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Value of Seamlessly Collaborative Integrated Studies

Presented by
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Society of Petroleum Engineers
Distinguished Lecturer Program
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OUTLINE

● Introduction
● Objective
● Premise of Collaborative Studies
● Critical Resources/Drivers
  ➢ Qualified Professional Manpower (Minds)
  ➢ Multidisciplinary “Know-How” (Expertise)
  ➢ Integrated Decision Analysis (IDA) - The Process, Bases and Methodology
● Conclusions : A Corporate Check List
Introduction
Sequential vs. Collaborative Processes

- Sequential “Asset Team” Approach (Late 1980’s)
  - Exploration & Delineation
  - Reserves Assessment
  - Reservoir Development & Management
  - Production Operations
  - Processing & Sales
  - Sub-Optimal Solutions

- Seamlessly “Collaborative Team” Approach (During 2000’s)
  - Exploration & Delineation
  - Reserves Assessment
  - Reservoir Development & Management
  - Production Operations
  - Processing & Sales
  - Parallel workflows & synergies captured: Optimal Solutions.

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Objective

Create Value and **Maximize Shareholders’ Wealth**
through Synergizing **minds, tools and database.**

**HOW?**

- Educate, Recruit, Develop and Retain Qualified Professional Workforce

- **Integrate Multidisciplinary “Know-How”**\(^*\) to carry out appropriate studies to help make rational investment decisions.

\(^*\) Defined as Core Competencies/Expertise in **Technical, Business and Leadership Skills** ★

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Collaborative Studies
The Premise

Focus only on what matters

Work in parallel with faster tools

Improved Resources Utilization & Substantial Savings in Time ★
Collaborative Studies
Key Attributes

- Multi-disciplinary / Cross-Functional Teams
- Dedication & Focus
- Parallel Workflows
- Full Spectrum of Alternatives
- B-i-C Integrated Decision Analysis (IDA)
- Better & Faster Results and Decisions
- Synergy (Minds, Tools & Database) ★

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Collaborative Studies

Synergies Captured: Minds, Tools & Database

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Critical Resources / Drivers

- **Qualified Professionals:** Minds
  - Key Attributes, Education, Learning & Development (L&D)

- **Multidisciplinary “Know-How”: Expertise**

- **Integrated Decision Analysis (IDA):** Putting it all together to capture synergies of Minds, Tools and Database
Qualified Professionals
Key Attributes

Successful Professional

- Ambitious
- Results-Oriented
- Technically Proficient
- Team Player
- Effective Communicator
- Business Savvy

Summary: Possess Technical, Business & Leadership Skills

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* How learning the topic like porosity (e.g. reserves) is going to contribute to this bottom line must be emphasized.
Qualified Professionals…

L&D – Competency Development Cycle

Define
Set / Review
Personal Goals &
Business Needs

Assess
Identify Development
Needs & Skills GAP

Create Personal Skill Inventory
(Discipline Specific)

Environment
Conducive for
Quality Learning &
Development (L&D)

Review
Assess Effectiveness
& Create Personal
Skills Inventory

Plan
Prepare/Modify
Development
Action Plan

Execute
Implement
Development
Actions

- Courses
- Planned Work Experiences
- Special Job Assignments

Adapted from “Oxy’s input to PetroSkills (2004 Conclave, Houston, TX)”

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Qualified Professionals…
L&D - Career Progression & Value Added

Measures Progress & Sets Expectations for Performance Delivery ★

Adapted from “Unocal’s input to PetroSkills (2004 Conclave, Houston, TX)”

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Critical Resources / Drivers

- Qualified Professionals - Minds

- Multidisciplinary “Know-How” - Expertise
  Technical, Business and Leadership Skills

- Integrated Decision Analysis (IDA)
Multi-Disciplinary “Know-How”

Three (3) Core Competencies / Expertise:

● **Technical Specialties/Skills**
  ✓ Earth Sciences – Geology & Geophysics
  ✓ Petrophysics
  ✓ **Engineering** - Drilling & Completion, Reservoir, Production & Facilities
  ✓ Statistics & Decision Analysis
  ✓ Maintenance & Operations, etc.

