Understanding the Value of Simops Decisions on Well Planning and Execution Using Decision Analysis

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What is Simops?

Simops is an industry term for **simultaneous operations** of any number of high risk activities.

Typically classified into business operations:
Drilling
Facilities Installation
Production/Injection
Product Export

- An offshore facility has a limited amount of space.
- To protect people, environment & equipment mitigation plans are developed to deal with simops risks
- Limited flexibility for scope change after design of the operation.

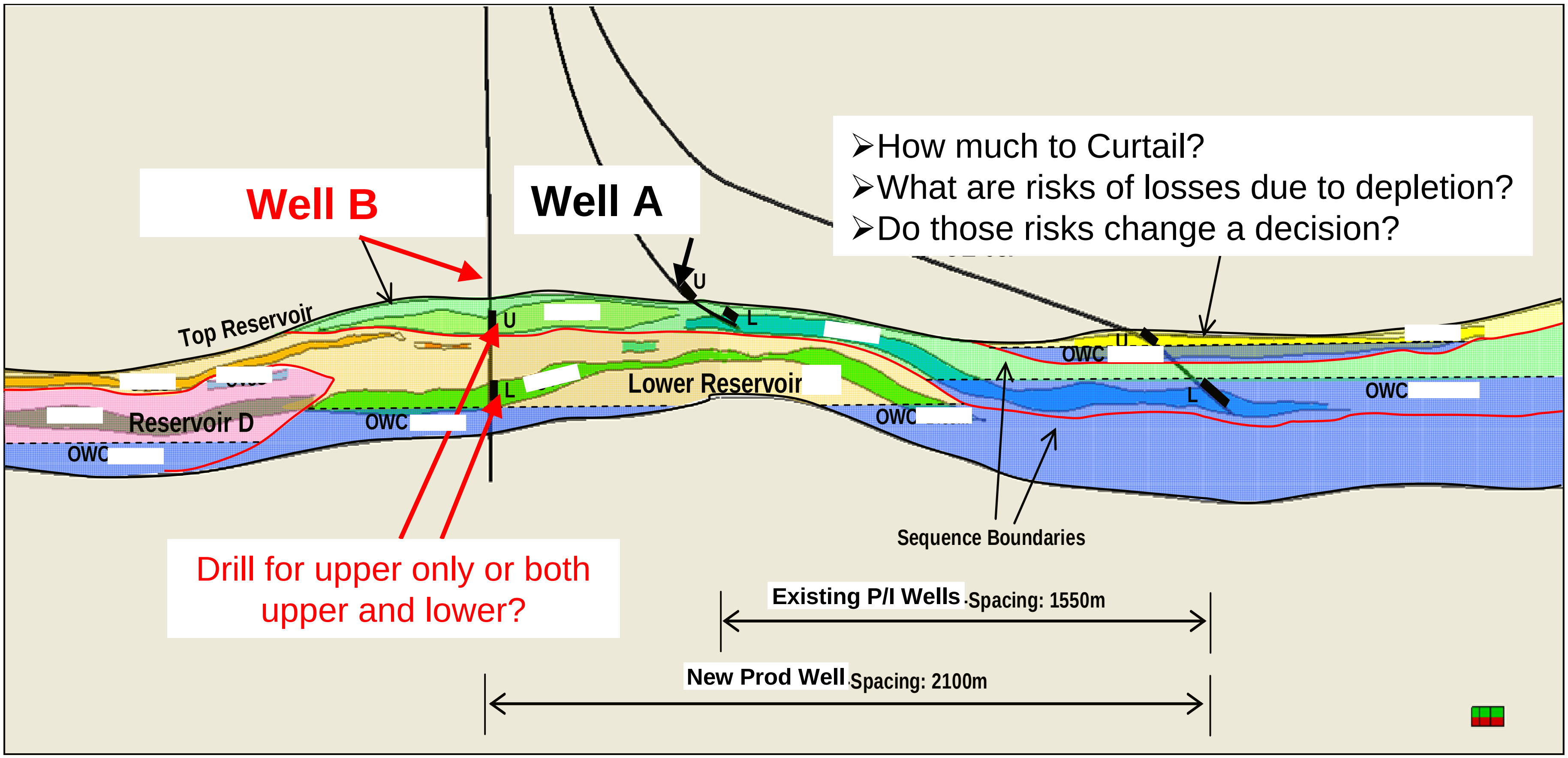
Some Terminology………

- **Slot:** Location wellhead enters production facility
- **Pore Pressure:** Fluid pressure in the reservoir
- **Depletion:** Reduction in pore pressure from original conditions
- **Frac Gradient:** Pressure gradient (psi/ft) where the reservoir breaks down and begins to accept fluid
- **Losses:** Weight of drilling fluid column is greater than pore pressure, resulting in loss of drilling fluid to the formation.
- **STOOIP:** Original Oil In Place
- **EUR:** Estimated Ultimate Oil Recovery
- **NPV:** Net Present Value
- **EMV:** Expected Monetary Value
- **Downtime:** Production Loss due to an event
- **Swept:** Oil is ‘swept’ from injection to producing well via water injection

Field and Well Overview

Producing offshore oil field currently under water injection.

The case study is focused on the drilling decisions associated with '**Well B**' seen in the cross section.



Problem Statement and Objective

- Value, risk and uncertainties associated with drilling 'Well B' ,while producing from the zone it would drill into, were intertwined and sensitivity of value to each was not clear.

- Functional Organization and significant uncertainty drive decision makers in different functions to the extremes.
  - Lack of clear understanding of sensitivity to probability

- Complex decision process
  - ➢ The team must fill the last rig slot with a well. (Given)
