Patterns in Oil E&P

Value of Information Decisions

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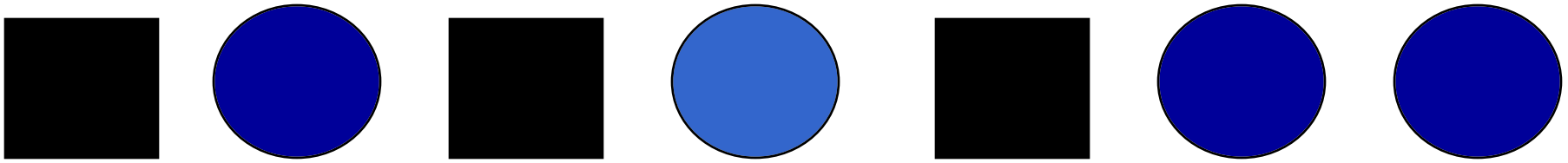
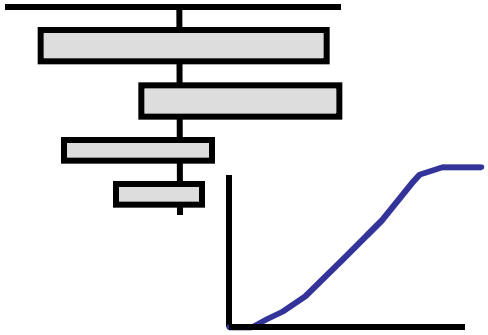
Decision Frameworks
DAAG – Las Vegas
February 27, 2002

Value of Information
It's Place in Exploration & Production

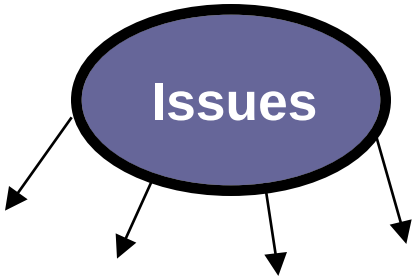


The entire oil field life cycle is a series of value of information stages.

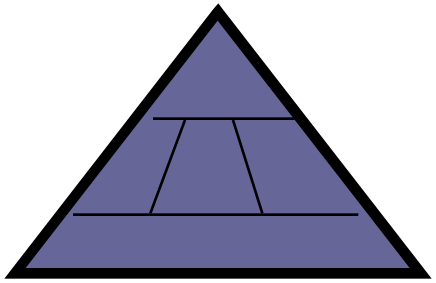
General VOI Framing Pattern



"No Info" Case
(Key Uncertainties)



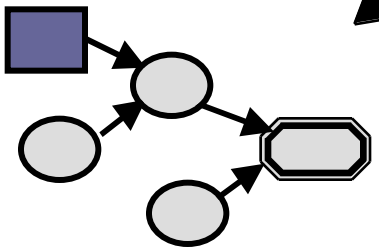
Issue Raising
(Strategic Q's)



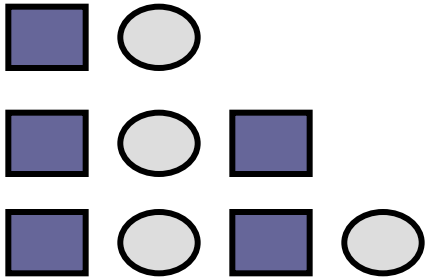
Decision Hierarchy
(Focus)

Uncertainties	U1	U2	U3
Decisions Which Can	D1	D1	D2
Info Options			

VoI Uncertainty Table
(VoI Alternatives)

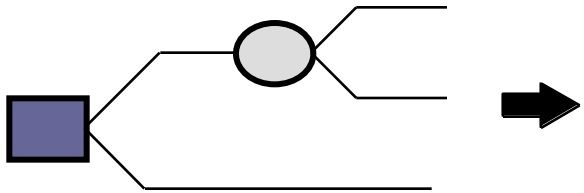


Influence Diagram
(Interdependence)

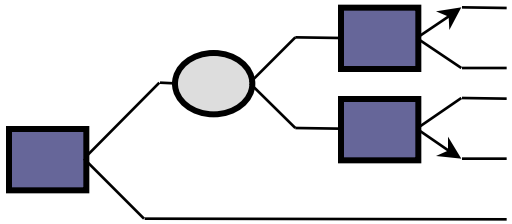


Decision & Risk
Timeline
(Structure)

