



Decision Analysis - Comparison of Pharmaceutical & Upstream Oil

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“Analogy is the core of cognition”

Douglas Hofstadter

Cognitive scientist best known
for his book “Gödel, Escher, Bach
– An Eternal Golden Braid”

My Goal for the Talk

Brief comparison of the relevant features of
pharma and oil

Comparison of stages of development and
uncertainties

Sequential risk resolution process

Decisions in different stages/examples

Comparing cultures, DA practice & processes

Summary and Takeaways

Pharmaceutical Development

Objective: Bring the compound to market by proving safety and efficacy and maximize value over lifecycle

Cost, risk, time-to-market – all high

Product development through progressively larger investments in multiple phases – to learn and manage risk

Complex project management

Unique aspects:

- Projects centered around developing drug compounds for specific indications or uses
- Patent / exclusivity
- Product differentiation and oligopoly – high brand equity
- Stable prices on a short-term basis – Typically declines over longer term with competition
- Regulatory approval before product launch
- Licensing agreements between big pharma and innovator companies
- Life cycle management by expanding product label or approved uses

Oil & Gas Upstream

Objective: Develop the field safely to maximize value

Cost, risk, time to first-oil high

Field development through progressively larger investments in multiple phases – to learn and manage risk

Complex project management

Unique aspects:

- Projects centered around developing fields
- Largely a commodity and price determined in market
- Volatile price
- No regulatory approvals for product (but environmental and host-Government related regulations)
- Complex Production-Sharing Contracts and other fiscal agreements with Governments
- Contractor partnerships
- Life cycle management through secondary/tertiary recovery and reservoir management

It is all about “Information”

Every step of a Pharma R&D or E&P project is an information gathering exercise

Even the final result of phase 3 pharmaceutical trial is “information”

To understand the uncertainties and develop the alternatives for the next stage

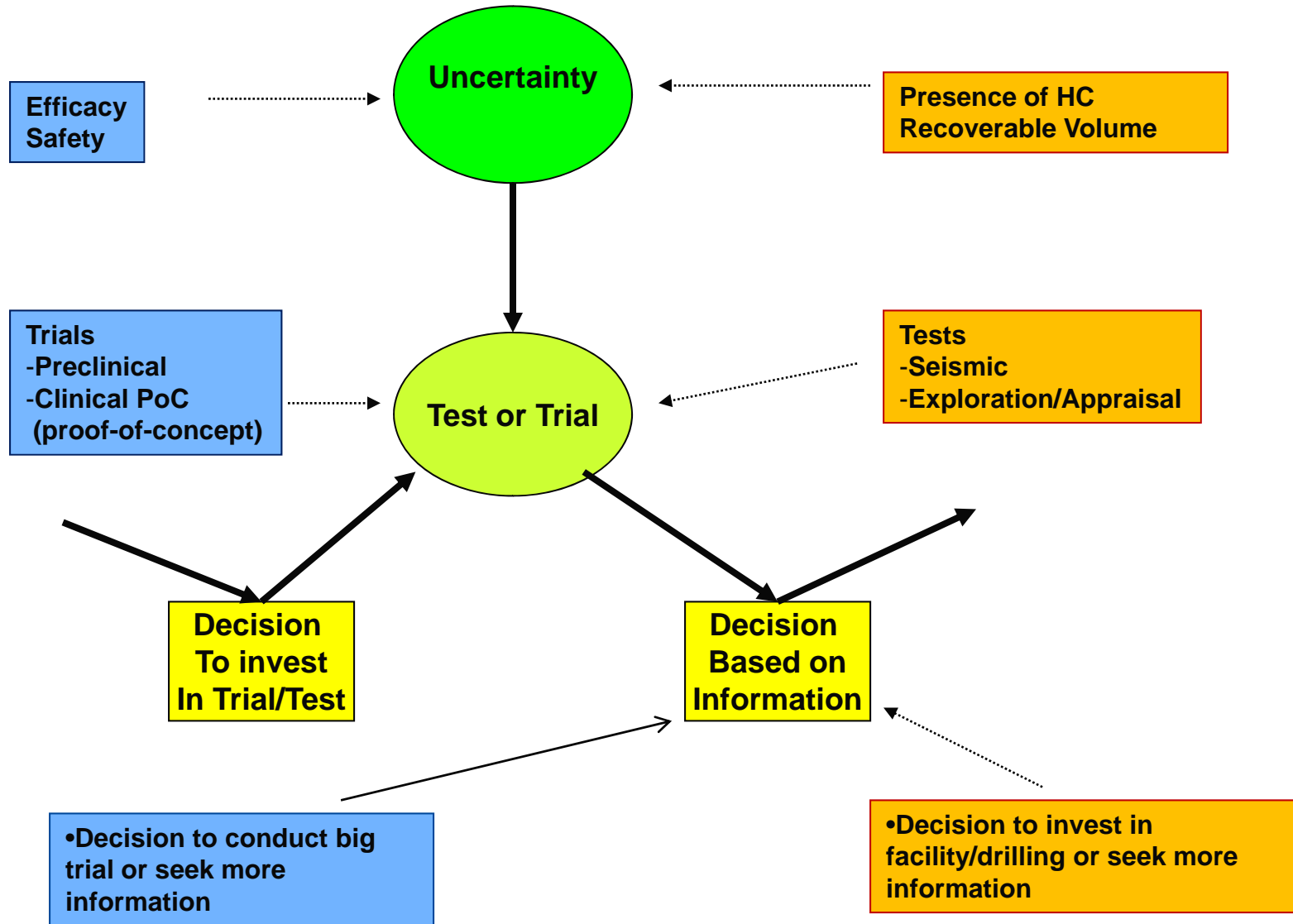
To determine whether to proceed with the “big trial” or the “big investment in facility”

