



Oil & Gas Appraisal and VOI

How the Game Changes Things

Presented to:
DAAG

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Agenda

- DA and VOI
- VOI with a game-theoretic lens
- Lessons to take with you

Received Wisdom

- Decision analysis teaches us that the value of information (VOI) is either positive or has no value
- While the costs to obtain information may exceed the value to be gained, the value of the information itself is always nonnegative
- The only debate is around how best to calculate the costs and benefits of seeking information

**The received wisdom is wrong and
can be dangerously misleading**

Case example

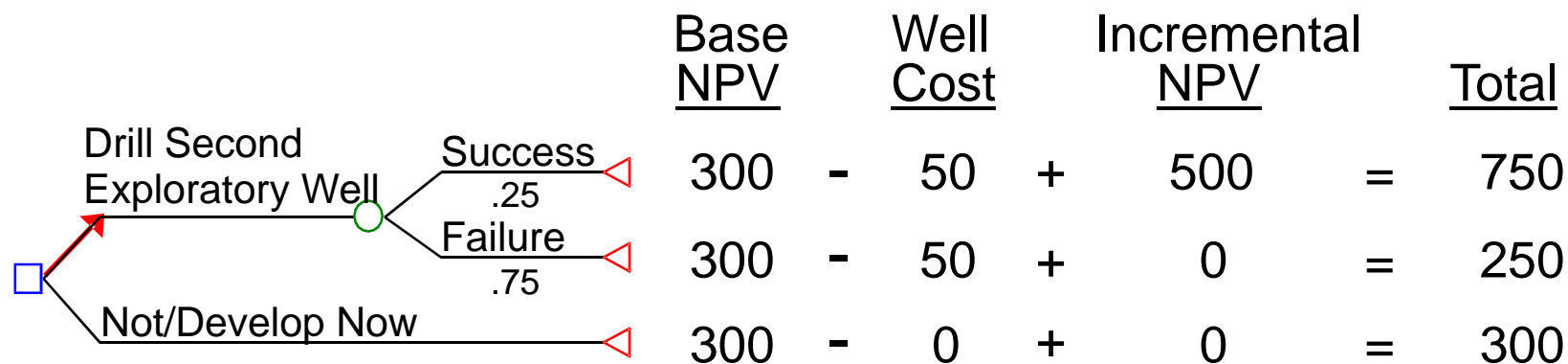
Situation

- Upstream oil & gas case involving Nash Oil Company
- Nash is considering whether to drill a second exploratory well in a block it owns
- The Nash team does a traditional VOI analysis to figure out whether it is worthwhile

Assessments

- Base value for development without second exploratory well = \$300 MM
- Well cost is \$50 MM
- If positive results, new development plan would result in \$500 MM of additional value
- The Nash team sees the well as having a 25% chance of success

The decision tree



Expected value of drilling is $.25*750 + .75*250 = 375$

This is greater than the 300 from not drilling, so standard VOI analysis tells Nash to drill

