
**Economic Risk and Decision Analysis
for Oil and Gas Industry
CE81.9008**

**School of Engineering and Technology
Asian Institute of Technology**

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Value from Real Option

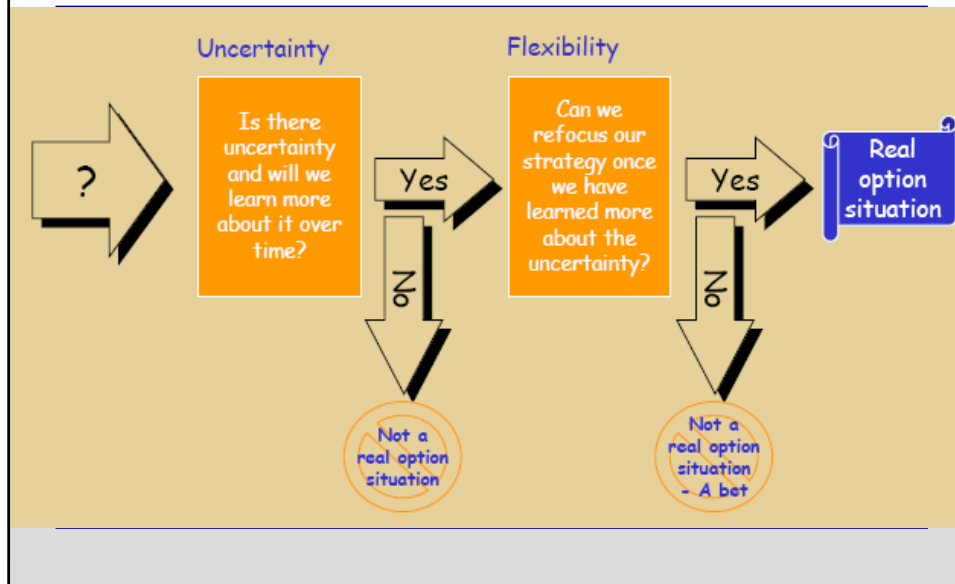
Real Option

- **Real Options:** The *flexibility* to alter the course of action in a **real assets decision**, depending on future developments.
 - **Real Options** arise from the **ability to delay** and **revise investment and operating decisions** over time as uncertainty is resolved.
 - The decision is discretionary: **upside potential** can be captured, **downside** can be avoided.
 - **Something can be learned** before the decision must be made.
 - Sometimes these can have a **simple framework** similar to a financial call option: exercised and monetized in one step.
 - Other times real options are a **series of sequential decisions** that are played out over a life of an oil field
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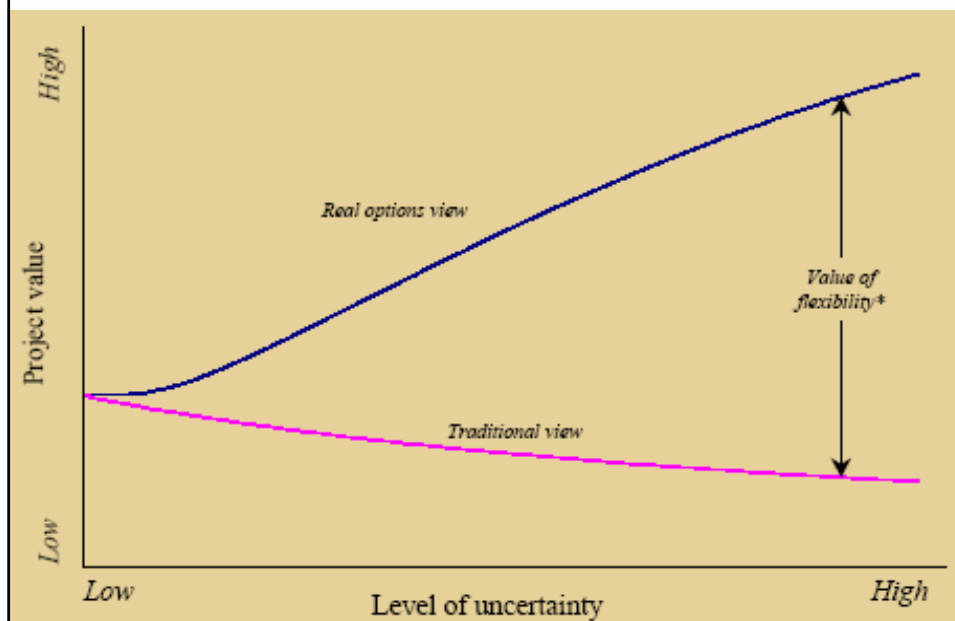
Key Concepts of Real Options