Basic Questions

	Pharmaceuticals	Oil & gas
What are the primary uncertainties being resolved through learning?	Efficacy of the drug for a specific indication Safety of drug	Presence of HC Recoverable volume Recovery Efficiency
How is it being resolved (tests, trials, pilots)?	Preclinical and clinical trials – specifically proof-of-Concept trial to confirm efficacy	Seismic studies, exploratory and appraisal drilling, and various other tests
What important decisions are taken?	Should we invest (typically hundreds of millions \$) in a phase 3 trial	Should we move forward with capital investment (billions of \$) in drilling and facility

Uncertainty-Information-Decision

Pharma vs. E&P

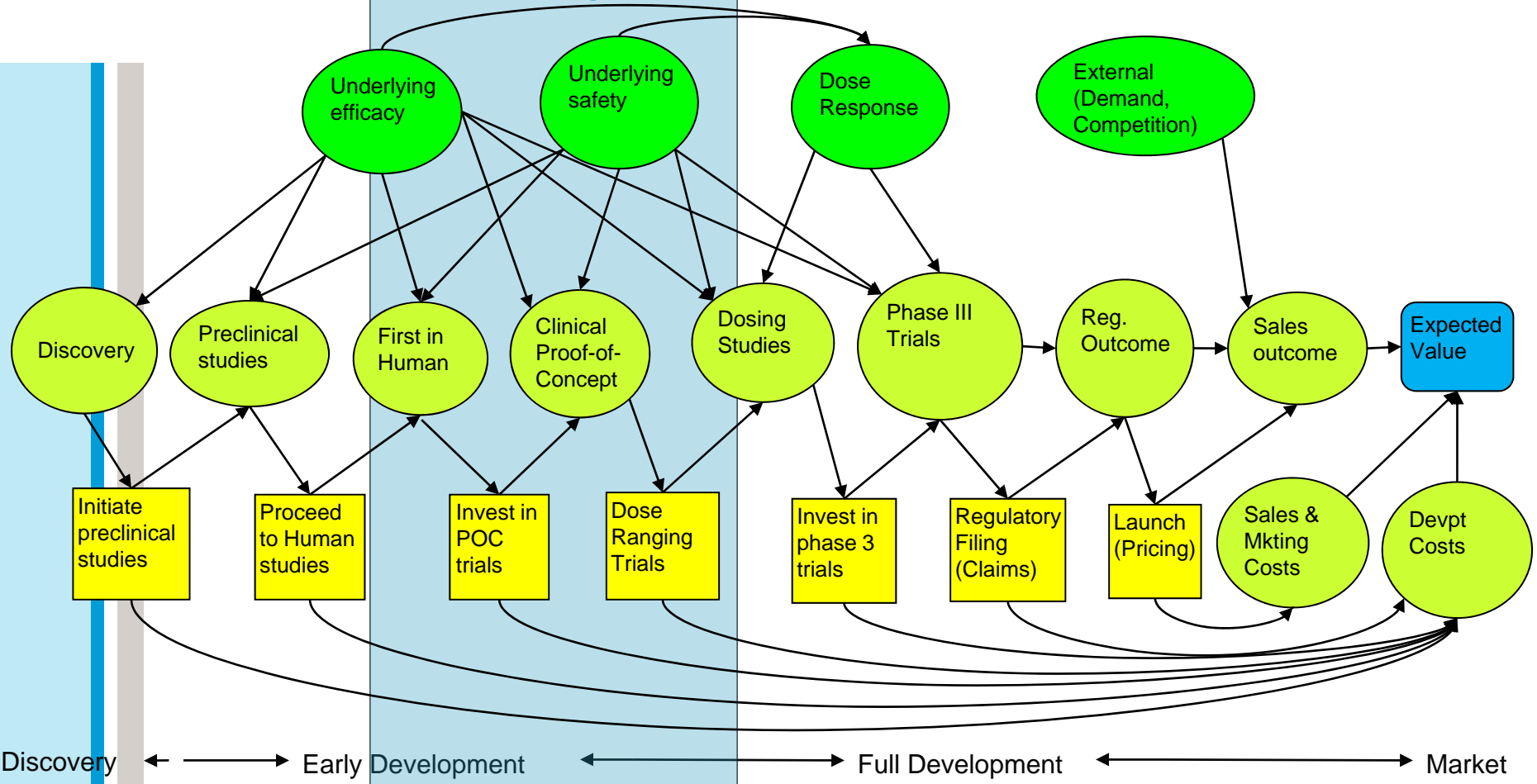


“Probability is not really about numbers; It is about the structure of reasoning.”