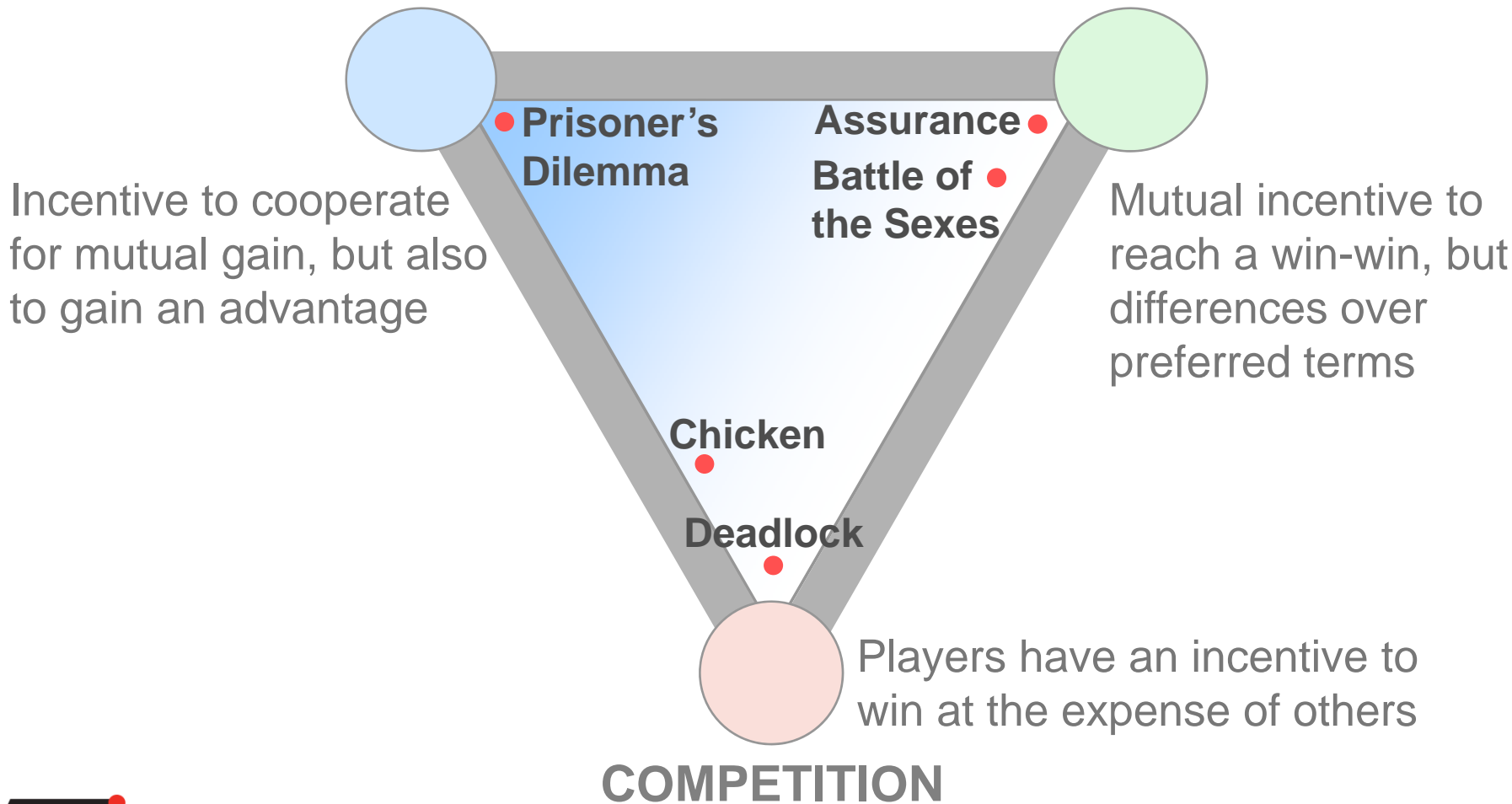
But, there is a “game” going on...

- **Collaboration** potential:
 - Kahuna Oil & Gas owns an adjacent block
 - Unitizing (combining) the two fields is possible, and talks have begun
 - Negotiations would involve **coordination** issues
- **Competitive**, first-mover advantage issue:
 - Kahuna has recently been talking about moving to develop its block soon, and independently of Nash
 - Kahuna would be able to drain some oil from the Nash side of the reservoir, leading to a transfer of about \$150 MM in value from Nash to Kahuna
 - Nash could be similarly motivated; could drain \$50 MM in value from Kahuna’s side of the reservoir

Game theory is the most appropriate tool when the issues lie within the 3C space

COLLABORATION

COORDINATION



Game theory is in the same family as DA, but differs in subtle yet important ways