General VOI Analysis Pattern



Tree without info



Tree with perfect info

Reliability Interview

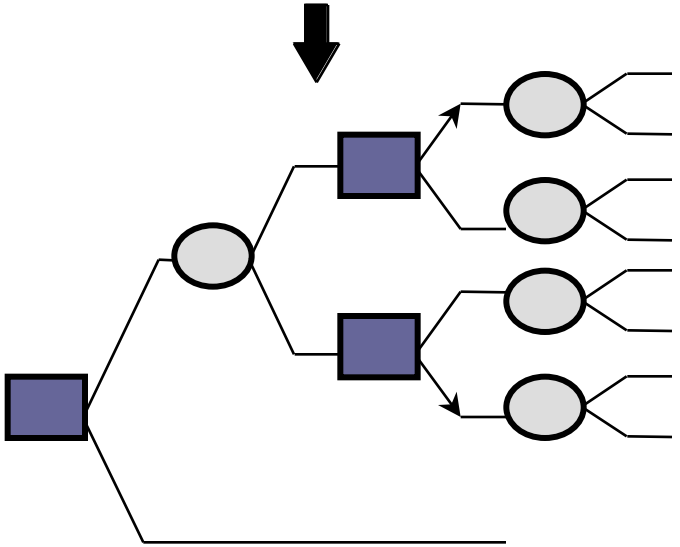
Reliability

Value of Information =

= Value with imperf info – Value without

= Value with (incl. cost) – Value without

Calculation & Insight

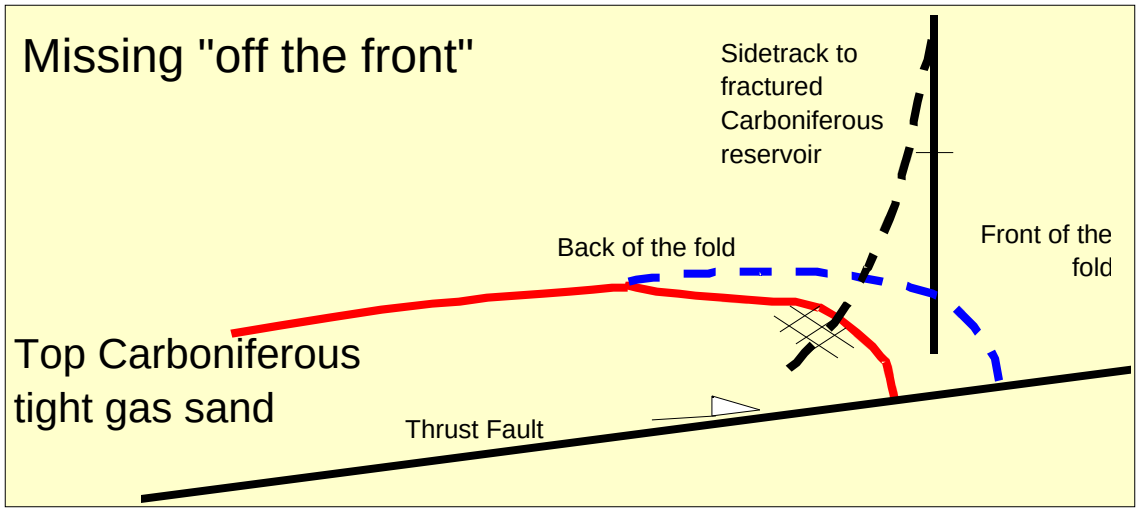


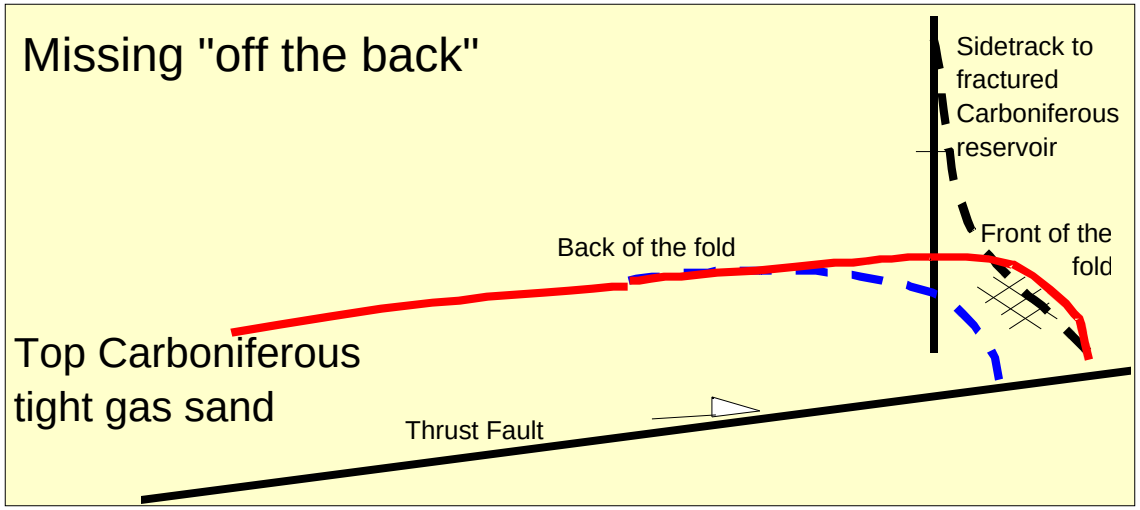
Tree with imperfect info

Through exploration to development, three distinct patterns may be identified.

- **Seismic & Drilling**
  - » **Seismic – 2D, 3D seismic processing**
  - » **Hydrocarbon presence geologic dependencies (well or seismic)**
- **Appraisal & Development:**
  - » **Concept/contract selection**

Example: Buying a Seismic Line May Change Where to Place Well





Strategic Questions:

What is the value of PSDM?

Is it worth buying at $60K?

VOI Uncertainty Table

Promotes the Right Conversations

	Key Uncertainty
	Location of Highly Fractured Fold
Decisions Which May Change (Impact of Info)	If/Where to Position Well
Information Alternatives	• As-is 2D seismic • PSDM of 2D seismic • Pilot hole

Key VoI Questions:

Most uncertain about?

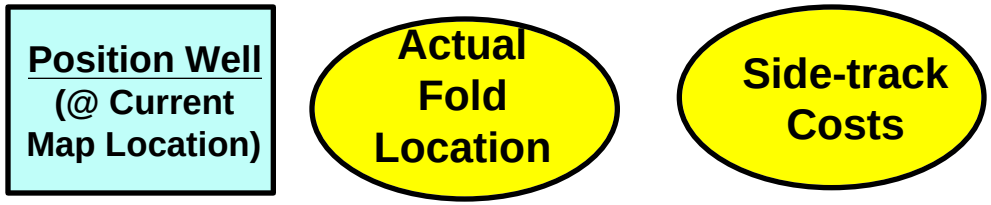
What decision may change?

How reliable is the info & is it worth the cost?