Glenn Shafer
Researcher,
AI / Computational
reasoning

Stages of Drug Development

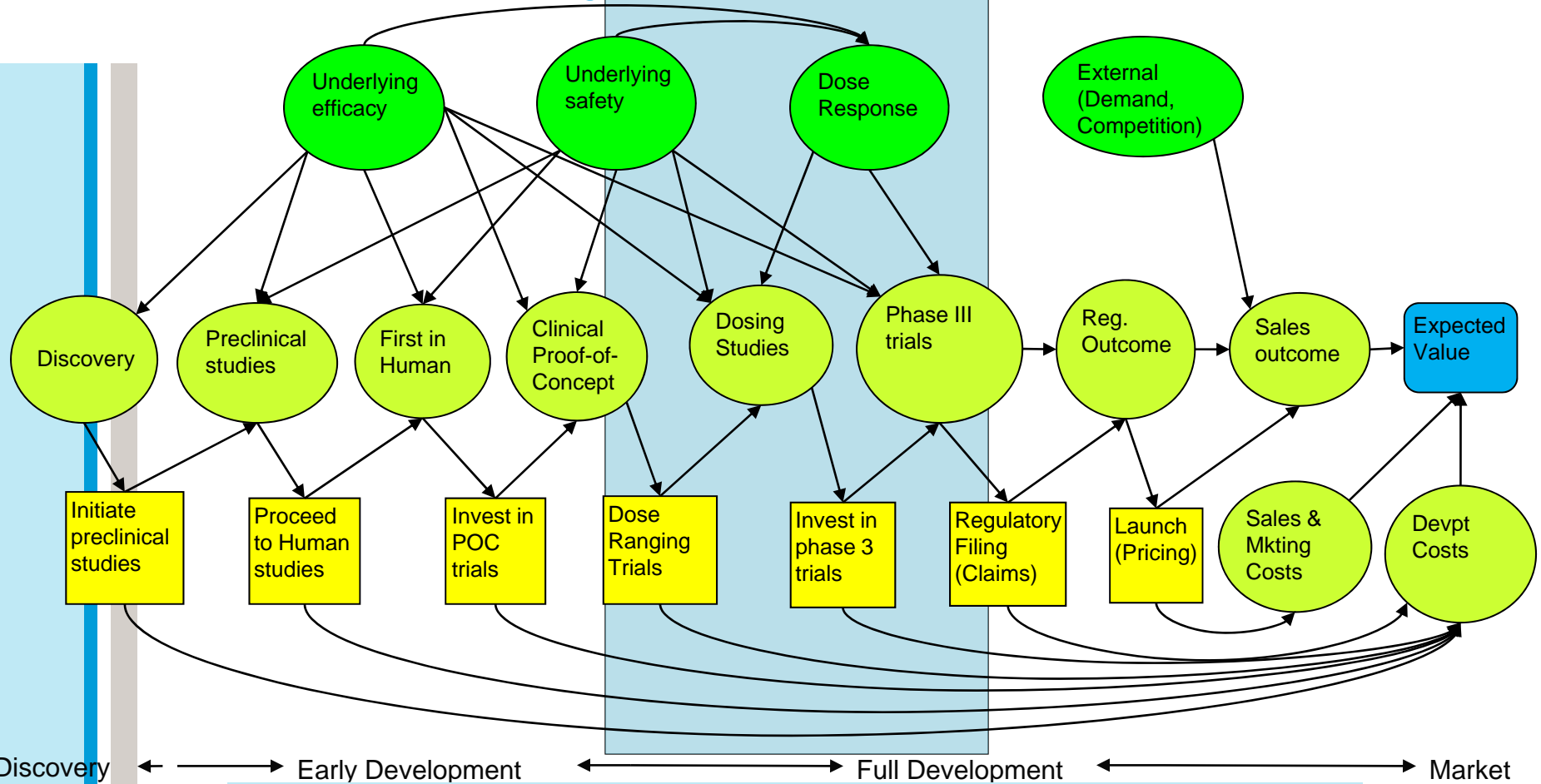
Uncertainty – Information -- Decision



- Should we invest in a new proof-of-concept trial or is there sufficient evidence to move forward directly or just stop?
- Which among the proof-of-concept trial designs will yield the most VOI?