Real Option Situations

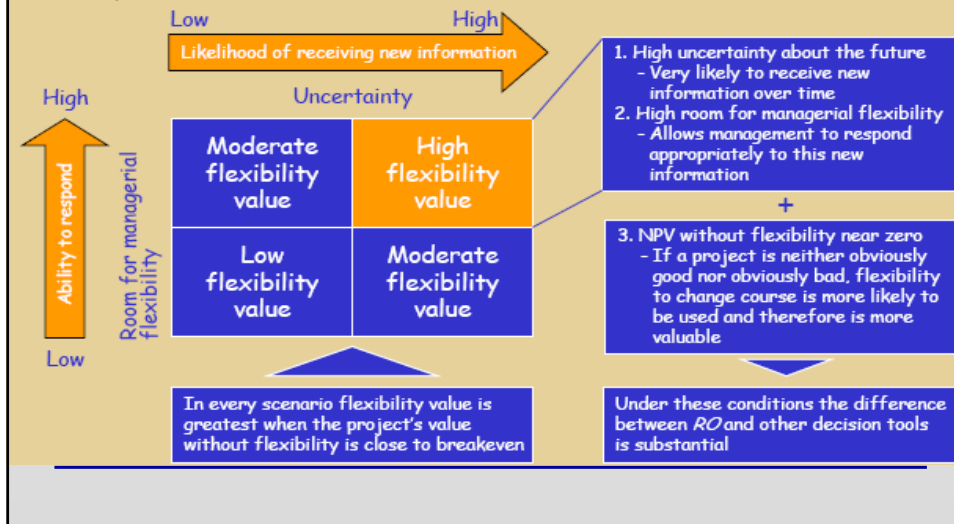


Uncertainty lead to higher project value in real option situations



When managerial flexibility is valuable

Flexibility is largely driven by uncertainty and by management's ability to respond to this uncertainty.



How are companies using “Real Options”?

- A survey of 39 managers at 34 companies conducted in Spring 2001 (“Real Options: State of the Practice” by Alex Triantis and Adam Borison, *Journal of Applied Corporate Finance*, Summer 2001, pp.8-24) revealed **three primary ways** in which real options is currently used in practice:
 - Real Options as a **conceptual tool** or a “way of thinking”
 - Real Options as an **analytical tool**
 - Real Options as an **organizational process**

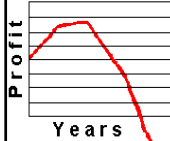
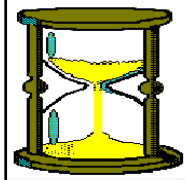
Real Options Analysis: A Conceptual Tool

- A **language** and **framing tool** for decision making
 - A shorthand language for ***communicating opportunities***
 - Identify and understand the nature of ***key uncertainties***
 - Recognize, create, and optimally ***manage flexibility***
 - **Key insights** (build on options intuition)
 - Don't automatically dismiss a project with $NPV < 0$
 - Don't necessarily invest (today) in a project with $NPV > 0$
 - Don't fixate on most likely scenario
 - Invest in stages - each step provides information
 - Pursue several paths at once (and expect failure...)
 - Think explicitly about "downstream decisions"; remain flexible
 - Volatility can enhance value if you keep your options open
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... and an Analytic Valuation Tool

- A valuation tool that properly measures the risk of complex projects, and uses the **appropriate risk-return relationships** from financial markets.
 - Line up strategy with shareholder value creation
 - NPV/DCF are theoretically correct, but the traditional application of these techniques is inappropriate in cases where *option value is significant*:
 - *Cash flows* are altered by downstream decisions, so they need to be mapped out very carefully
 - *Discount rates* are very difficult to estimate accurately since risk changes over project life and across different scenarios
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Main Petroleum Real Options



◆ Option to Delay (Timing Option)

- Wait, see, learn, optimize before invest
- Oilfield development; wildcat drilling