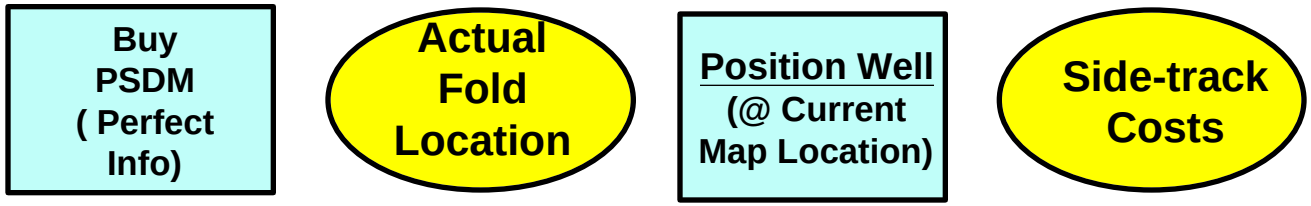
Decision & Risk Timelines

Structure the Analysis

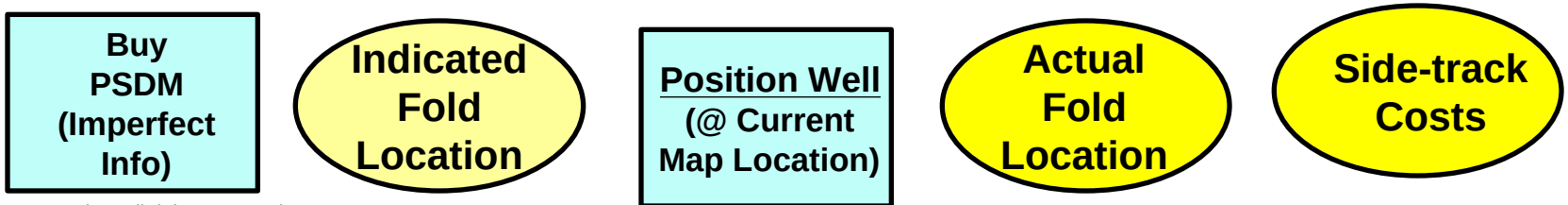
Without Information:



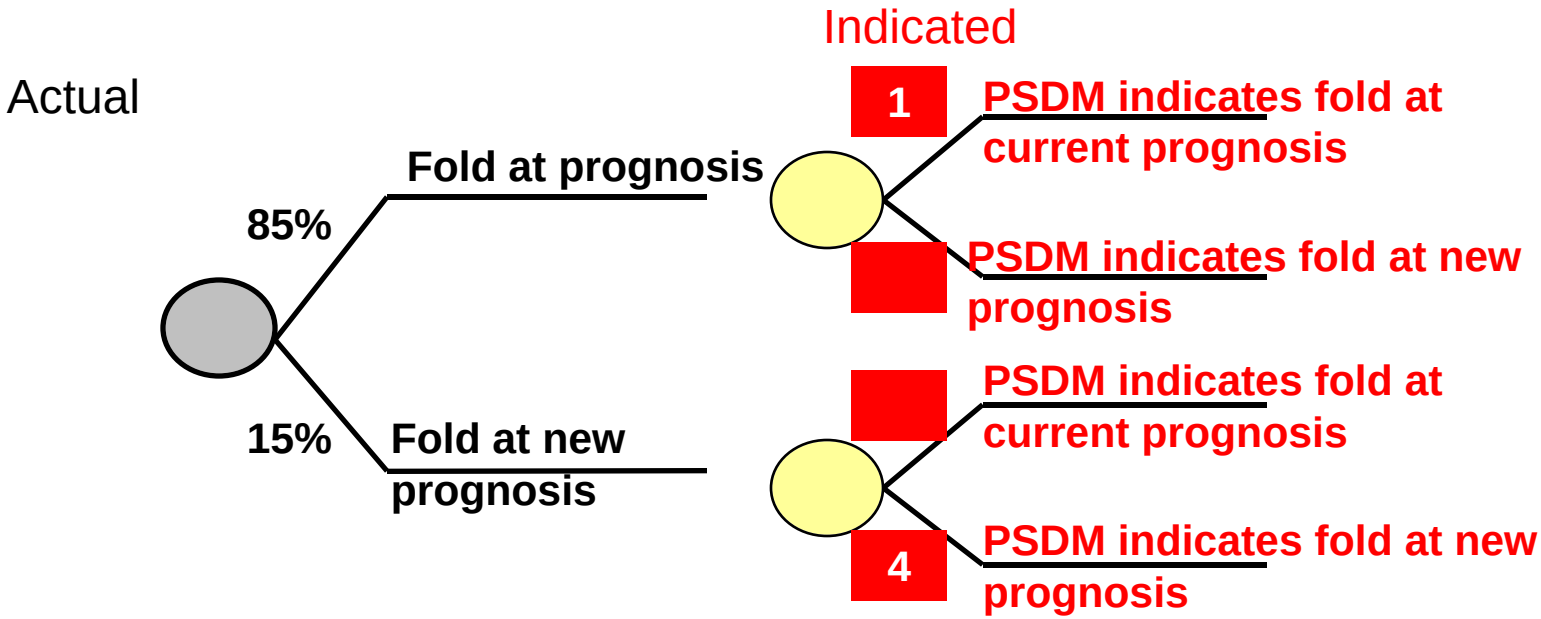
Buy Perfect Information:



Buy Imperfect Information:



The VOI Reliability Interview for Imperfect Information



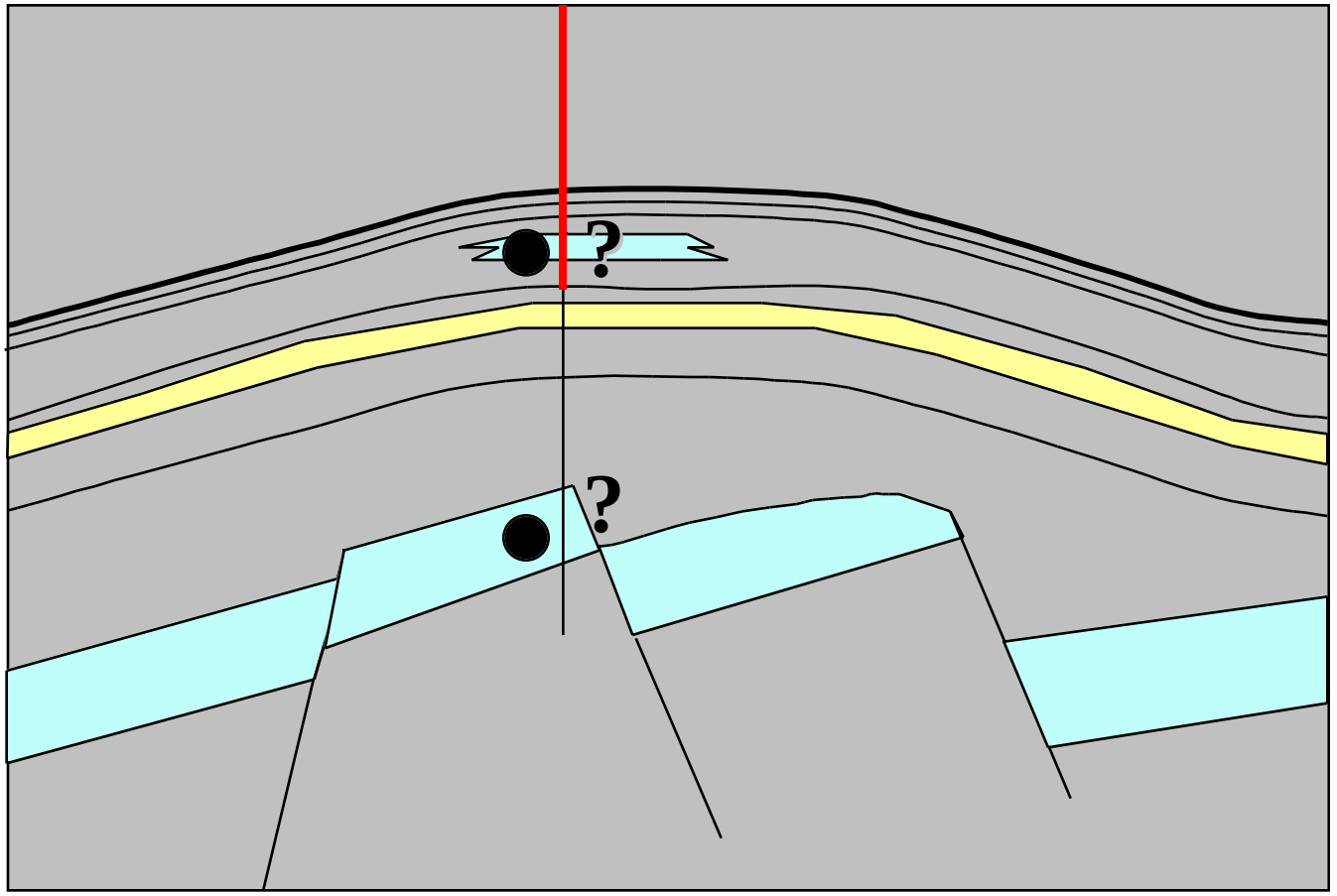
Question to "1" probability: "Given the Scoobydo fold actually is where it is currently mapped, what is the chance the PSDM will indicate the same location?"

…….

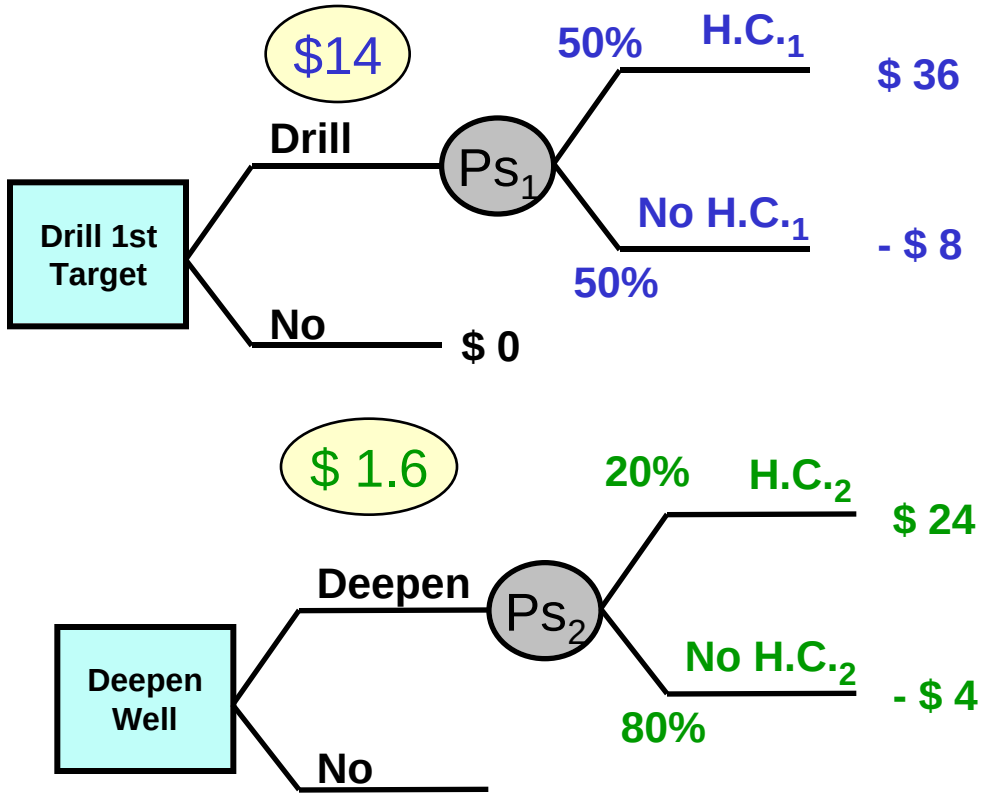
Question to 4 probability: "Given the Scoobydo fold actually is at a new prognosis (different location from its currently mapped location), what is the probability that PSDM will indicate the new prognosis (location)?"

