the cumulative frequency (factor of participation) is to be represented on the coordinate as well.

Event	Mutually $P_{(TEP)}$ Exclusive $P_{(T)}+P_{(E)}+P_{(P)}$	$P_{(T+E+P)}$ Nonmutuallyexclusive $P_{(TEP)}=P_{(T)}+P_{(E)}+P_{(P)}-P_{(T)}*P_{(E)}*P_{(P)}=P_{(TEP)}$low of addition	$P_{(TEP}$)either mutuallyexclusive or Non-mutually exclusive $P_{(T)}*P_{(E)}*P_{(P)}$ low of multiplication
Independent			
Joint conditional non independent	$P_{(T)}+P_{(E)}+P_{(P)}$	$P_{(T)}+P_{(E)}+P_{(P)}-P_{(E/T)}*P_{(E/P)}*P_{(T/P)}*P_{(E)}*P_{(P)}*P_{(T)}$	$P_{(T/E)}*P_{(E)}*P_{(E/P)}*P_{(P)}$

8. Results and Advices:

a-We can confirm that the Iraqi western deserts are of frontier stage & still in need for extended deep exploration efforts, although geologic

$P_{(T+E+P)}$ Nonmutuallyexclusive $P_{(TEP)}=P_{(T)}+P_{(E)}+P_{(P)}-P_{(T)}*P_{(E)}*P_{(P)}=P_{(TEP)}$low of addition	$P_{(TEP)}$either mutuallyexclusive or Non-mutually exclusive $P_{(T)}*P_{(E)}*P_{(P)}$ low of multiplication
$P_{(T)}+P_{(E)}+P_{(P)}-P_{(E/T)}*P_{(E/P)}*P_{(T/P)}*P_{(E)}*P_{(P)}*P_{(T)}$	$P_{(T/E)}*P_{(E)}*P_{(E/P)}*P_{(P)}$

exploration, drilled wells and surficial seepages were not encouraging.

b-Lack of information is a problem (at least to this paper), except little publications, here and there, which affect the accuracy of analysis either for estimation or calculations.

c-Western desert exploration is needed urgently, particularly in Neongene subsidence.

d-We s still say that, using new technologies after a century of old development is becoming more than necessary.

e-The new model is one more as a predictive model, with triple constraints; its accuracy is a function of quality of data, All these models are

f-The model is elementary and still under development, It was introduced as part of new out look to the reservoirs management since 2009.

g-Carbonates, and Sandstones structural reservoirs from Miocene to Triassic, from north to south of Iraq had been well exploited, but those of stratigraphic prospects, are not yet, thus they have to be put under consideration.

h-Supposed reservoirs and fields under consideration .

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