◆ Abandonment Option

- Managers are not obligated to continue a business plan if it becomes unprofitable
- Sequential *appraisal program* can be abandoned earlier if information generated is not favorable

◆ Option to Expand the Production

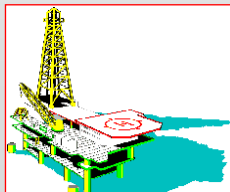
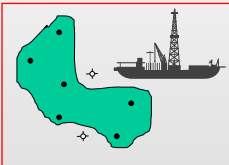
- Depending of market scenario (*oil prices, rig rates*) and the petroleum *reservoir behavior*, new wells can be added to the production system

E&P as a Sequential Real Options Process

Probability = p

Expected Volume of Reserves = B

Revised Volume = B'



⇒ Concession: Option to Drill the Wildcat

Exploratory (wildcat) Investment

⇒ Undelineated Field: Option to Appraise

Appraisal Investment

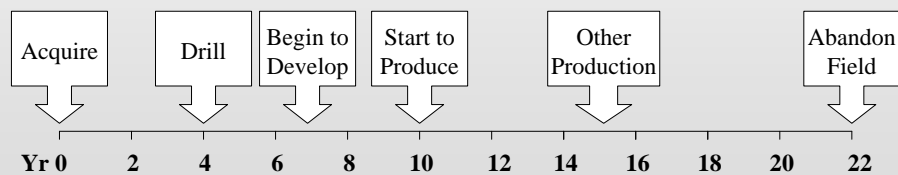
⇒ Delineated Undeveloped Reserves: Option to Develop (What is the best alternative?)

Development Investment

⇒ Developed Reserves: Options to Expand, to Stop Temporally, and to Abandon.

Real Options as a Series of Decisions

- Acquire a lease ♦ Option to Drill a well
 - Make a Discovery ♦ Option to Develop and Produce the Oil
 - Produce Oil ♦ Option to further develop adjacent Oil Fields
 - Produce More Oil ♦ Option to Provide Processing to Third Parties



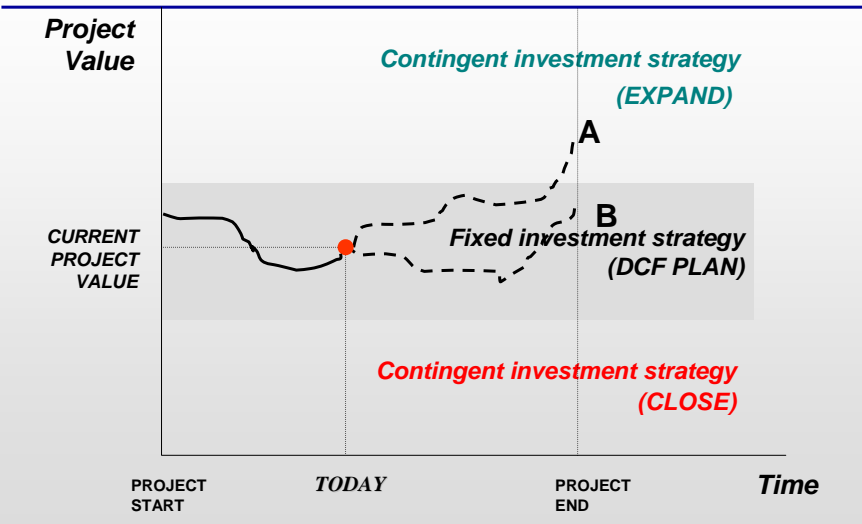
Real Options Mindset

- New Ventures (Entry into New Country, Basin, Market, Value Chain Segment)
- Development of Oil & Gas fields
- Evaluation of New Technology
- Mergers & Acquisitions

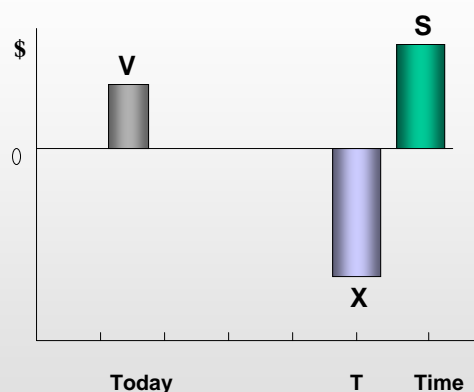
There is likely to be the **most value** where there is the **most to learn** (the higher the uncertainty, the greater the option value in general).

