

## **Basin Evaluation: A Tool to Help Assess the Petroleum Prospectivity of Australia's Offshore Frontiers**

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Australia is vastly under-explored, with a large number of frontier basins comprising diverse geology. From an Australian Government perspective, there is a need to evaluate the petroleum prospectivity of these basins, to ensure informed and strategic decisions can be made to maintain security of energy supplies. For this reason, Geoscience Australia has evaluated the petroleum prospectivity of Australia's offshore frontiers using a new methodology. The evaluation enhances Geoscience Australia's ability to provide advice to Government, identifies the key factors of high uncertainty in each frontier that are currently impacting upon perceptions of prospectivity, and high-grades areas for future data acquisition and research.

The new basin evaluation methodology is based upon standard prospect risking models, but modified to answer the question: "what is the relative likelihood of an economic petroleum field being present in this frontier?" rather than risking individual prospects. The basic ranking unit is the play level, which is risked for both geology and economics. Two versions of the geologic risking have been developed, involving eleven weighted risk factors, or four weighted groups of risk factors, respectively. Economic risking is mainly based upon functions of minimum economic field size versus expected field size distributions at each play level. Delphi meetings assess each risk factor, guided by a standardised indicative risk for each particular geologic or economic circumstance.

A key component of each frontier evaluation is a knowledge rating – poorly known regions normally have higher risk factors for geology, and economic risking can be highly speculative. For these reasons, ranking between frontiers is only valid for regions with a similar knowledge rating. The evaluation methodology is designed to be easily modifiable, so that variations to weightings, risk factors assessed, and indicative risks can be made to reflect the preferences of the user.

## **Enhancing Risk Management Using AS/NZS 4360:2004 Risk Management Standard**

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Good outcomes in Risk Management can only happen if two key elements are present – sound interdisciplinary processes and the right information.

It is important to focus on comprehensive review processes that involve broad interdisciplinary participation and improve communication. The use of a Risk Management process facilitates these objectives.

Risk Management is flexible in its application, and can deliver a range of benefits depending on the nature of the system and business concerned. These can include:

- Effective Risk management
- Public Confirmation
- Commitment to Shareholders
- Market Recognition
- Reduced Expenses Market Entry
- Enhanced Corporate Knowledge
- Improve Employee Commitment

This presentation is designed to assist participants in understanding the purpose of Risk Management and applying the AS/NZS 4360:2004 Risk Management Standard.

Underlying frameworks and related tools will be discussed including

- Risk Identification,
- Risk Analysis,
- Risk Evaluation, and
- Risk treatment.

The Risk Management processes are illustrated using relevant examples.

Participants will be able to engage in integrated risk management activities in their organisation, outline the high level goals and framework of risk management, define roles and responsibilities for risk management and use effective tools of risk management.

## **Strategies and Challenges to Set the Framework to Utilize Regional Deepwater Infrastructure for Smaller Fields**

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Block 14 offshore Angola has been under exploration, appraisal, development and production since being awarded in 1995 to a Contractor Group consisting of CABGOC (the operator, a Chevron company), Sonangol P&P, ENI, GALP, and Total. Over 1 billion bbls of recoverable oil have been discovered in 25 reservoirs in water depths from 300 to 1200 meters. In the exploration and appraisal period many "smaller" resources have been discovered and subsequently incorporated into the regional deepwater development strategies for the major hub facilities in the block.

There are many issues and challenges to set the appropriate framework for to allow for the incorporation of these "smaller" assets to allow for economic development and maximize the utilization of the installed deepwater regional infrastructure. Strategies to deal with cross-border issues, timing and phasing of developments, consideration for tie in points and associated fluid capacity are required early in the life of a deepwater project to ensure all resources in the accessible area are developed.

Over the past decade, the Contractor Group in Block 14 in conjunction with the Concessionaire has formulated workable development plans and strategies to incorporate the potential of the complete discovered resource base. This has required the early consideration of full cycle depletion plans, work plans and phasing

considerations to optimize the development strategy and work efforts. Lessons learned from implementing these strategies are relevant to future developments in the deepwater along with incorporating exploitation discoveries.

## **Decisions and Optimal Appraisal Planning for LNG Gas Supply: A Case Study**

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A 5 MMtpa LNG plant is going to be built in West Africa. This multi-billion dollar project will receive associated gas from existing oil fields, oil fields which have been discovered but are as yet undeveloped, and future discoveries. The LNG facility is sized to take near-term associated gas at rates that will not impede oil production, but not too large so as to retain a reasonable probability of continued full capacity for as long as possible. Unfortunately, as the current associated gas fields decline the plant will fail to maintain liquefaction at full capacity without sources of additional gas. Four non-associated gas sources of uncertain size are known to exist within the gas supply area for the LNG plant. An appraisal and development plan was required that maximized throughput of the LNG facility while providing sustained domestic gas supply and a foundation for infrastructure development. Questions remained as to the order, number, and extent of appraisal required to ensure adequate production capability.