Deepening a Well
with H.C. Presence Geologic Dependencies

Information can be gained while drilling multi-targeted wells to assist with decision to proceed or not. But will it change a decision?

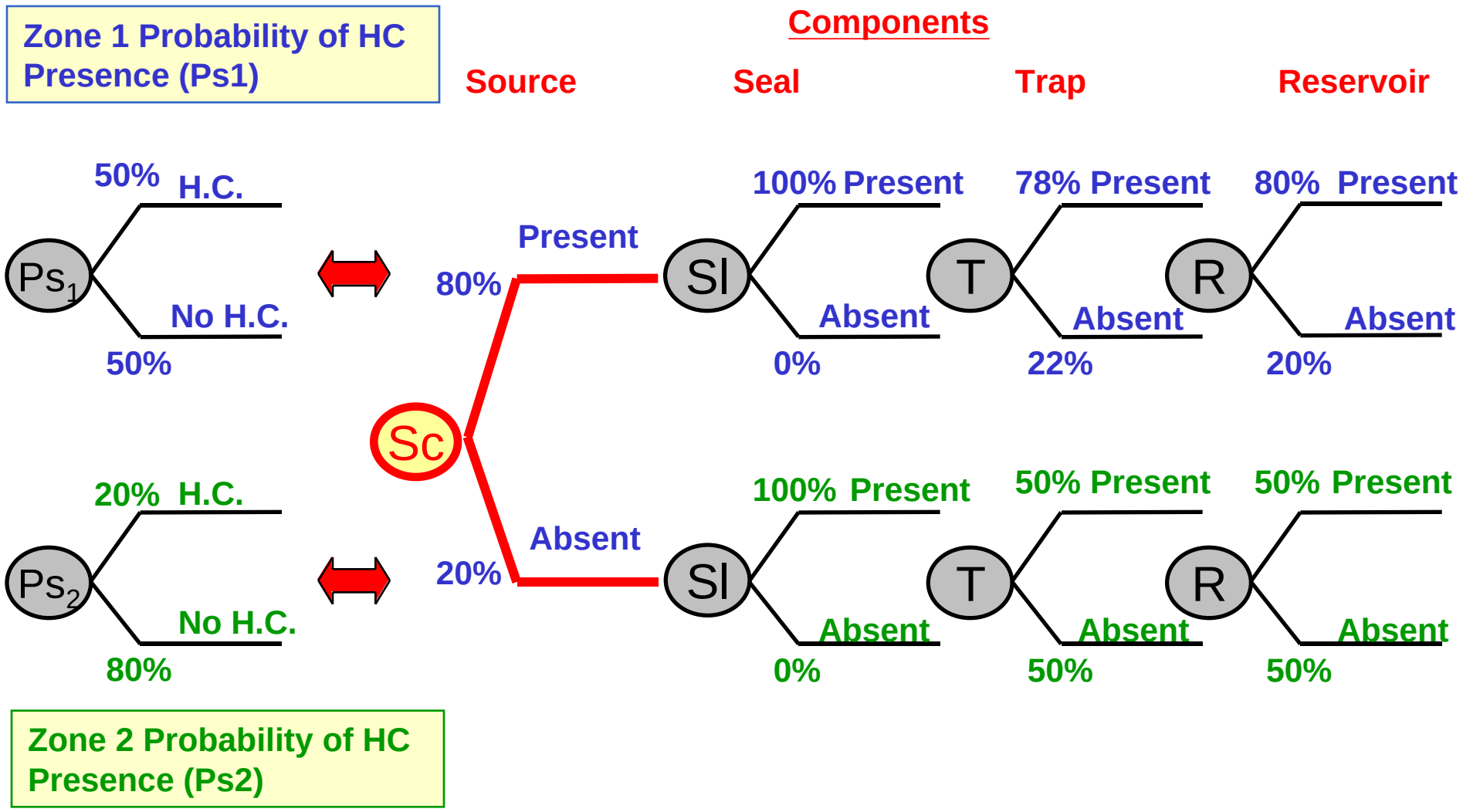


Independent targets are relatively easy to evaluate.