  - ➢ Drill both upper and lower sands or just upper? (Focus)
  - ➢ Curtail production to drill the well? (Focus)
  - ➢ Optimize drilling sequence of the last two wells? (Tactical)
  - ➢ How to curtail production and for how long? (Tactical)

Uncertainties and Value Measures At Odds

- Controllable and Uncontrollable Uncertainties
  - production rate and depletion of existing wells
    - depletion in the new well location likely due to connectivity of sands within the reservoir
  - pore pressure vs frac gradient relationship
    - if pore pressure less than frac gradient higher risk of well control problems
    - well control problems are not a given
  - STOOIP and whether it is swept by existing wells leads to EUR uncertainty
    - risk that the drive mechanism different than modeled

- Value Measures = Max Well NPV and Production Rate
  - Define a process and workflow to manage depletion prior to or during drilling
  - Minimize production downtime

Organizational Complexity Affects Decision Quality

HESS

Functional Roles

R: Responsible A: Accountable C: Consult I: Inform	DRILLING & COMPLETIONS	PRODUCTION	SUBSURFACE	OPERATIONS
Target reservoirs for drilling	C		A, R	
Can we reach X, Y, Z target?	A, R		I	
Revise X, Y, Z target	C		A, R	
Interpret pressure data		C, I	A, R	
Perform reservoir simulation model		C	A, R	
Provide pressure depletion range	I	C	A, R	
Generate rock model strength	A, R		C, I	
Develop action plan	R	A, R	R	I
Implement depletion plan	I	C	I	A
Terminate well plan	C	I	A, R	
Monitor pressures (regularly)	I	R	A, R	
Pick notional casing point	A, R		C, I	
Develop drilling execution plan	A, R	I	C	

➢Targeted Benefits of DA Process:

Incorporate depletion to assess drilling risk and mitigation

Determine if risk can be engineered out by drilling, or, if a change in well conditions is required by operations.

Cross-functional understanding of well operational strategies

Decision Tree Frames the Problem

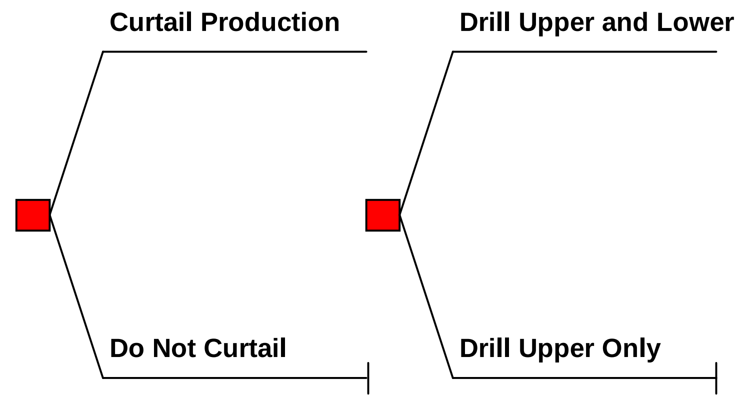
Team Recommendation:

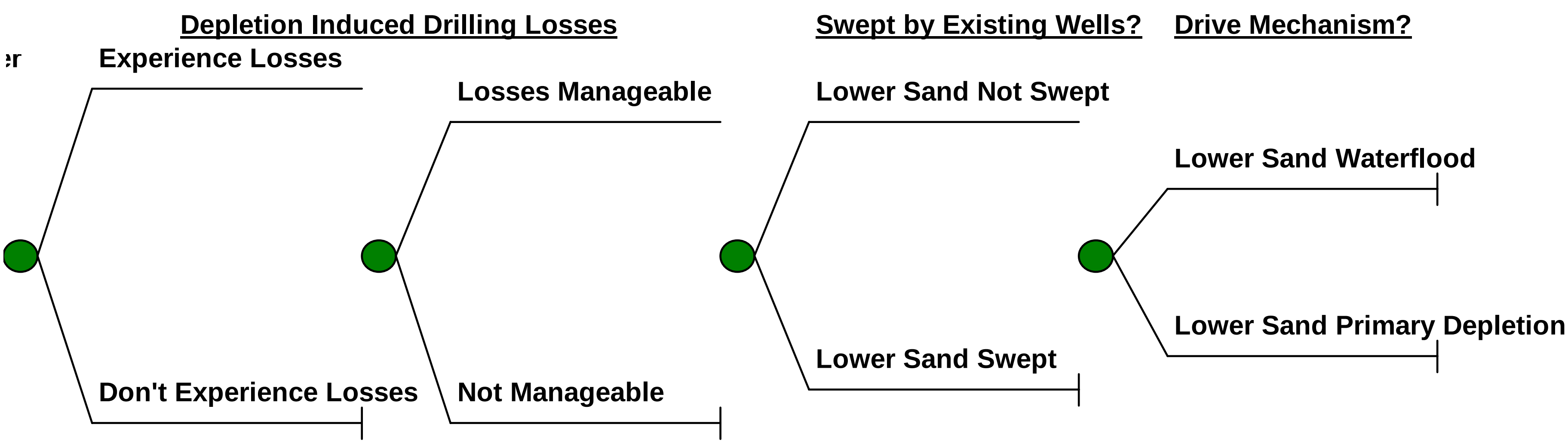
- **Curtail Production, Drill Upper & Lower sands**
- **+15% EMV vs Alternative**

Alternative Evaluated:

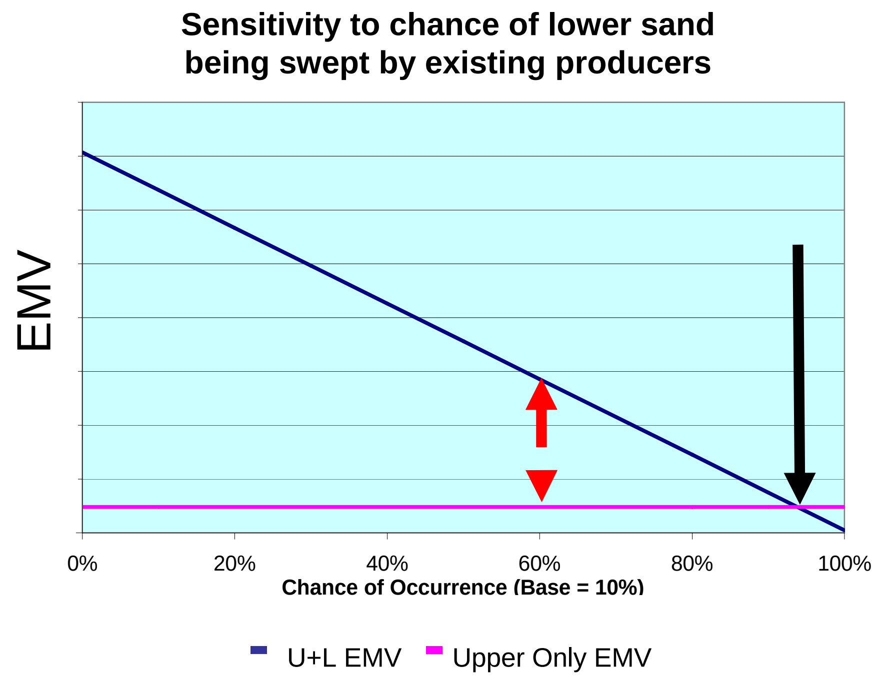
- Do Not Curtail Production, Drill Upper
- Abandon potentially unswept lower sand that will not support drilling a stand alone well in the future.