- In the case of two related indications, which POC trial to first? Can we learn about both by doing just one? Do both?

Stages of Drug Development

Uncertainty – Information -- Decision



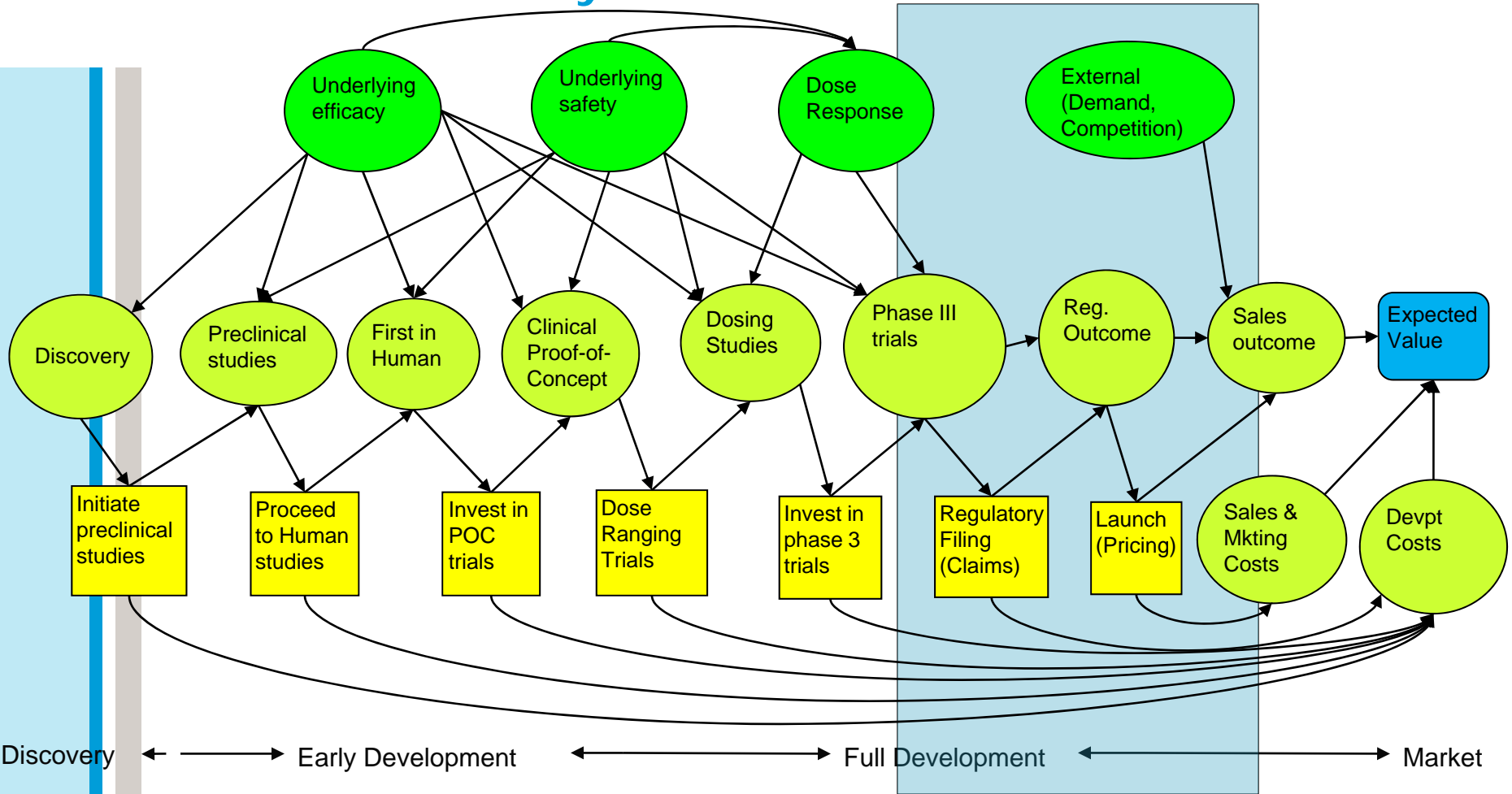
Discovery ← → Early Development ← → Full Development ← → Market