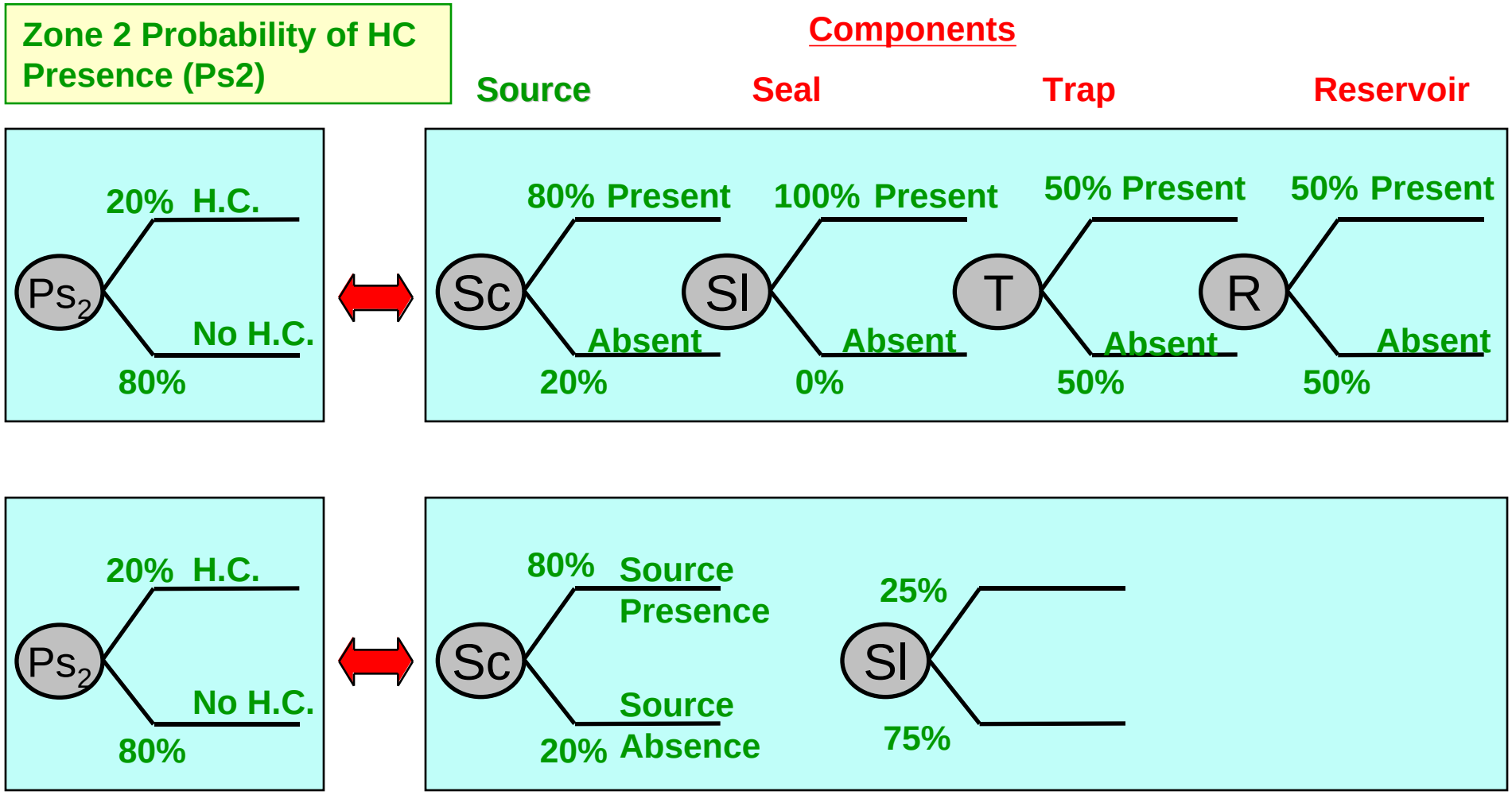


What happens when target 1 tells us nothing about target 2?

Splitting up the components of HC presence shows the shared risks.

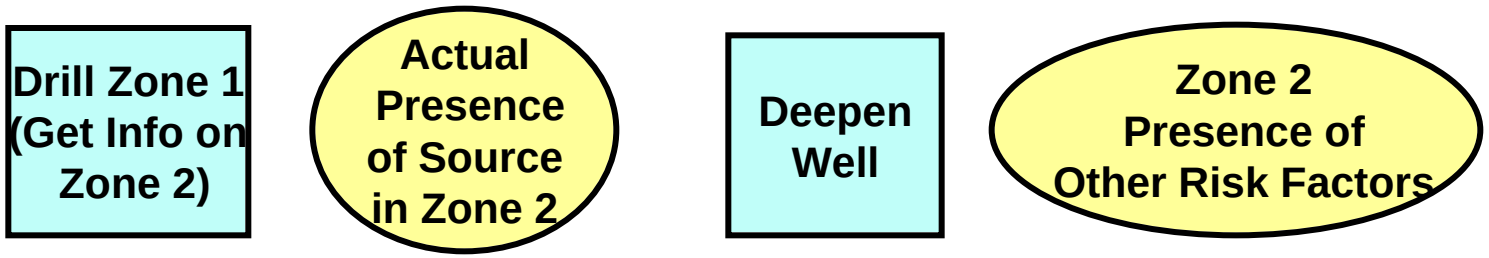


To determine the impact of the info, the interdependent variable(s) is isolated.

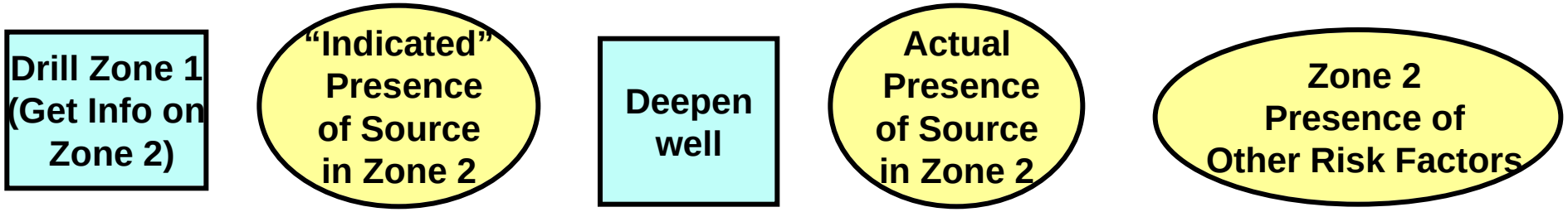


The Decision and Risk Timelines show the decision trees to be evaluated.