Where there is little to be learned, real options tend to have little value.

An Investment Opportunity: The Contingent Decision



An Investment Opportunity: The Contingent Decision



V = Value of the expansion option (captures the upside potential of **S**)

S = The investment's payoff

X = The investment's cost

σ = Volatility of payoff's value

Is Real Options Valuation (ROV) different from DA?

• No, not really

- It is built around a Decision Quality Framework
- It uses decision trees and probability theory
- It is based on discounting cash flows
- Results are displayed as “S-curves” and expected values
- It focuses on providing clarity of action
- It is the same basic process with a different emphasis

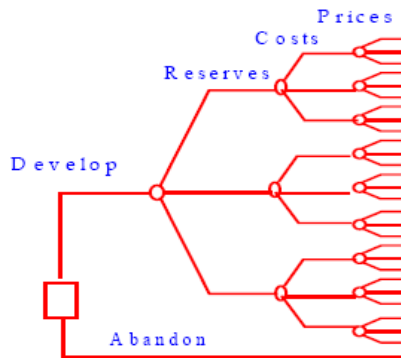
• Yes, in practice

- It emphasizes future decisions when uncertainty is resolved
- It involves a more open and expansive framing of the opportunity
- It often requires dynamic programming to “solve the decision tree”
- It provides signposts and policies for future decisions
- It handles market risks through forward market information and tracking portfolios

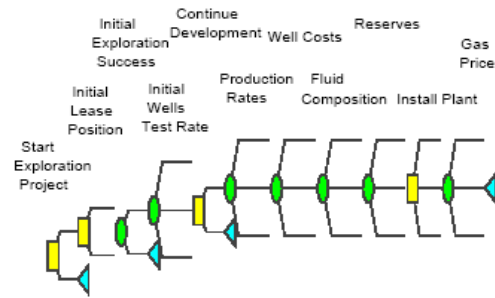
Framing

- Our “**Framing Paradigm**” made it very difficult to identify & value flexibilities and options (e.g. Schedules are fixed, processing rates are “known”, costs are fixed)
 - We tend to frame an **opportunity** such that it is “easy to solve”
 - The admirable goals of **efficiency and reduced cycle time** tend to work against spending the effort to properly frame the opportunity
 - Just because some uncertainties are difficult to assess DO NOT AVOID THESE ASSESSMENTS (e.g. Political Risks, Competitive Issues, Learning & Technology Development)
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Risk analysis overlook the option associated



Decision tree for a major offshore development project

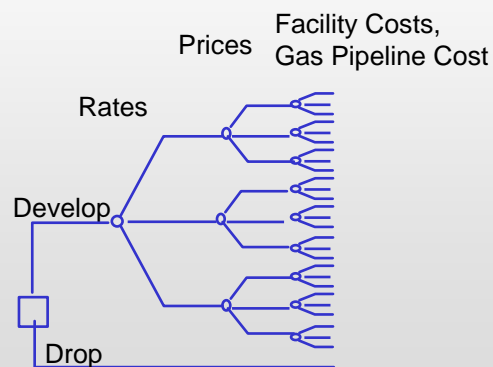


Decision tree for a non-conventional gas exploration play

In these evaluations, "exercise strategies" were typically hard-wired in the model rather than optimized.

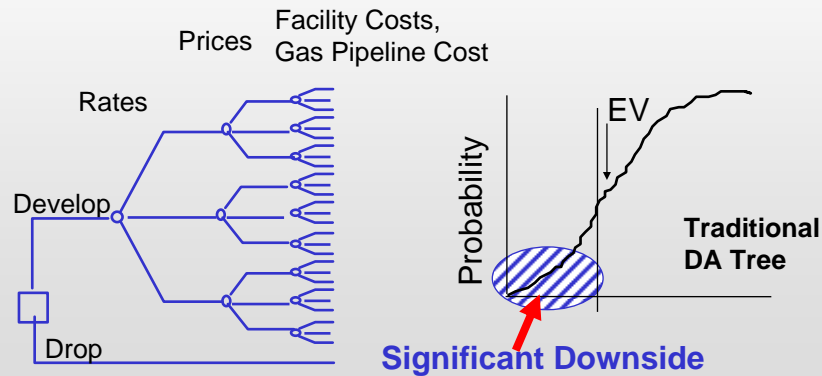
Uncertainties: Costs, Rates, and Price

Traditionally the development schedule was treated as a "given"

