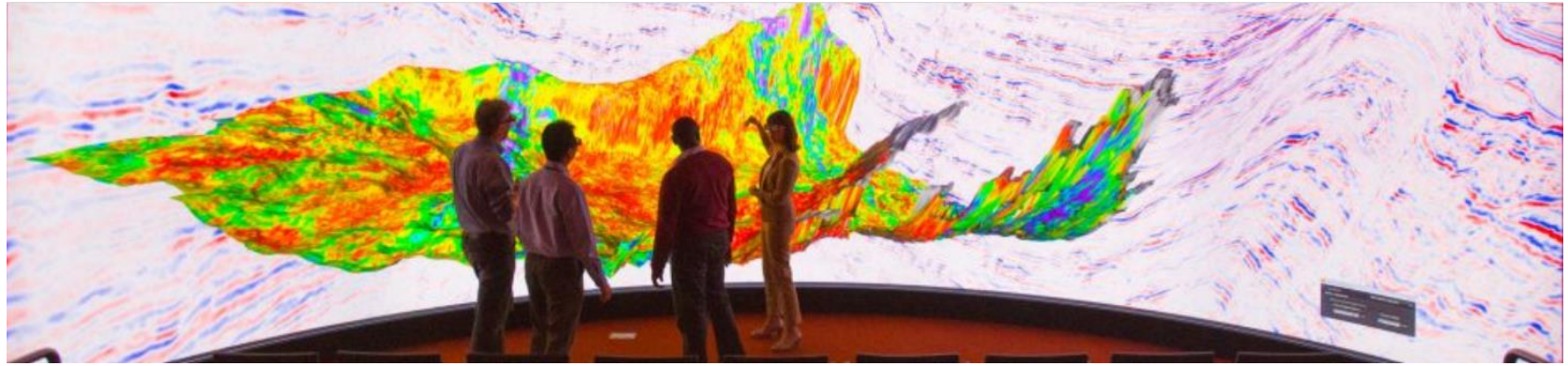
Integrated Modelling for Optimum Scope to Ensure Economic Viability: Shell's Approach



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Outline

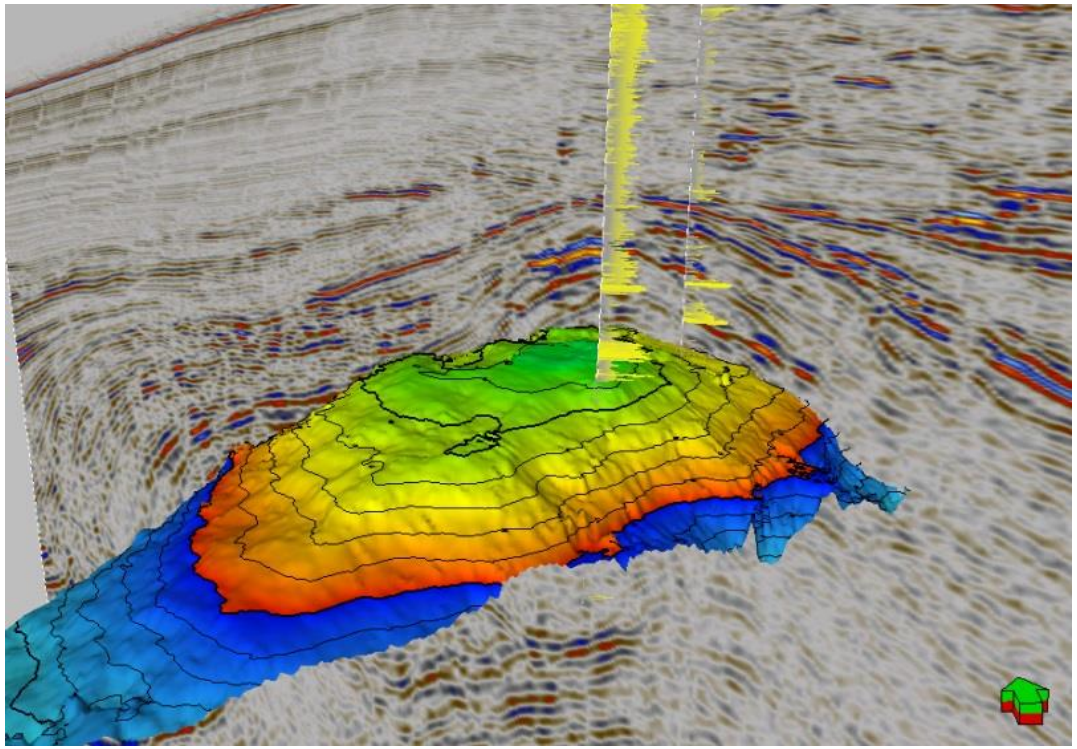
- Background / Challenges
- Subsurface / Surface Integration
- Examples
  - Subsurface Integration (multi disciplines)
  - Subsurface / Surface Examples
- Conclusions