Should we move forward with full development? Or stop?
What is the best strategy for development?

- Should we develop it for more than one indication?
- Develop it for the indication that will get it fastest to market and follow-up with the next
- Should it be a combined phase 2b/3 trial with Interim Analysis?

Stages of Drug Development

Uncertainty – Information -- Decision

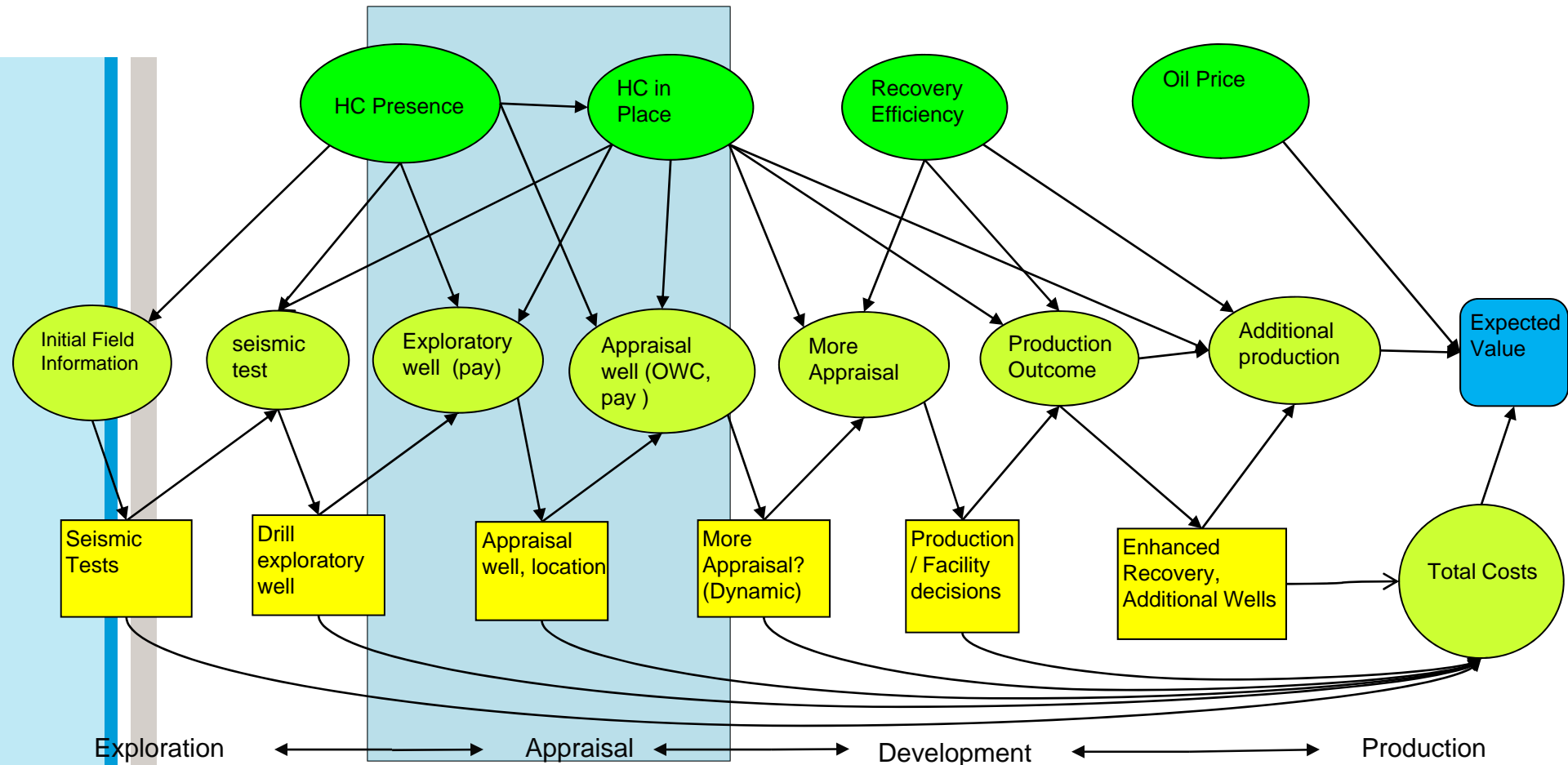


In regulatory filing,

- Based on the actual phase 3 results, what specific claims to file for?
- Which regions? (US, EU etc.)
- Promote or just use a publications strategy?
- Pricing Decision