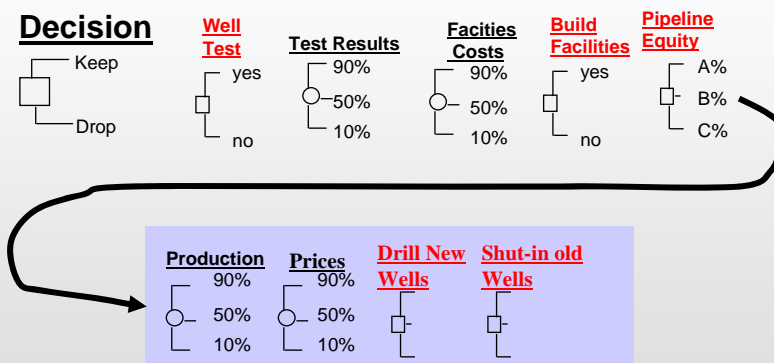


Uncertainties: Costs, Rates, and Price

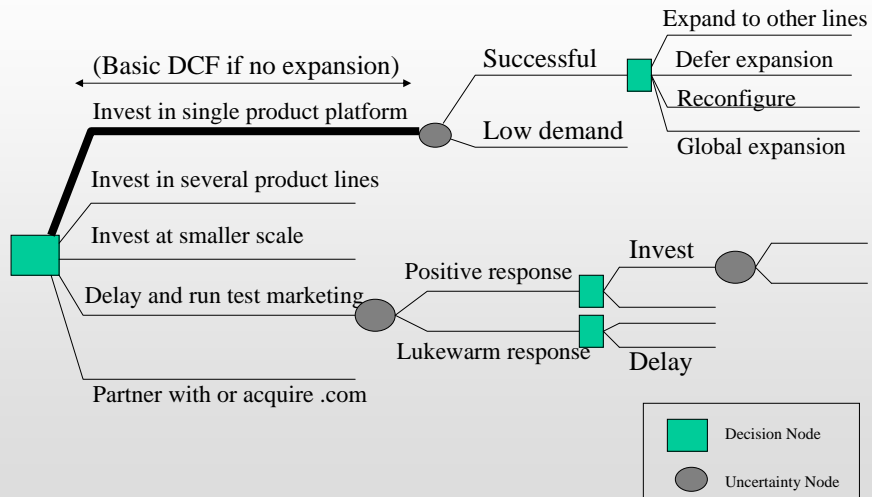
In practice we should be able to *avoid the downside* by adjusting plans as future uncertainties are resolved



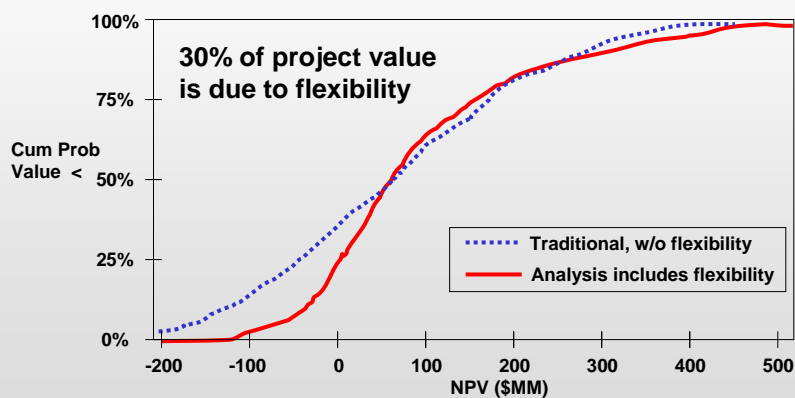
Here we model the development plan looking at Future Decisions - Learning as we go