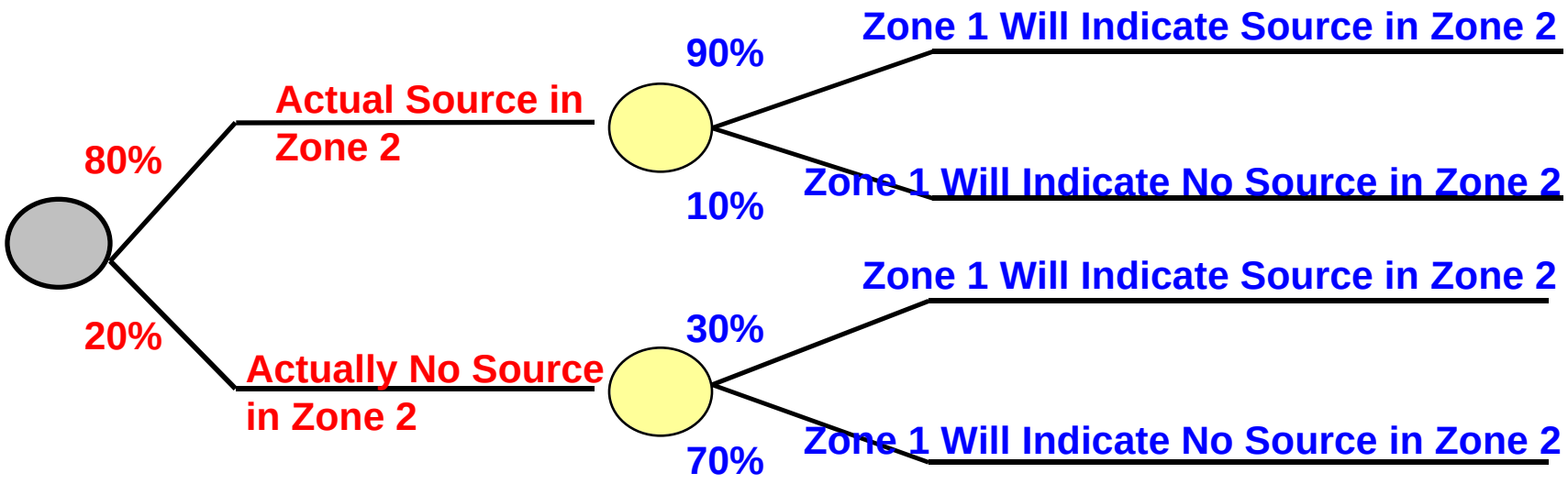
Perfect Information – on the Presence of Source in Zone 2



Imperfect Information – on the presence of Source in Zone 2



A Reliability Interview is required to determine the impact of the information provided by Zone 1 on the underlying uncertainty of H.C. source in Zone 2.



Interview Question: If there actual is the presence of source in Zone 2, what is the probability that Zone 1 will indicate the presence of source in Zone 2? (I.e. How reliable is info on Zone 1 for indicating the presence of source in Zone 2?)

Appraisal & Development
Concept Selection

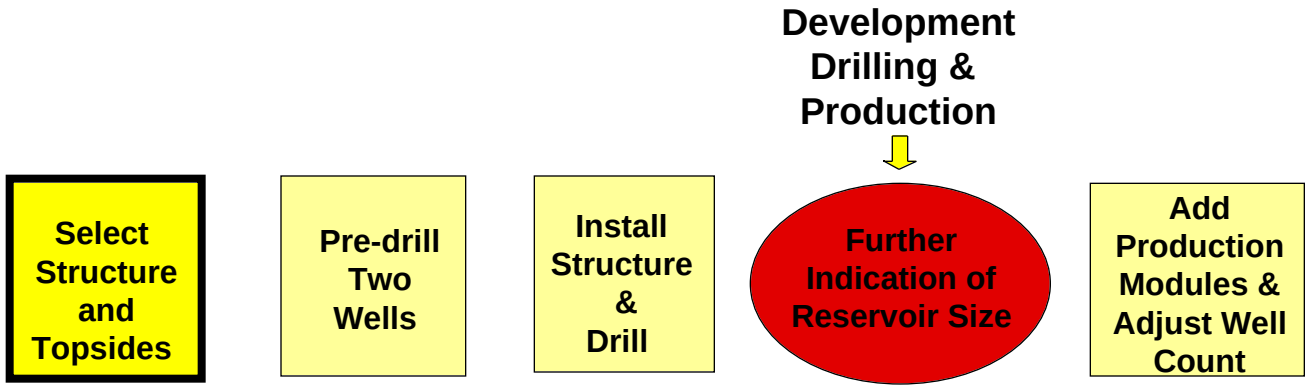
Choice of Development Concept…

Trying not to over capitalize nor undersize the development scheme.