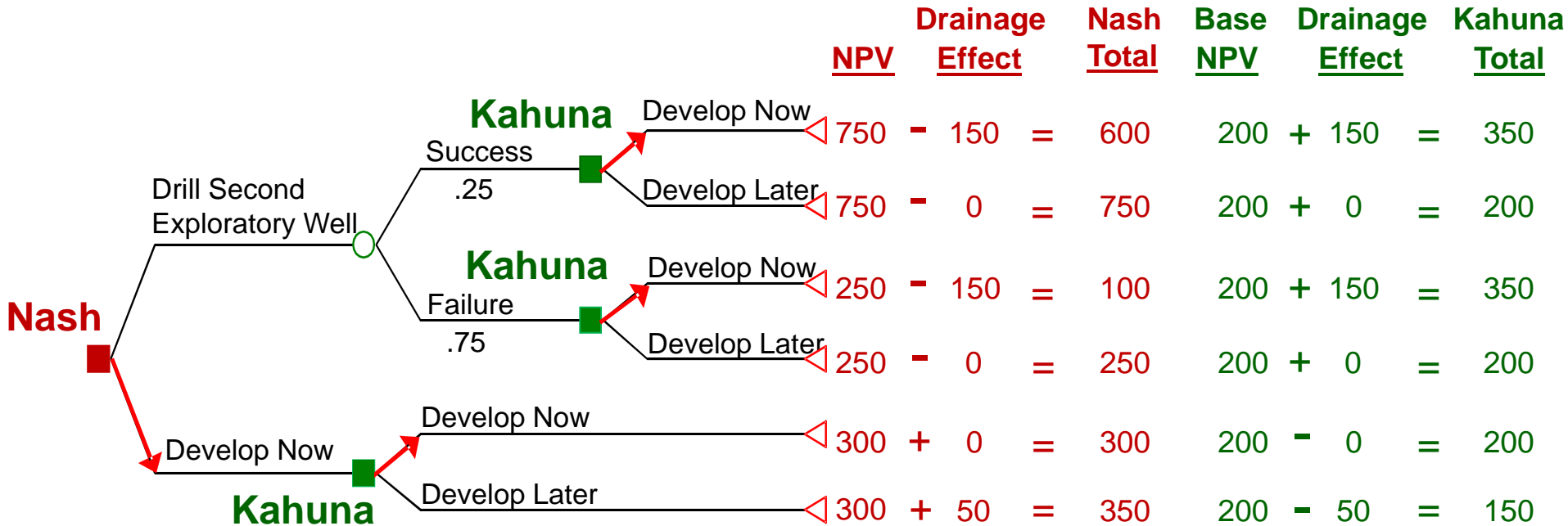
Game vs. Decision Trees

- Game trees model the actions of other players as decisions, not uncertainties
- Each player's decisions are a function of others' decisions and their own payoffs (value)
- Chance events can be incorporated as in decision trees

Economic Modeling

- Similar to DA, but done from each player's perspective
- Decision switches in the model are for all key players

The game tree for this case



Game theory shows:

- Kahuna will always have an incentive to develop now
- The expected value of drilling for Nash is 225 ($.25 \cdot 600 + .75 \cdot 100$), clearly less than the 300 from not drilling
- Contrary to the DA, Nash should not drill the second exploratory well
- The first-mover advantage means the information has negative value