● **Business Skills** - Economics & Finance

● **Leadership Skills** – Knowledge Sharing, Communication, Impact & Influence, etc ★
Critical Resources / Drivers

- Qualified Professionals - Minds
- Multidisciplinary “Know-How” - Expertise

- Integrated Decision Analysis (IDA)
  Synergies captured thru Minds, Database & Tools
Integrated Decision Analysis (IDA)

The Process – A Pictorial View

Geological Model

Data Acquisition

Database

Simulation Model

Interpretation & Modeling

Technical Analysis

• Multiple Realizations
• Reserves
• Development Options

Decision Analysis

Plans for Execution

Business Model

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Integrated Decision Analysis (IDA)  
The Process – A Conceptual Premise

Reservoir Characterization, Modeling & Simulation  
(Multiple Realizations – Volumes & Profiles)  
TECHNICAL ANALYSIS

Data & Knowledge Management  
(Acquisition & Learning)  
DATABASE

Evaluation of Alternatives, including Risk Analysis  
(Reserves, Development Plans and Producing Strategies)  
DECISION ANALYSIS

Planning and Field Implementation  
ACTION PLAN

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Integrated Decision Analysis

Technical Issues – Key Parameters

With Significant Impact on Results:

- Proper Physics
- Details - Grid Size, Number of Layers
- Petrophysical-based Rock Typing
- INPUT DATA Quality – Static and Dynamic
- Initialization – How to propagate & distribute data?
- Simultaneous Nodal Analysis (Reservoir, Completion, Wellbore & Surface) ★
Integrated Decision Analysis

Technical - Location of Trapped Oil Example

Delta Sw in 30 Years
(14 Layer Model; 53,000 cells)

Delta Sw in 30 Years
(128 Layer Model; 1.4 million cells)

SPE 71628 Pavlas

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Integrated Decision Analysis
Technical - Quantifying Uncertainty

Risk Profile & Expectation Curve

Mean=28
Average or Expected Value (EV)

SD-Variability/Risk

Cumulative Probability

Reserves (MMSTB) / Value (MM$)

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Volumetric Equation: \( \text{EUR} = \left[ A \times h \times \phi \times (1 - Swi) / \text{FVF} \right] \times \text{RF} \)

Random Variables
(Probability Distributions)

- Porosity Normal
- Swi Log-Normal
- Ah Triangular
- RF Uniform

Volumetric Model

Fixed Parameters

Expectation Curve

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Production Profile Realizations

Exaggerated Scales

- Oil Rate (STB/Day)
- Cumulative Production (MMSTB)
- Years

Exaggerated Scales

- Oil Rate (STB/Day)
- Cumulative Production (MMSTB)
- Years
Integrated Decision Analysis
Technical - Reserves Assessment (Dynamic)

Model Results

- P90
- P50
- Mean
- P10

Best Technical Scenario

Cumulative Probability

- 100%
- 50%
- 0%

Oil Recovery (MMSTB)

- 0
- 20
- 40
- 60
- 80
- 100
- 120
- 140
- 160

Distribution fit
Simulated realization

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Integrated Decision Analysis

Business Issues - Sustainable Earnings Growth

--

Annual Earnings ($)

Growth Objective for Corporate Earnings (with New Investments)

Net Earnings required to meet Objectives in year $T_i$

Projected Earnings from Existing Projects (no further Investment)

Earnings Gap Analysis (Newendorp & Schuyler, 2000)

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Integrated Decision Analysis

**Business - Corporate Objectives**

- Maximize shareholders’ value (SHV) while
  - minimizing exposure to loss; and
  - ensuring earnings growth at a stipulated rate

- Preferable when the Corporation
  - makes Profit each year,
  - stabilizes Profit and sustainable Growth,
  - maintains Liquidity and Solvency, and
  - is a good Corporate Citizen.
Maximize Market Value Added (MVA)

\[ MVA = \text{Market Value (MV)} - \text{Book Value (BV)} \]

Maximize (MV:BV) Ratio thru making continuous and sound new investments

Balance Sheet explains 15\% (1/6) of Value Added only.