Stages of HC Field Development

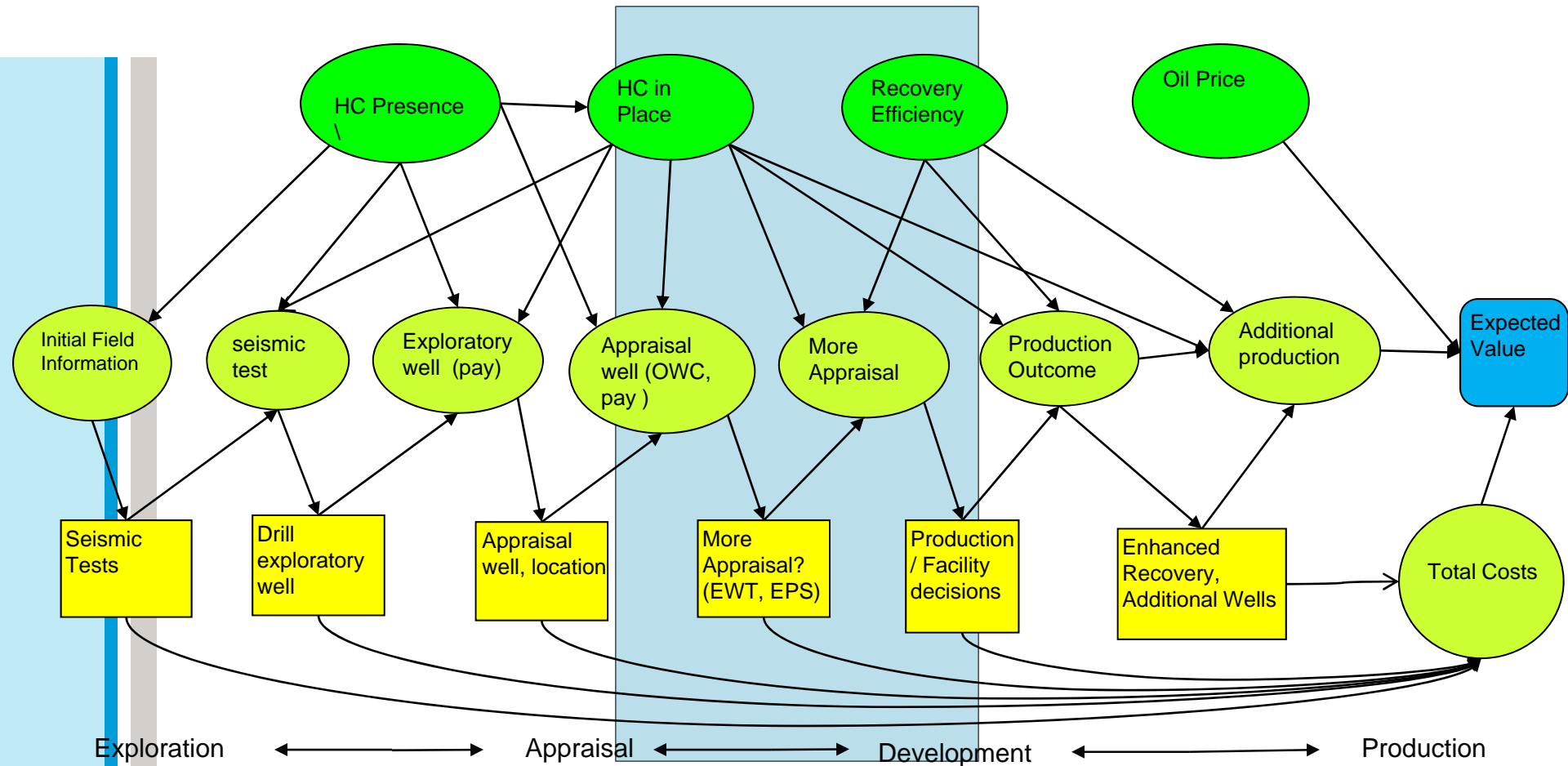
Uncertainty – Information -- Decision



Initial appraisal decisions:
 Should we drill an appraisal well?
 Which of the appraisal options will yield the most VOI?
 What other follow-up tests, coring, DST?

Stages of HC Field Development