Background

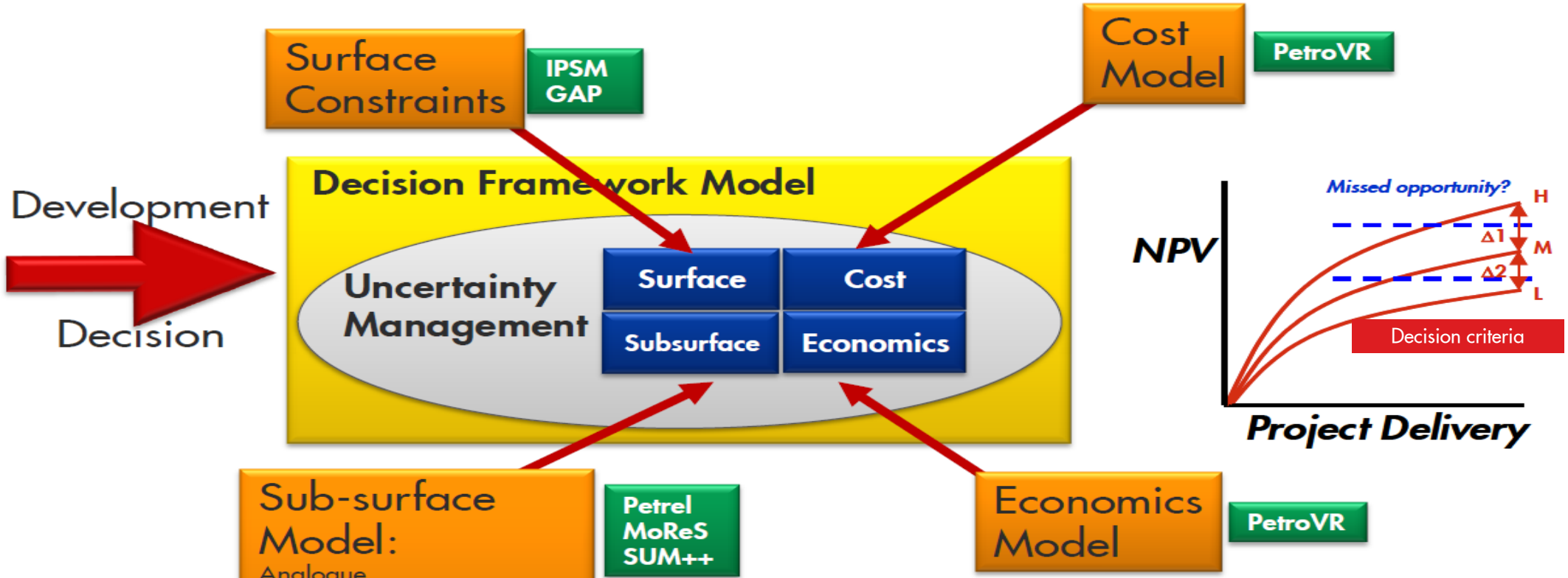
- Challenges
  - Current climate: “Lower for longer”
  - Insufficient funding to afford all the projects
  - Subsurface modelling suffers from cognative biases (e.g. Anchoring to base case)
- Shell’s solutions
  - Shell’s responce to the increasingly competitive landscape. Ensuring affordability of a Venture’s projects through control of scope and cost
  - Scaled Decision Based Modelling – (Shell Multi Scenario Modelling)
    - Scaled & tailored to answer the development decisions
    - Exploring wide range of uncertainties
    - Integration across multiple subsurface disiplines
    - Integration between surface & subsurface