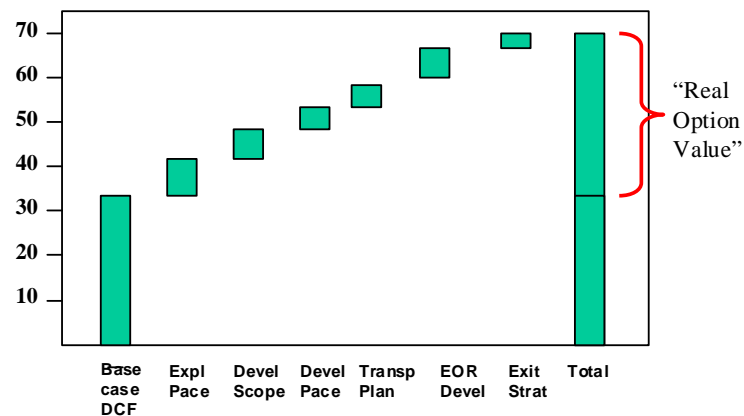
Framing - Uncertainties and Strategic Alternatives



Flexibility gives higher EV with less downside



In addition to the \$ Value, Real Options Analysis identifies the source of the value

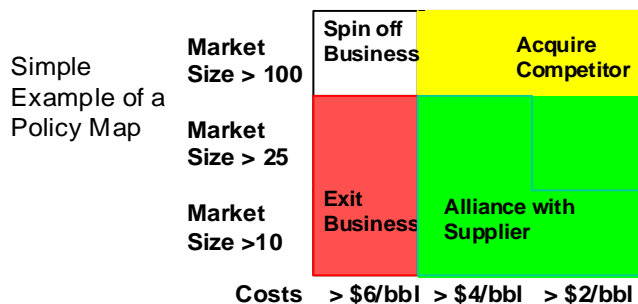


Interpretation of Analysis - Insights

- The analysis output looks like a Standard DA output:
 - “S-Curves” with expected values
 - 10-50-90 plots of inputs and outputs
 - Tornado Diagrams
- The added output is a series of “Policy maps or diagrams”
 - These identify what choices would be made based on particular signposts
 - This is the proactive planning part of Real Options and links the analysis into the implementation of the strategy

Build a Proactive Plan with a Real Options Mindset

- Incorporate the policies, signposts and options into the asset or business plan
 - Monitor and measure when signposts are observed
 - Take action based on signpost



Is this something new and different??

- No, but
- By asking the question “What choices do I have?” **at each step into the future** more **value** may be discovered.
- We often do this **when a project is not economic**, but do we put the effort into finding added value if the project base case “flies”?
- Thinking in terms of real options creates a “**Real Options Mindset**” that in turn searches for and creates value

Learning is Key...

- What would a stock option be worth to you if you were unable to monitor the price of the stock while the option was in force?
 - Not much, you would just have to guess when to exercise it.
 - Value of a real option ~ Value of Information + Flexibility
-

Learning Styles

- **Passive Learning:** comparable to market risk
 - Simply watch the underlying variable move
 - (e.g., oil prices, stock index)
 - **Active Learning:** comparable to technical risk
 - Invest to learn more (no spending, no learning)
 - (e.g., market acceptance rate, trial well drilling, drug testing)
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Two types of risk

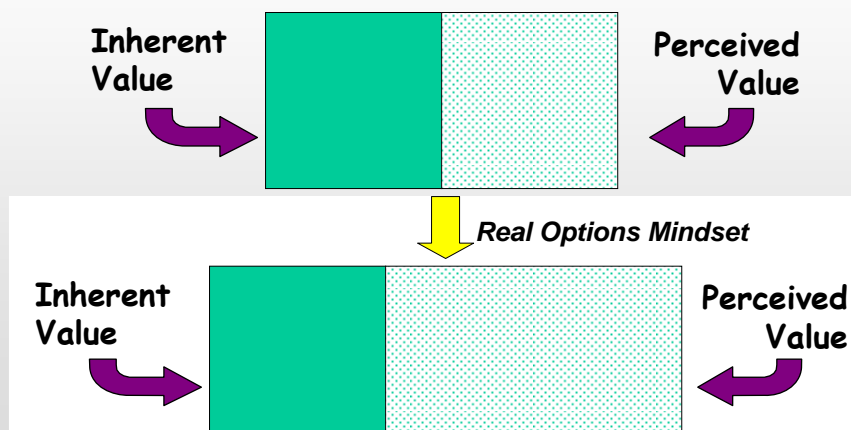
- **Market risks or economic risks**

- Risks that depend on the prices of assets traded in competitive markets. (e.g., price of securities, oil, minerals, jet fuel and commodity prices)