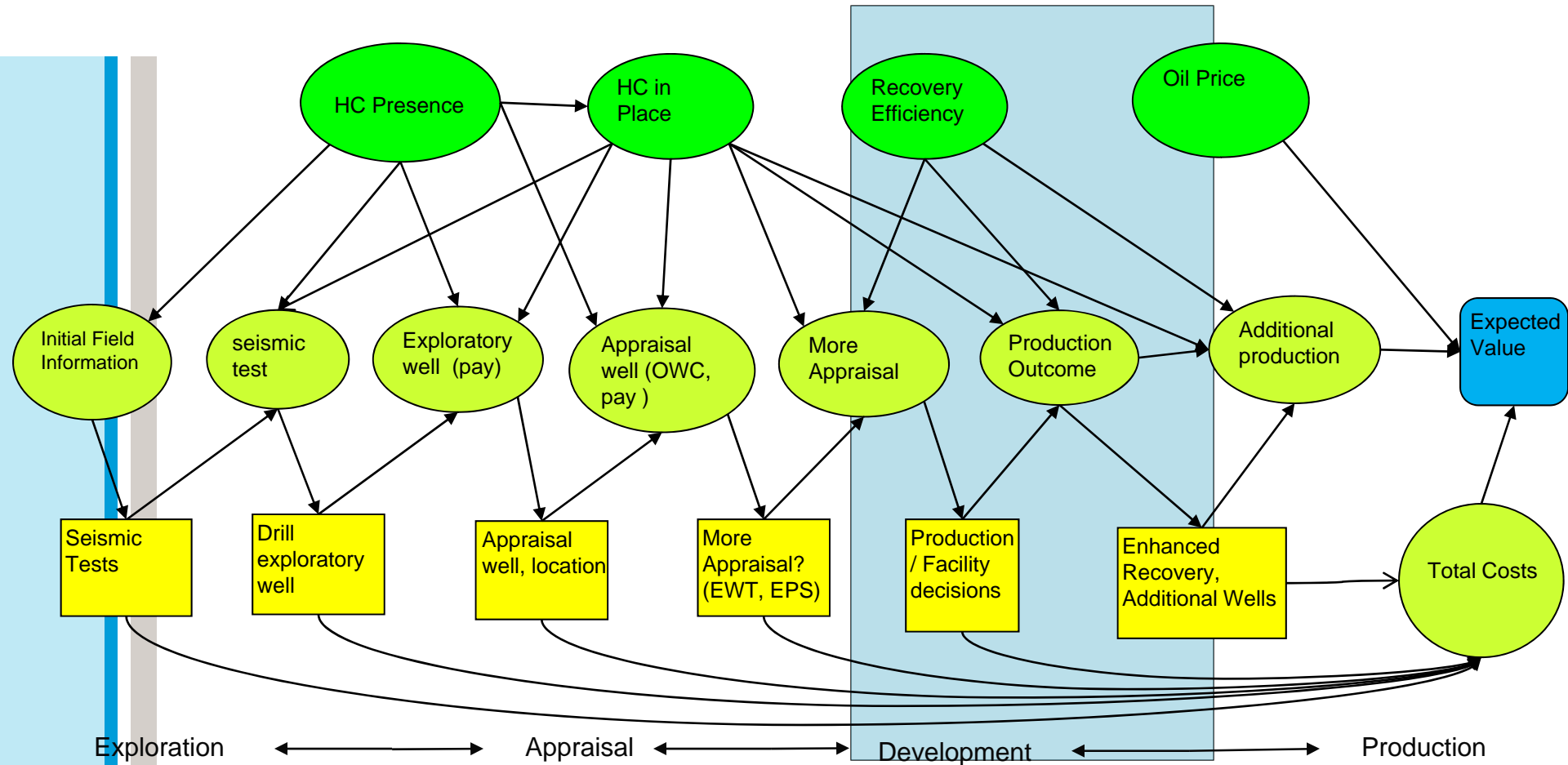
Uncertainty – Information -- Decision



Additional Appraisal:
 Should we drill an additional appraisal well?
 Should we conduct an EWT on one or more of the appraisal wells?
 Should we go for a phased development?
 Should we do some combination of the above?