Paradigm shift

- Paradigm shift
  - Simple first approach
  - Accept what we do not know and offer solutions that provide range of outcomes
  - Shift from project optimisation mentality to building options bottoms up
  - Top Quartile recovery is a journey but not a target
  - Maintain flexibility for life cycle development

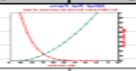
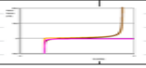


The Decision Framework Models



- Decision acceptance criteria defined
- Inputs developed on consistent scale
- Models tested against an economic metric

Example – Anchoring Bias

	Structure	RESERVOIR ARCHITECTURE	Faults	RESERVOIR PROPERTIES			Residual saturation		MATRIX RELPERMS		Capillary Pressure/SHF		Aquifer	
				PHI	K	Kv/Kh	Water	Gas	OW	GO	OW	GO	Perm	Size
														
High case	Hi case structure	high connectivity	low density open faults	Phi-strat +0.024	3 realizations	Kv/Kh =0.9	0,050	0,050	NWO_ = 2.5 NOW_ = 4.5 KROW_ = 0.85	Nog=4	Base case * 1.2 Swir		15mD	3000m
Base case	mid case structure	Mid connectivity	mid density partially sealing faults	reference depth trend AVG PHI-D	3 realizations	Reference (Kv/Kh=0.6)	0,10	0,100	KRWO_ = 0.5 KROW_ = 0.75 NWO_ = 3.2 NOW_ = 2.3	Nog=4.5	look up tables generated from Base Case pseudo cap curves per RT		25mD	2500m
Low case	Low case structure	Low connectivity	closed faults	reference - .024	3 realizations	Kv/Kh = 0.4	0,300	0,175	NWO_ = 3.5 NOW_ = 2.8 KROW_ = 0.6	Nog=5.6	Base case * 0.8 Swir		35mD	2000m

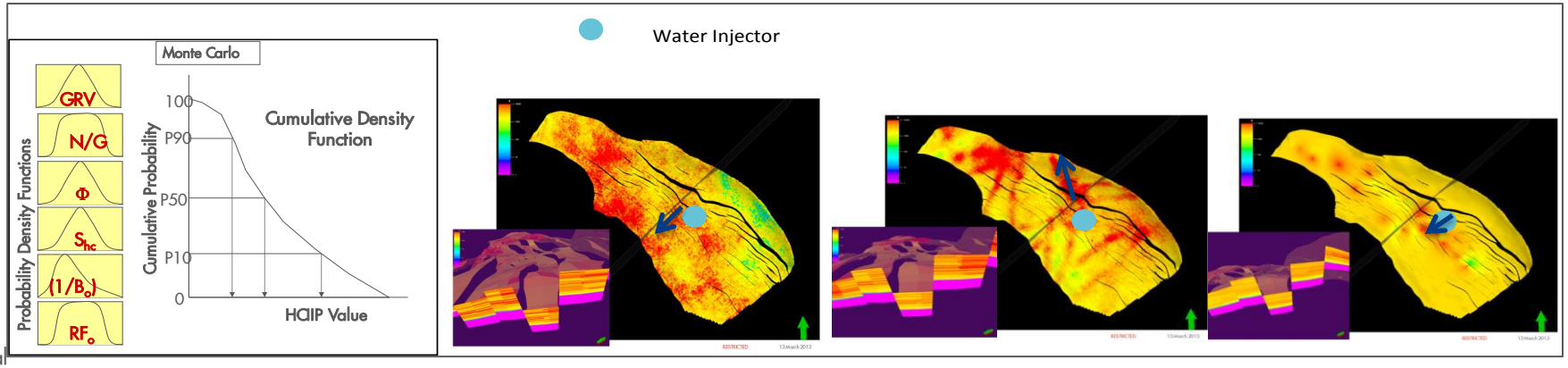
Low Case Model
- Reference correlation
- STOIIP reduction