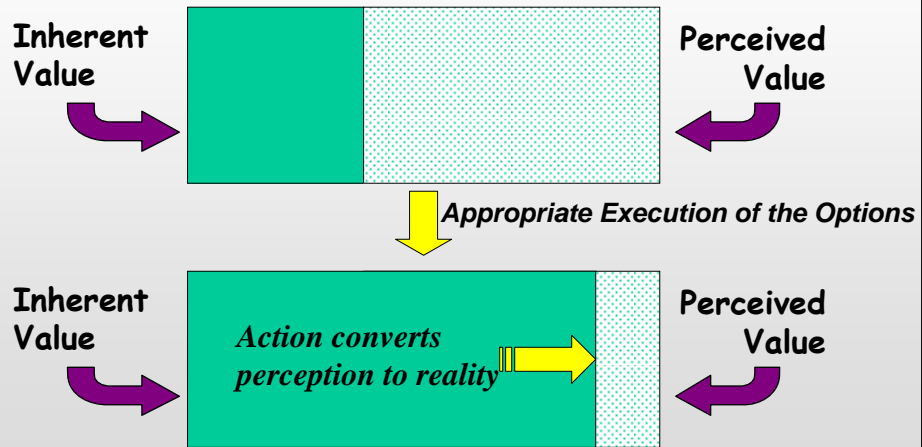
- **Private risks or technical risks**

- The sources of uncertainty that are not directly related to the value of market-traded assets. (e.g., size of oil resources, the rate of technology acceptance, and failure rates)
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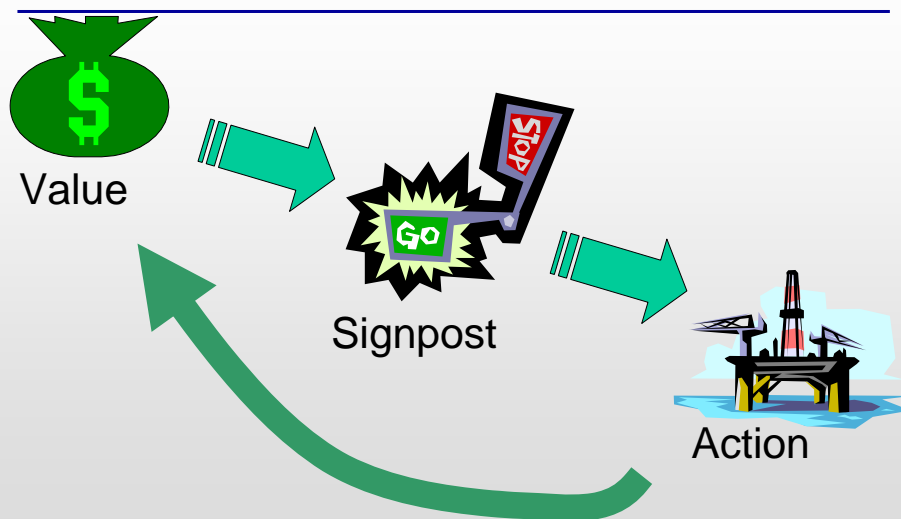
Real Options: Change the perception of value



Real Options: Change the perception of value



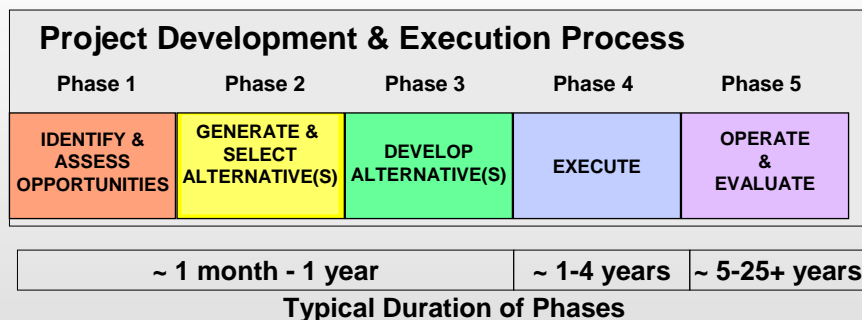
Linking Value Assessment to Signposts and Actions which Deliver the Value