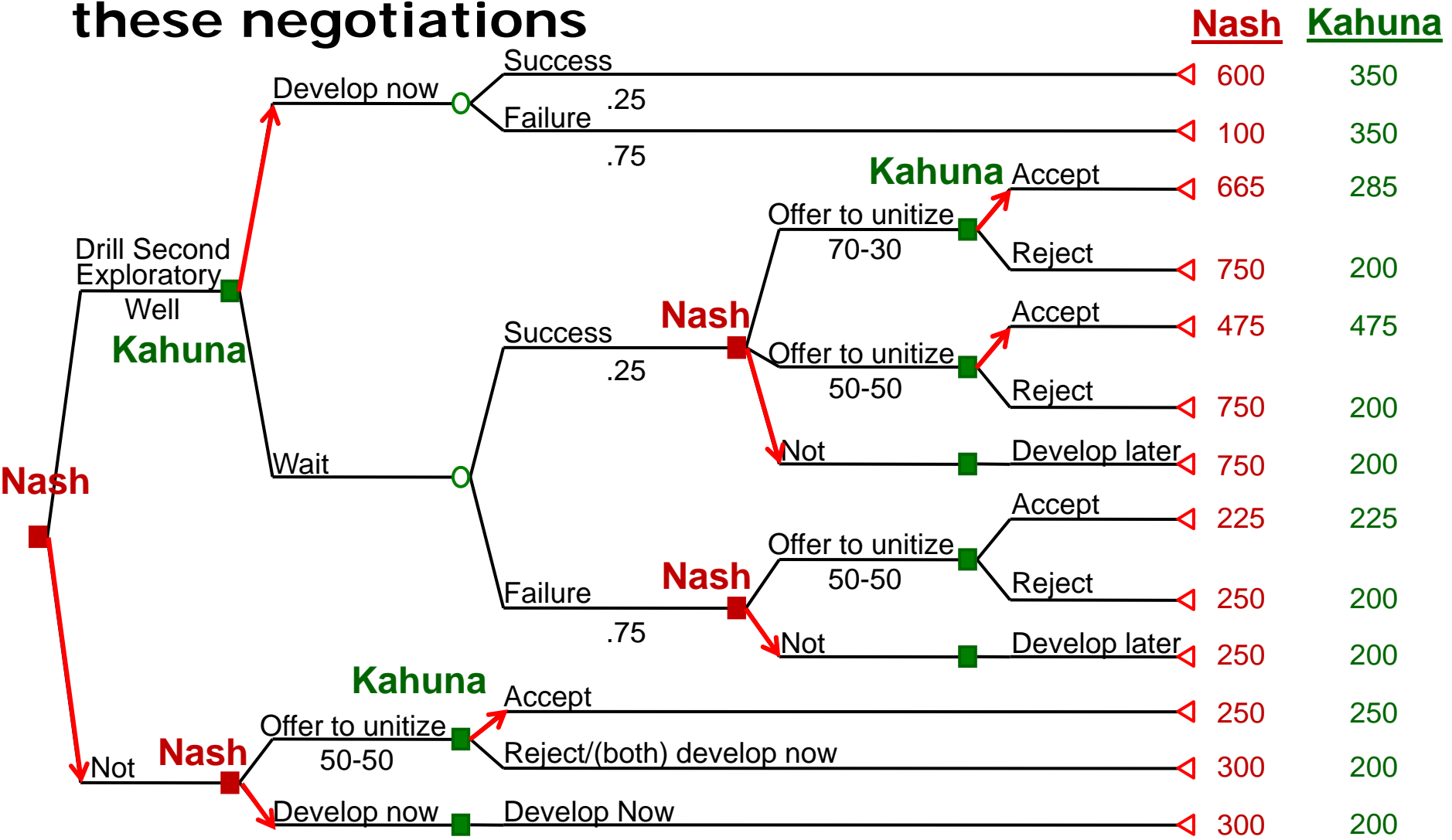
There may also be signaling issues in games

- Information may become known to other players, who can then use that information to their advantage
- In this case, Kahuna would surely discover something about the results of a second exploratory well
 - If the well is a success, Nash would surely trumpet the results
 - If it fails, Nash would say little, if anything; this silence would be a clear signal to Kahuna

One also needs to consider whether information can bolster a negotiating position

- For example, if Nash and Kahuna are negotiating unitization, will the information improve the chance of achieving a win-win?
- With a positive test result, Nash may feel it is fair to demand a predominant share of the unitization equity split
 - May be more “fair,” but fairness is beside the point
 - The prospect of such a demand may give Kahuna more reason to develop its own block separately and quickly
- A second exploratory well may not bolster Nash’s negotiating position and, in fact, may ensure that Nash is a disadvantaged second-mover (illustrated on next slide)

Why information-seeking does not add value to these negotiations



Whether drill or not, there is no unitization win-win. Kahuna will still have an incentive to develop now. In turn, so should Nash.

Summary and points to take with you

- Using a DA framework to calculate VOI and assess its strategic implications can be dangerously misleading
 - Game situations can make VOI negative due to issues around timing and signaling
 - A DA approach to VOI can also blind us to negotiation realities
- In framing, structuring and evaluating a VOI question, as well as many strategy issues, analysts thus need to pay heed to interactions
 - If 3C issues exist, a game-theoretic analysis is usually more appropriate than DA
 - Game theory should be seen as an extension of DA