Remaining 85\% (5/6) by Talent & Intelligent Assets ★
Integrated Decision Analysis

Business - Valuation/Appraisal Model

- Has Appropriate Business Model
- Accounts for the Time Value of Money Concept
- Quantifies Judgments about Uncertainty and incorporates the Risks in project cash flows.
- Uses realistic Company Discount Rate (or MARR)
- Has a Figure of Value, the best value measure:
  - NPV @ MARR % (Deterministic Analysis)
  - EMV @ MARR % (Probabilistic Analysis)

Decision Rule: Accept if Project NPV or EMV ≥ 0

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Integrated Decision Analysis

Business - Cash Flow based Valuation Model

Net Cash Flow (NCF)

Income Taxes

Costs

- OPEX
- CAPEX

Revenue

Production Taxes

Royalty

Production Profiles

- Drilling – Platforms & Wells
- Well Flowlines
- Production & Injection Facilities
- Oil & Gas Pipelines ★

- Fixed Costs (Labor)
- Variable Costs
  - Lifting Costs
  - Electricity
  - Etc.
Integrated Decision Analysis

Business - Evaluation Methods (How?)

- **Deterministic Methods**
  - DCF Analysis and NPV Profiles
  - Sensitivity Analysis

- **Probabilistic Methods**
  - Decision Tree Analysis
  - Monte Carlo Simulation
## Deterministic Approach

### Comparing Projects by NPV Profiles

#### Key Profitability Measures Summary

<table>
<thead>
<tr>
<th></th>
<th>Project A</th>
<th>Project B</th>
<th>Incremental Project (A - B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment Capital (MM$)</td>
<td>300</td>
<td>200</td>
<td>100</td>
</tr>
<tr>
<td>NPV @ 10% (MM$)</td>
<td>416</td>
<td>205</td>
<td>211</td>
</tr>
<tr>
<td>DCF - ROR (%)</td>
<td>46%</td>
<td>53%</td>
<td>39%</td>
</tr>
</tbody>
</table>

### Graphical Representation

- **NPV Profiles**
  - **Project A**
  - **Project B**
  - **Incremental Project (A - B)**

- **Nominal Discount Rate (%)**
  - **MARR = 10%**
  - **RORA = 46%**
  - **ROR(B) = 53%**
  - **ROR(A-B) = 39%**

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Integrated Decision Analysis

Business - Evaluation Methods (How?)

- **Deterministic Methods**
  - DCF Analysis and NPV Profiles
  - Sensitivity Analysis

- **Probabilistic Methods**
  - Decision Tree Analysis
  - Monte Carlo Simulation
Deterministic Approach
Sensitivity Analysis – “Project A” NPV

Tornado Diagram for a Typical Oil & Gas Producing Property

Sensitivity of Project NPV to Changes in the Key Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>-30%</th>
<th>+30%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Price</td>
<td>$28/bbl</td>
<td>$40/bbl</td>
</tr>
<tr>
<td>Discount Rate</td>
<td>+30%</td>
<td>13%</td>
</tr>
<tr>
<td>CAPEX</td>
<td>+30%</td>
<td>-30%</td>
</tr>
<tr>
<td>OPEX</td>
<td>+30%</td>
<td>-30%</td>
</tr>
</tbody>
</table>

Net Present Value, NPV (Million $)

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Integrated Decision Analysis
Business - Evaluation Methods (How?)