Each non-associated gas field requires appraisal, development, facility design, and tie-in prior to being able to contribute to gas supply. Factors taken into consideration for the decision on the appraisal order and specific appraisal location included specific field learnings and risk reduction, contribution to gas supply uncertainty reduction, ease of tie-in, ability to delay significant capital investment, and most significant of all, the extent of demand from the LNG plant. Qualitative and quantitative decision methods were used.

An integrated multi-disciplinary decision-based approach allowed a plan that will maximize value to the project and provides a certainty of supply sufficiency.

## **Risk Assessment, Decision Making and Play Fairway Analysis in a Fluvial Setup: Risk and Uncertainty**

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Play risk consist of regional risk element, constrained by regional depositional model, which is further enhanced by poor or lack of quality data. Risk and uncertainty are inherent aspect of investing in exploration venture, and a successful and economically viable exploration programme requires a consistent consideration of risk aversion and accurate perception of uncertainty. The major attributes to define risk are (1) Quality of the seismic dataset (2) Presence of source, reservoir and trap (3) Play dynamics. In Muglad basin of Sudan the Mega elements of petroleum system are fluvial in nature, since this adds to uncertainty in predicting lateral facies variation in short distances. As the reservoirs are mainly thin fluvial sandstone they are not quite decipherable in conventional 2D seismic. Authors have made a case study by analyzing role of 3D data in reducing the uncertainty and pre and post 3D data acquisition scenario is being analyzed and it is deciphered that more the Geological uncertainty, as in fluvial system, the level of uncertainty and risk factor increases exponentially if the data is not of high resolution to track the sand geometry. With the maturity of data base the risk factor decreases and confidence level for decision making and investment increases. The authors have shown by case history, the risk, both pre and post drilling, viz a viz success ratio and prospect identification, pre and post 3D data acquisition.

## **Human Bias in Geological Interpretation – How Much Uncertainty Does It Introduce?**

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To quantify the range in interpretations of geological data by professionals, we have asked over 200 geoscientists to interpret a seismic section. Our aim was to assess the impact of interpretation on structural models and, ultimately, on prospectivity. A crucial element of the project was to create a known geological scenario, to compare interpretations against, a 'catch 22' situation if using 'real' seismic. We have created our data-set in the structural modelling and restoration program 2D Move in which we determined the input parameters for the model. Synthetic seismic was 'shot' across the model to create an image for interpretation. Individuals were asked to interpret the image and provide information on their level of experience in: years, tectonic regimes, industry, academia etc.

Initial findings suggest that people's previous experience affects both their approach and the outcome of their interpretation. Differing interpretational styles have resulted in interpretations of the single data-set ranging from salt to inversion tectonics. We have quantified the range in interpretation of the seismic data set for style and tectonic regime, and consider the impact this has on potential prospectivity. Our initial results show that those that have worked predominantly in a particular tectonic regime have in many cases brought their experience from that regime to play in their interpretation. Their prior knowledge has biased their interpretation. Can we quantify the bias of individuals in the generation of this range of interpretations and modify industry workflows to minimise the impact on prospectivity?

## **An Analysis and Comparison of Real Option Approaches for the Petroleum Investment**

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In many instances, oil companies struggle with decisions pertaining to petroleum investment. The difficulty partially stems

from the uncertainties in many of the inherent variables. As commonly acknowledged, traditional valuation methods are unable to properly portray investment opportunities. Due to large uncertainty in Petroleum Exploration and Production (E & P), investors are gradually turning to a more dynamic approach to investment decisions.

Real Options Valuation involves a methodology for evaluating the value of an opportunity, leading to a strategic decision in an uncertain environment. Based on academic research in finance and business management, Real Options Valuation may be extended from option-pricing tools of the finance sector to that of evaluating E & P projects. However, although Real Options thinking has been widely accepted and used in some cases, the wider use of the Real Options approach is still a "hot" debate in the petroleum industry.

A permissible definition of "Real Options" may lead to inconsistencies among Real Options approaches. The opportunity may involve technical aspects or may be purely commercial in nature. In all cases a quantitative approach is required. In the work by Borison (2003) and Bratvold et al (2005), the authors have listed five Real Option methodologies: the Classic approach, the Subjective approach, the Market Disclaimer approach (MAD), the Smith approach, and the Luenberger approach. A comparative analysis of these Real Option approaches is presented in this paper.

In comparing the above-mentioned Real Options approaches, two petroleum cases are considered. The technical uncertainty dominated case is related to reservoir management. The market uncertainty dominated case involves a Liquid Petroleum Gas (LPG) distribution project. The case studies presented the functionality of the five Real Options approaches.

The research suggests that the petroleum industry could benefit from using Real Options Valuation in their investment strategy, thus improving petroleum business performance.