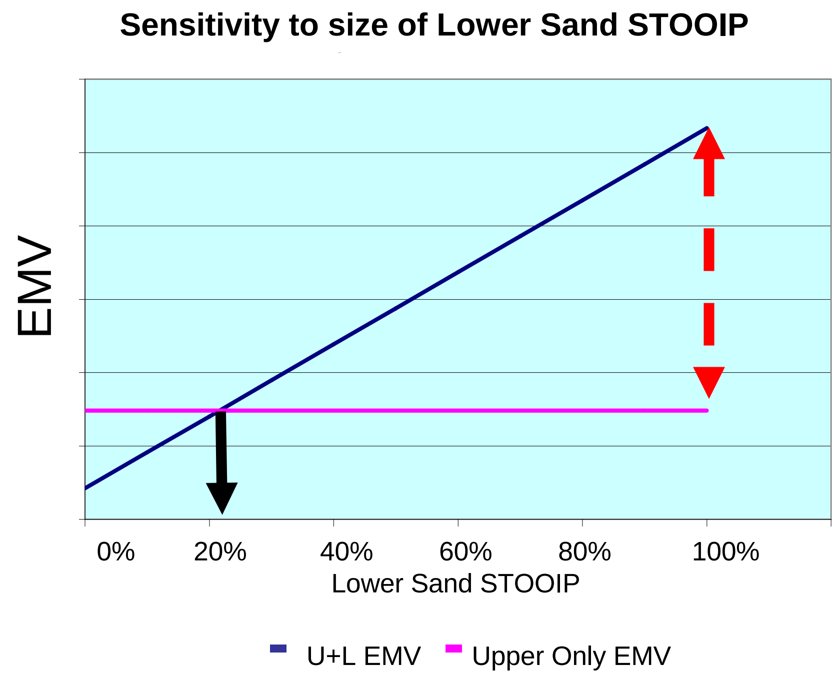
Legend:
Decision
Uncertainty





Subsurface Sensitivity to Probability Provides Insight



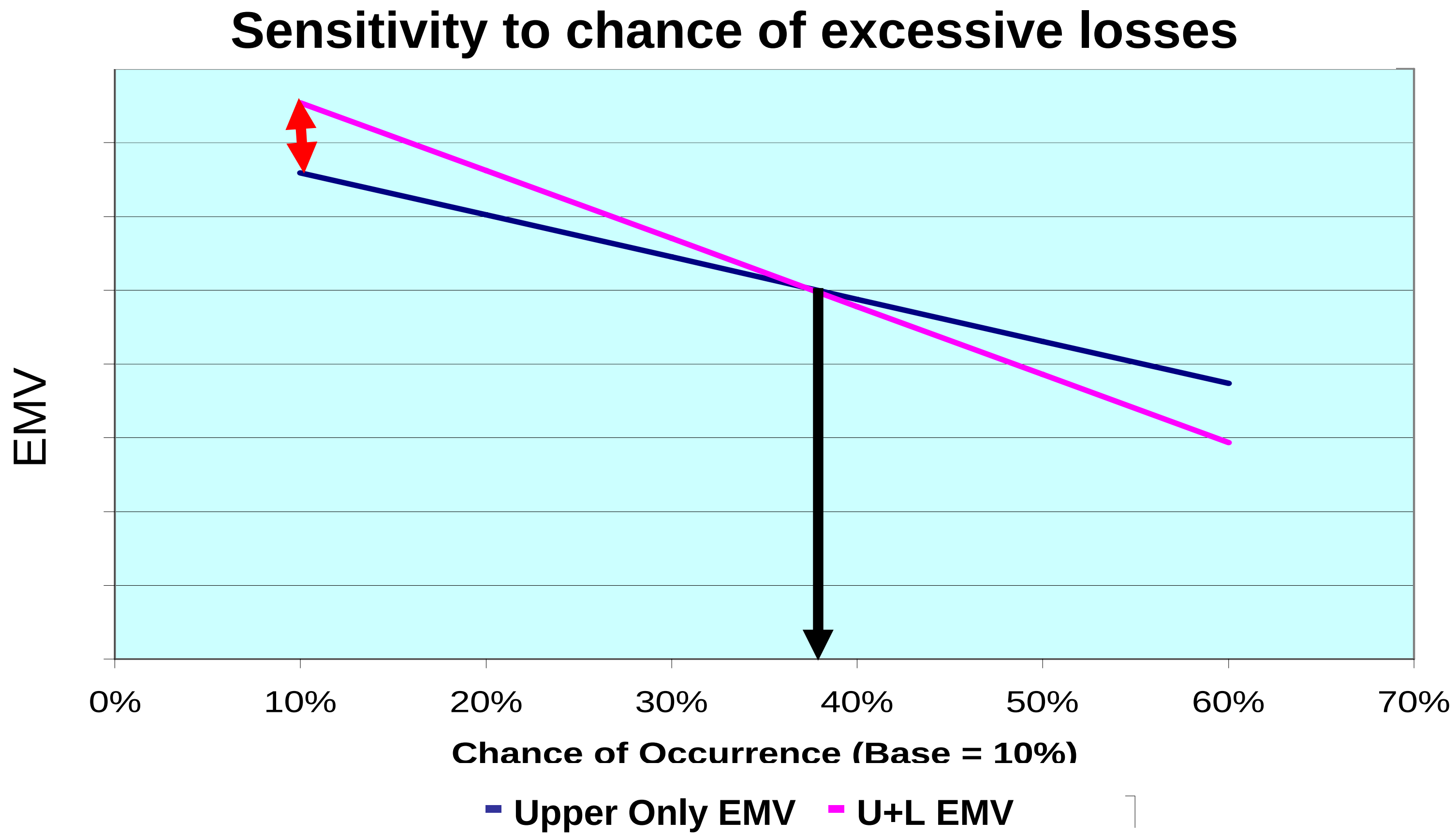


➢+ EMV at 60% chance of Lower being swept by existing wells

➢Must be very sure lower is being swept to make a risked base decision NOT to drill it

➢Must be very sure Lower STOOIP is less than 20% of the 'Best Technical Estimate' to make a risked based decision NOT to drill for lower

Operational Sensitivity to Probability Provides Insight



- ➢Lower Sand EMV+ at current 10% chance of loosing the well
- ➢Chance of loss occurrence must exceed ~38% for decision to drill both sands to be impacted
- ➢Not likely if production curtailed & depletion risk is mitigated

DA Process Business Impact and Results

- Minimized drilling risk
- Reduced duration and volume of production curtailment
  - Increased 2010 production by 42,000 bbl
  - At $100/bbl this amounts to increased revenue of over $4 MM
- Well was successfully drilled through both upper and lower sands with no losses
- Depletion as expected in one sand and higher than expected in the other sand
- Rate has been as or better than expected in both sands.

Lessons Learned

- Reduced emphasis on trying to shut in wells completely, allowing effective communication with management of production impact
- Better understanding of value of deepening the well
- Sensitivity to probability provided insight and allowed intelligent risks associated with decisions to be understood.
- Performing simple decision trees and risk assessments through a multi-disciplinary team drives alignment on well planning and operations decisions at the team and management levels.

Thank You!