- Deterministic Methods
  - DCF Analysis and NPV Profiles
  - Sensitivity Analysis
- Probabilistic Methods
  - Decision Tree Analysis
  - Monte Carlo Simulation
**Decision Tree Analysis**

"Project A" Expected Value Estimates

<table>
<thead>
<tr>
<th>Reserves Size (MMSTB)</th>
<th>NPV @ 10%</th>
<th>EMV @ 10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>$200 MM</td>
<td>$60 MM</td>
</tr>
<tr>
<td>0.3</td>
<td>$400 MM</td>
<td>$240 MM</td>
</tr>
<tr>
<td>120</td>
<td>$700 MM</td>
<td>$70 MM</td>
</tr>
<tr>
<td>0.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

EMV of the Project A: $370 MM

**Decision Rule:** Higher the EMV better the project profitability.

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Integrated Decision Analysis
Business - Evaluation Methods (How?)

- Deterministic Methods
  - DCF Analysis and NPV Profiles
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  - Monte Carlo Simulation

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Monte Carlo Simulation

“Project A” NPV Risk Profile

\[ NCF_t = Volume_t \times Price_t - Royalty_t - OPEX_t - CAPEX_t - Taxes_t \]

Cash Flow Model

Fixed Parameters (Deterministic)

Profile with an EMV of $385 MM as compared to Single NPV Estimate of $416 MM

\[ NPV @ 10\% = \sum_{t=0}^{t=n} \frac{NCF_t}{(1 + MARR)^t} \]
Probabilistic Analysis
Comparing and Ranking Projects

Decision: Project B is clearly superior to Project A. ✮
Decision: 1) For a risk-neutral investor, Project A is better than Project C.

2) For a risk-averse investor, it is not clear & further analysis required. ★

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**Probabilistic Analysis**

**Comparing Projects - Risk Neutral vs. Averse**

Risk Adjusted Value, \( \text{RAV} = \text{EMV} - \frac{\sigma^2_{NPV}}{2B} \)

**Decision Rule:** For a given Budget \((B)\), the **higher the RAV, better is the project profitability.** ★

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Portfolio Optimization

Example Investment Portfolios

<table>
<thead>
<tr>
<th>Portfolio Budget, B</th>
<th>NPV @10% (MMS)</th>
<th>SD (MMS)</th>
<th>Actual Inv (MMS)</th>
<th>No. of Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>B = $400 MM</td>
<td>1,069</td>
<td>705</td>
<td>400</td>
<td>9</td>
</tr>
<tr>
<td>Risk Neutral</td>
<td>788</td>
<td>466</td>
<td>382</td>
<td>6</td>
</tr>
<tr>
<td>Risk Averse</td>
<td>1,924</td>
<td>903</td>
<td>980</td>
<td>15</td>
</tr>
<tr>
<td>B = $1,100 MM</td>
<td>1,890</td>
<td>886</td>
<td>1,077</td>
<td>14</td>
</tr>
</tbody>
</table>

Funds Available for Investment ($)

Cumulative NPV Generated ($)

Started with 16 Projects
With NPV of $2,070 MM
(requires $1,165 MM Capital)
Investment Portfolio Optimization
Ideal vs. Actual

Maximizing Shareholder Wealth (or MV) requires:
- Optimized Capital Structure with Optimal D/E Ratio & minimized MARR
- Maximized Return on Existing Projects (Capital)
- Maximized Value Added by the New Investment Portfolio ($A w/ $Y)

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Seamlessly Collaborative Studies

Putting it all Together: Maximize Shareholders’ Wealth

Business Skills  Integrated IDA
(Business Impact & Execution)

Technical Skills  Leadership Skills

Degree of Collaboration

“Know How”/Expertise

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CONCLUSIONS

VALUE of Collaborated Studies

A Corporate Check list, Do You HAVE?

- Qualified **Professional Workforce** – Educate, Recruit, Develop & Retain
- Optimized **Capital Structure** and **Minimized Raider’s Gap**
  - Survival of the fittest
- Ranked Risk Adjusted **Inventory of Investment Opportunities**
- Continuous Development & Execution of **Optimal Business Plan Investment Portfolios (Repeatability)**
- Sustainable **Earning Growth**
- Distinct **Competitive Advantage** (Intelligent Assets)

**END RESULT:** Maximized **Shareholders’ Value** because of

**VALUE CREATION** thru **Synergies Captured** via **Integration, Technology & Scale** ★
Thank you...