

# A GIS Based Decision Support System for Prospects Screening and Evaluation

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**Abstract:** This paper discusses a GIS based decision support system that provides functions of prospect screening and evaluation in both technical aspects (Volume, structure, trap, reservoir and charge, etc.) and economic aspects (Net present value, Profit / investment Ratio, etc.). The decision support system has been tested in a virtual offshore exploration prospect to facilitate and improve the decision making process. The study represents a test bed for decision makers at all levels to establish prospect screening and evaluation guidelines that may be applicable to other related prospect investment issues.

**Keywords:** GIS, Prospects, Decision Support System

## 1. Introduction

The development of market economy in china greatly affected the upstream of petroleum industry in recent years. The resource hunting exploration and production process has been gradually replaced by the investment-profit driven process. The change arouses the urgent need of developing a decision support system that covers not only the conventional technical evaluation process but also the economic evaluation process that can be incorporated

together to produce the input for the final prospect investment decision-making. Geographic Information System (GIS) is a computer-based system providing advanced capabilities for handling spatial and descriptive data [1]. GIS is currently regarded as the only comprehensive tool available that supports the integrated digital analysis of multi-component processes by considering any needed attribute combination of the various components [2]. A GIS based DSS are much more powerful when dealing with the information that contains spatial features than the conventional DSS. Thus GIS is selected as the platform to develop a decision support system that provides functions of prospect screening and evaluation in both technical aspects and economic aspects.

## **2. The Development of A GIS Based Decision Support System**

To facilitate the decision-making process for Prospect screening and evaluation, a GIS based decision support system has been designed with four function modules. The Data Management Module is designed to manage the map data and database; the volume calculation module is designed to calculate the gross bulk volume and Standard Hydrocarbon Originally in Place (STHCOIP); the geological risking module is used to characterize the risk for structure, trap, reservoir and charge; and the Economic Analysis module is designed to do economic cutoff calculation, Net Present Value (NPV) calculation, Investment Profit Ratio (IPR) and the sensitivity analysis (Fig.1.).

Volume database is designed with the following attribute elements, i.e. the reservoir top area, depth, reservoir thickness, Net gross, porosity, GOR, oil saturation, formation volume factor, etc.

Geological Risking database is designed with risking attributes of structure, trap, reservoir, and source rock.

Economic database is incorporated with attributes of recovery factor, well production rate, Capital Expenditure (CAPEX), Operating Expenditure (OPEX), oil prices, inflation rate, NPV, IPR, etc.

The working procedure and data flow of the system can be described as following. At first, Structure, trap, reservoir and source rock data of the target prospect are gathered and imported into the GIS system. Near-field production data, OPEX and CAPEX data are also gathered is to serve as an analog for the economic analysis; then volume database, geological risking database and economic database are built and joined together to facilitate the calculation of production forecast, capital expenditure (CAPEX), operating expenditure (OPEX), economic cutoff, NPV and IPR; finally scenario analysis are done to fully acknowledge risks and uncertainties. The final investment decision will be determined based on the correspondent NPV and PIR, as well as the scenario analysis results.

## **3. Case Study in A Virtual Prospect**

A virtual offshore Prospect has been selected as a testbed for the DSS system. The prospect is a four-way dip closure near the proved kitchen (Fig.2). The water depth is less than 200 meters and the nearest harbor is about 100Km's away.

Firstly the relevant data were gathered and imported into the system and the correspondent database were constructed according to the procedure describe in section 2.

Secondly the oil and gas volume in the reservoir was calculated. The results show a medium-size reservoir with Originally In-place Oil (OIIP) 70.15million m<sup>3</sup> and Originally In-place Gas 7.46Giga m<sup>3</sup>. (GIIP)(Fig.2).

Thirdly the geological risks have been assessed based on 3-D composite structure maps. The results show the combined geological risk is 66%(Fig.3).

Then the production forecast and the

economic analysis was done with the CAPEX, OPEX, economic cutoff, NPV and IPR. The results show a medium-low return prospect with NPV of 33.63 Million\$, EMV of 6.43 Million\$ and Profit/Investment Ratio of 7% under base case. The scenario analyses shows the key controlling factor for investment is the oil prices. When oil prices is 25\$/bbl, the IPR become as high as 42% with NPV of 207 Million\$; but when oil price drops into 10\$/bbl, the IPR will become as low as -34% with negative NPV of -168 Million\$ (Fig.4).

Fig. 3. Basic geologic risk assessing.

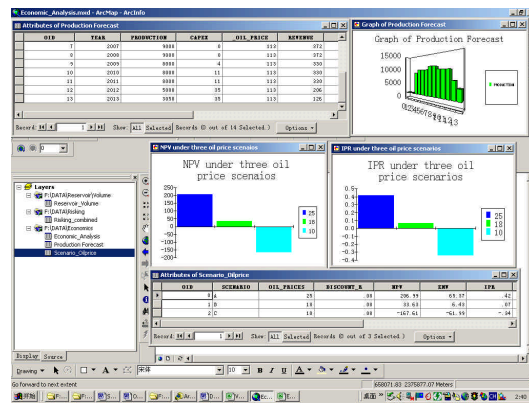


Fig. 4. Production forecast and Economic analysis.

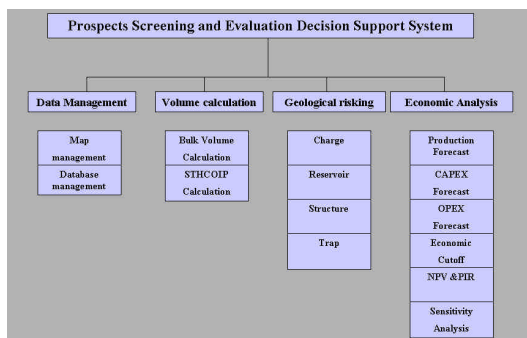


Fig. 1. Function structure of the DSS system

## 4. Conclusions

GIS based Decision Support System enables the upstream decision makers to make prospect screening and evaluation in a visual and systematic way. The incorporation of Economic analysis with the technical evaluation facilitate and improve the decision making process.

Fully functional GIS systems facilitate the input, management, manipulation/analysis, and display/output of spatial and descriptive data [3]. Though not yet fully developed, the system shows good potential as a powerful tool for explorationists and managers to screen and evaluate their prospects.

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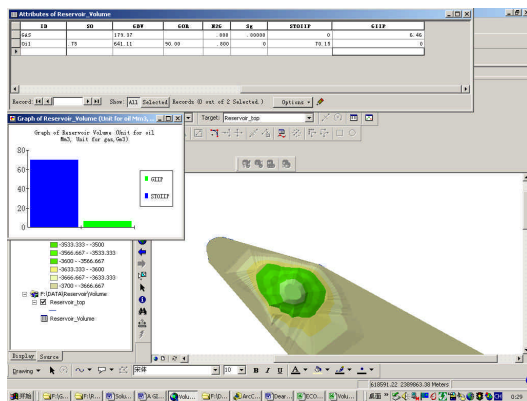


Fig. 2. Volume calculation