Base Case Model
- Reference correlation

High Case Model
- Reference correlation
- STOIIP increase

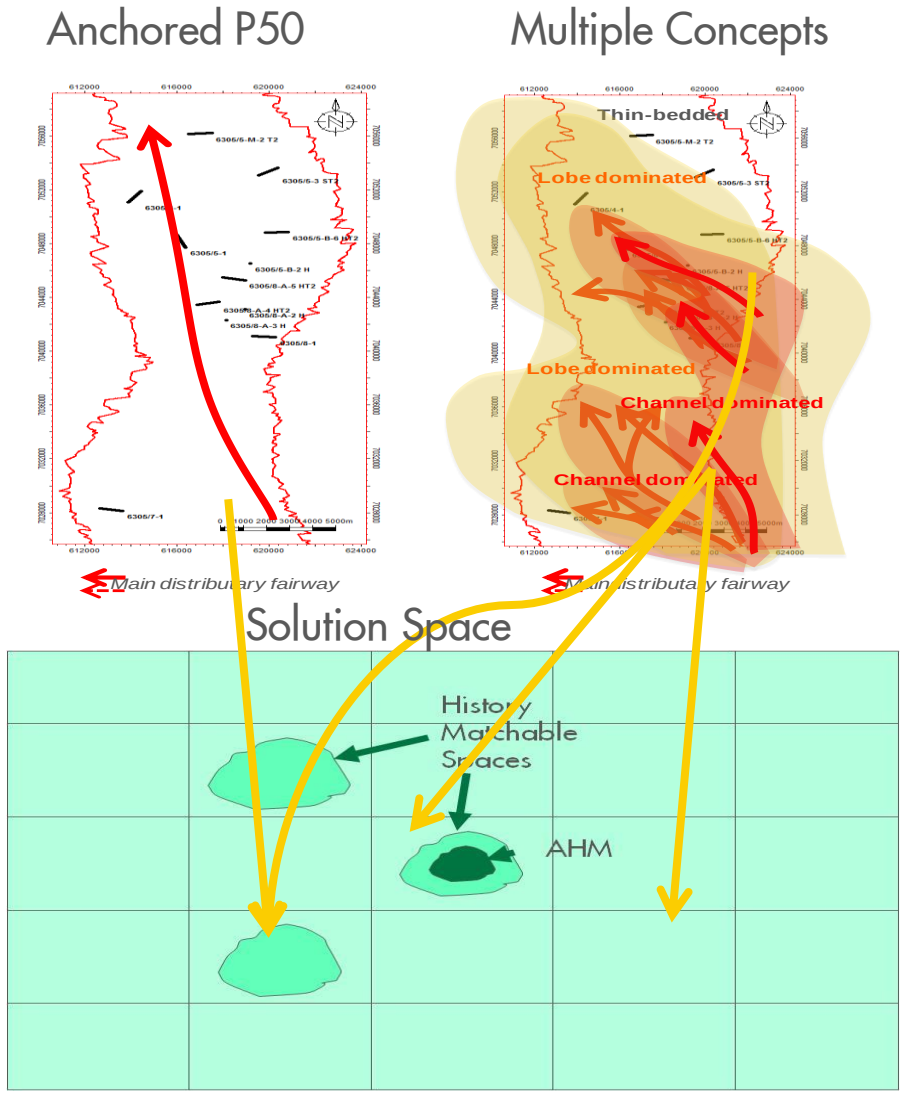
Decisions

All models have P50 STOIIP – Shell's way the P50 with different response to water Injection. Which one is the base case?