“Real Options Mindset”

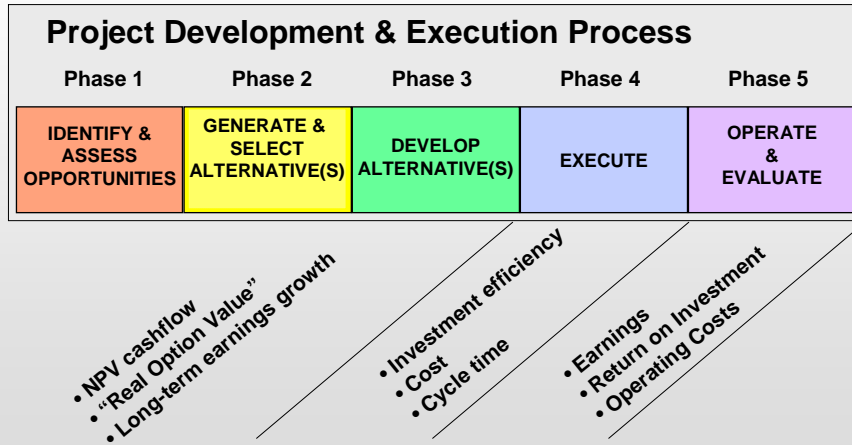
- When a decision is made based on evaluation of the real options embedded in a project:
 - There are *assumptions about future decisions* that must be understood
 - Those future decisions must be built into *business plans*
 - Think in terms of the *value created by those options*
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Ensuring Management Continuity throughout the Project



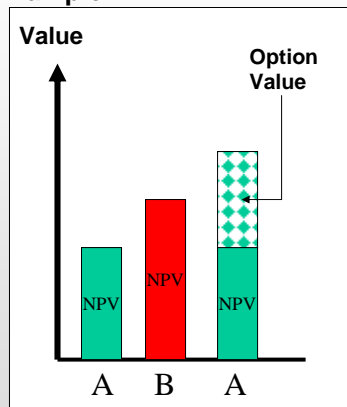
Make sure the manager who can exercise the option knows about it!

Typical Metrics in Different Phases



Metrics vs Decision Criteria

Example

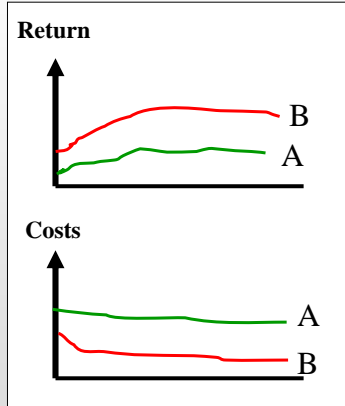


- The conventional NPV of project A is less than that of project B
- There is no option value associated with project B
- With its option value, project A is worth more than project B

Which do we select?

Metrics vs Decision Criteria

Example



- In this example the costs associated with “preserving” the option make “A” less attractive than “B” based on standard operating metrics
 - Unless the rationale and signposts are clearly understood and in the business plan, the manager of “A” will be under pressure to improve or divest.
-

Can we recognize option value when it's realized?

- Project investment process requires a “lookback” to compare the actual value realized to the pre-investment estimates
 - When investments are justified by the value of future options, that value must be recognized and measured - for most of our accounting systems this is not easy
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Tracking Options through the Life of an Asset

- Asset teams and business units should identify the signposts that would trigger an option and the incremental earnings expected as a result.
 - These should be tracked as part of the asset or business plan
 - Where the opportunities lie along the value chain the earnings may likely appear in another organization's plan and metrics
-

Building ROV into the planning process

- Integrating real option valuation into the planning process for frontier and growth exploration and production units
 - Identify what key options are and how they vary from trend to trend
 - Goal is to have greater confidence in our assessment of value from one trend to another
-

Real Options Mindset

- Real Options is not just a *valuation tool*
 - Real Options Mindset is a way of *thinking and talking* about assets and opportunities
 - It brings different questions to mind
 - What can I do with this asset?
 - What are my key future decisions?
 - Is there value present that I am not capturing?
 - How can this opportunity leverage my strengths and reduce my weaknesses?
-