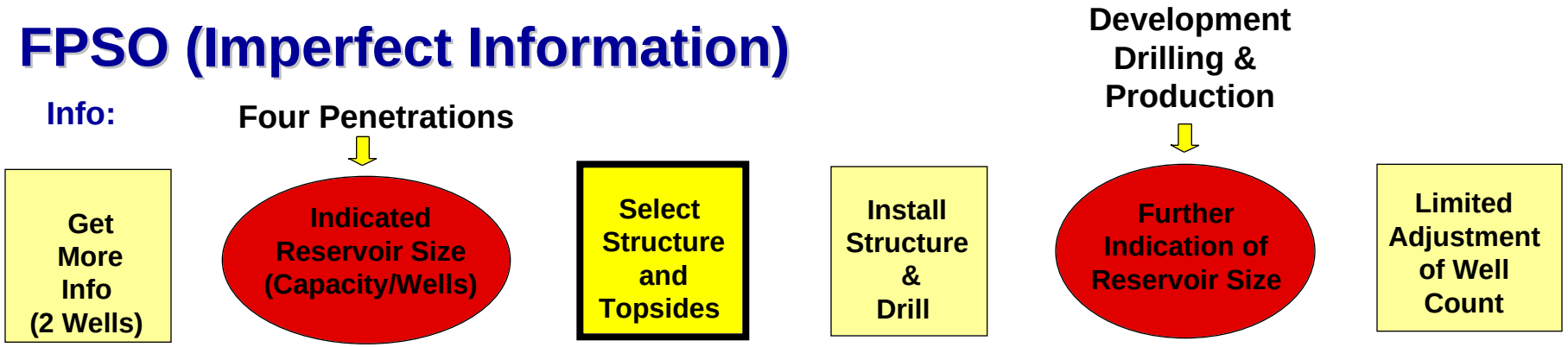
- **Tension Leg Platform**
- **Spar**
- **Floating Production Storage Offtake**

Concept Selection
The Development Decision Frame
(Getting to Know the Nine Branch Tree)

Full Field Development (without Information)

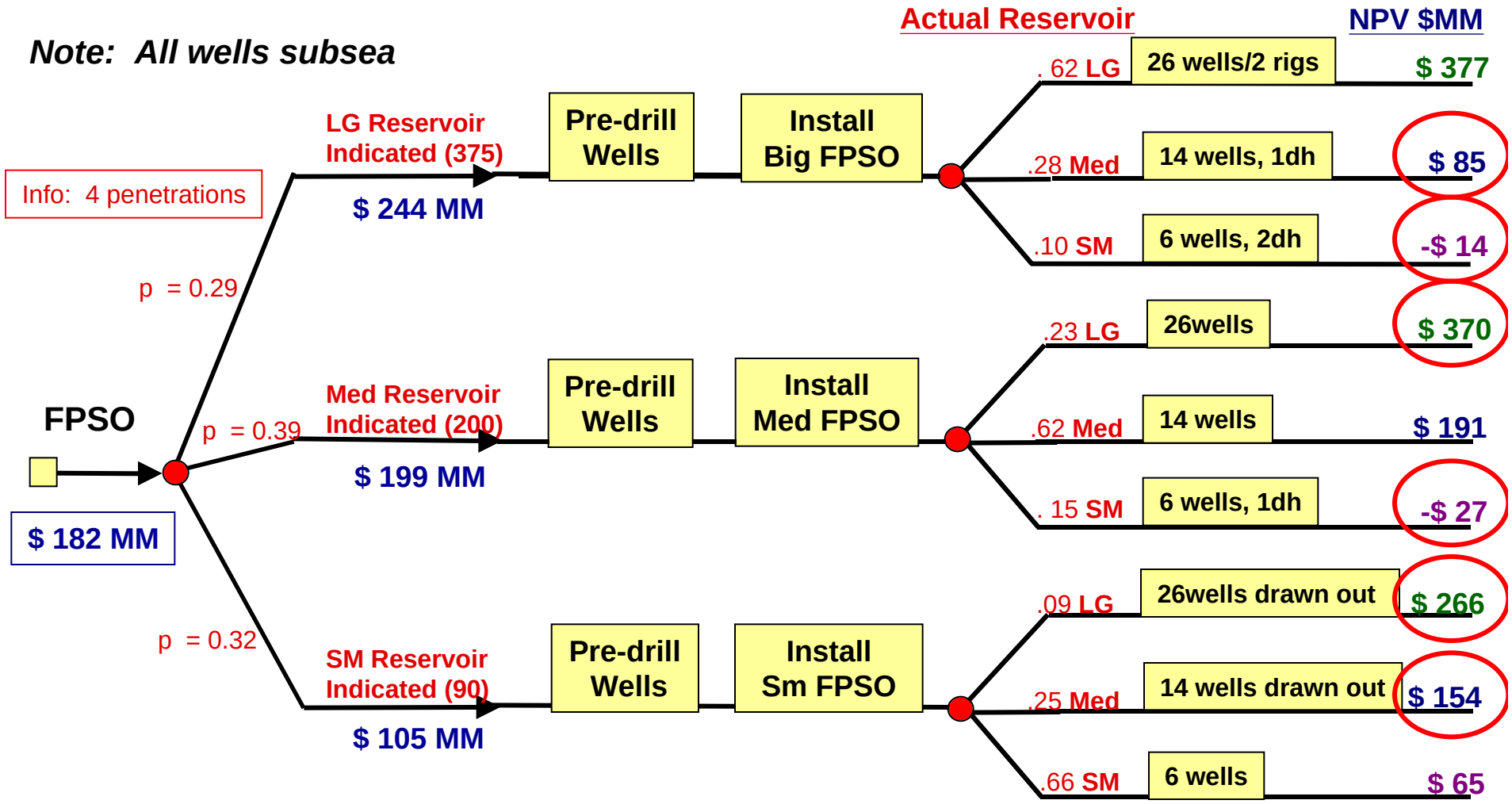


FPSO (Imperfect Information)



*** More information (wells) credited with higher probability of predicting actual reservoir characteristics.**

Discussion: what happens when adjustments have to made (When what you see is not what you get)?



Recognizing the consistency in the patterns is the key to Upstream VoI

- **Easy to make mistakes**
  - » **Solving in your head**
  - » **Non intuitive**
  - » **Not quantifying uncertainty**
  - » **Poor decision trees**
  - » **No application of Bayes' Law.**

- **Recognizing the decision pattern ensures consistency & quality in the approach**