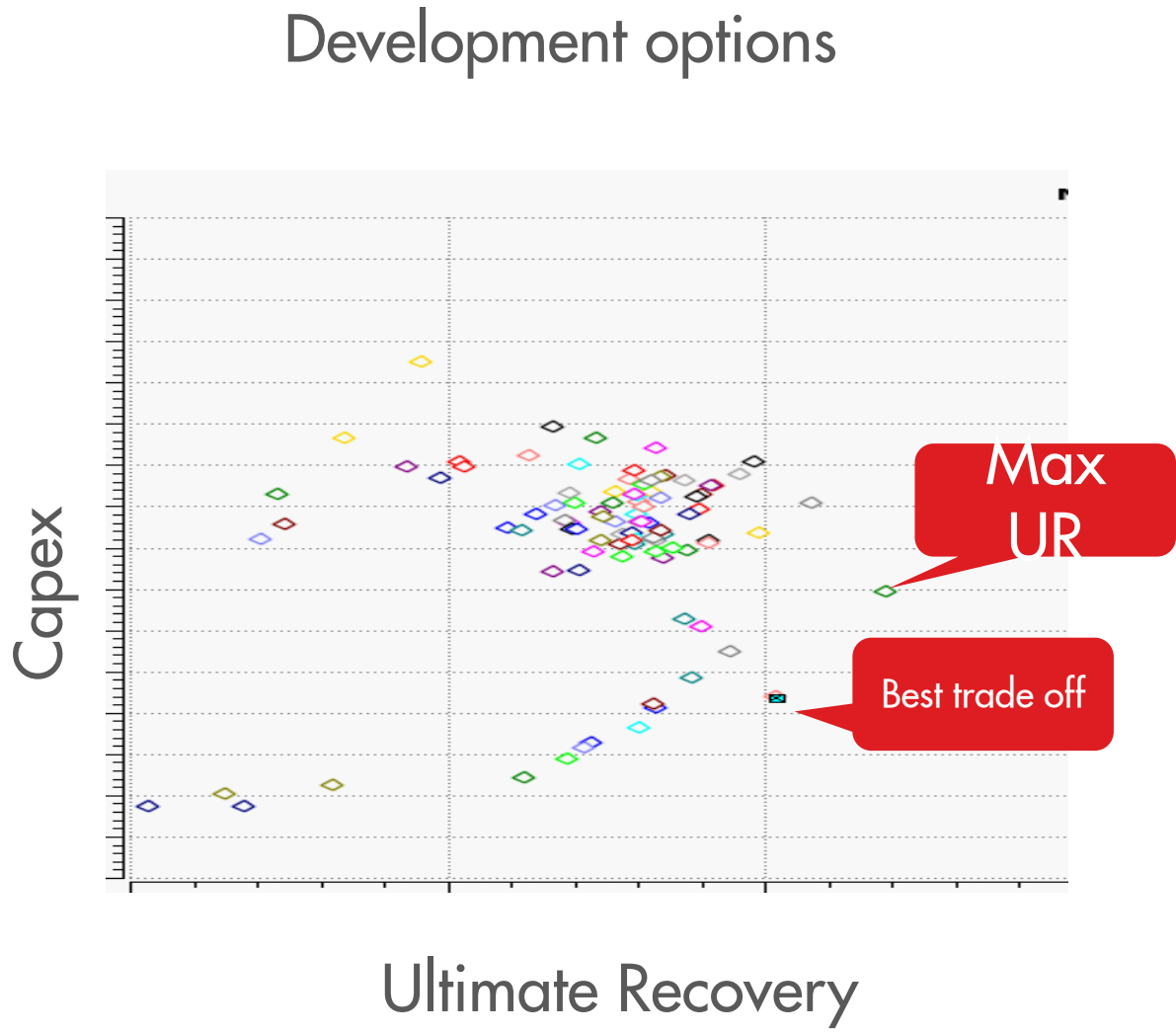
Subsurface Example

- Buisness Impact
  - Anchored to a single geological P50 case-> dry wells
  - Explored alternative geological concepts tied to contacts -> robust well locations
- Technical focus
  - Turbidite field
  - Both maps provide the same HCIIP
  - Alternative reservoir architecture linked to the contact
  - All other subsurface uncertainites are physically consistent with the depositional concepts



Example of Subsurface / Surface Integration

- Buisness Impact
  - Identified affordability at initial stage
  - Trade off between UR & affordability
- Technical focus
  - Focus on integrating subsurface & subsurface to economics
  - Multiple development options were considered
  - This was tested against relevant subsurface uncertainties



Conclusions

- We do need to respond to the current climate
- Pure cost reduction may hamper the long term field value
- The foundation of the development should be based on fully integrated subsurface / surface uncertainty framework

End