Stages of HC Field Development

Uncertainty – Information -- Decision



Facility decisions:

of wells

Size of the facility

Facility concept – wet tree/ dry tree, stand-alone/tie-back, facility type

Also:

Shoot 4D baseline seismic to enable infield drilling decisions later?

Some Interesting Analogies

New field → New drug compound

Reservoir → Patient population

Number of reservoirs → Patient populations with different diseases (targeting different indications)

Appraisal Well → Proof-of-Concept Trial

Presence of oil → Effect on disease

Oil-water contact → Lowest dosing that has efficacy

Extended Well Test → Longer term studies

Key Differences

There are important differences between the two industries

- Market and competitive structure
- Market uncertainties
- Cost Structure
- Patent/exclusivity
- Regulatory aspects
- Organizational Culture

Organizational Culture

Not surprisingly, there are big differences in organizational cultures

Pharma -

- Science/Medicine/Marketing with a lot of internal cultural differences (with concentration of Marketing side in upper management)
- DA adoption is spotty – not integrated into the culture
- Very vulnerable to management changes

Oil (Chevron)

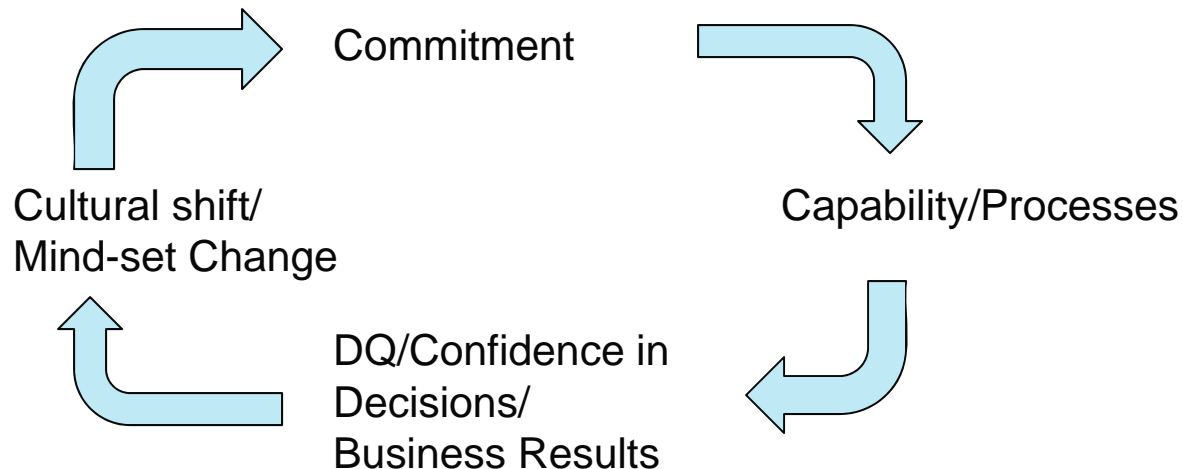
- Geo Sciences/Engineering
- DA has been systematically introduced, absorbed and nurtured over a 20-year period
- Able to endure organizational changes

DA Practice/ Processes

Discussion Points



- Extent of Use (Breadth/depth)
- Project vs. Portfolio
- Risk Assessment & Management
- Formal DA Processes (DA/DQ)
- Organizational Commitment/Capability



Summary

Pharmaceutical R&D and Oil & Gas development share some common characteristics

- High risk, high cost, long gestation, high potential pay-off
- Phased decision-making to manage risk

Value of information is key to effective decisions in both industries

There are key differences also -- industry structure, pricing, regulatory role, cost structure

The organizational cultures are different – Implications to DA adoption, commitment, process rigor

Both industries can benefit enormously by applying systematic decision analysis approach to key decisions early on

“We may not know very much, but we do know something, and while we must always be prepared to change our minds, we must act as best we can in the light of what we do know.”

W. H. Auden