Collaborative Planning: The Flexible Freeze (or Controlled Chaos) Required for Success – Khazzan Field, Oman*

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Abstract

Successful execution of major projects depends upon 1) a good plan; 2) good people; and 3) everyone working together to a common goal. Whilst 1) and 2) are usually a given, ultimate success or failure can often come down to how well different teams with diverse and sometimes apparently unrelated goals can work together and accommodate each other's' requirements and issues. The Khazzan Giant Gas development is one of the largest onshore new field developments undertaken by BP (and any other major IOC?) in the last 20 years. It includes construction of a huge Central Processing Facility (CPF), 1000s of kilometres of flow lines and roads and hundreds of wells. First Gas was achieved in a little over 3 years from project sanction, by which time over 70 wells had been drilled and completed. During this period, new well and seismic data during early field development enabled the subsurface team to identify an opportunity to cut 100 wells from the original plan and redefine the well layout. However, such a wholescale change is not easily accomplished when Project teams are busy constructing flowlines (and the CPF!) and building well pads while Drilling teams are operating 10 rigs drilling 30+ wells a year. In Khazzan, every individual well, both surface and subsurface locations had to be carefully examined to avoid topography hazards (such as mushy sabkha and sand dunes) and geological faulting in the overburden and reservoir, and agreed by Subsurface, Drilling and Projects teams prior to pad construction. Complex locations would require several iterations to get right. The current Khazzan development plan and drilling schedule is in a constant state of controlled change – such as to minimize costly rig move distances, or in response to forecast flow line capacity constraints. BP developed a planning tool to help decision making that integrates drillings schedules, individual well production profiles, flowline capacity limits, and the field reservoir property maps

that is used in the collaboration meetings of Subsurface, Drilling, Projects and Operations teams to visualize and optimize the field project plan. This has enabled rapid response and optimization of the plan in response to new information, be it a new well, production data, a reservoir interpretation or a change in rig count. Changes, however, are carefully controlled: the programme is frozen for a minimum 6 months (which amounts to the time required to plan and build a new well pad) to avoid chaos and delivering a better plan

Collaborative planning: the flexible freeze (or controlled chaos) required for success – Khazzan Field, Oman.

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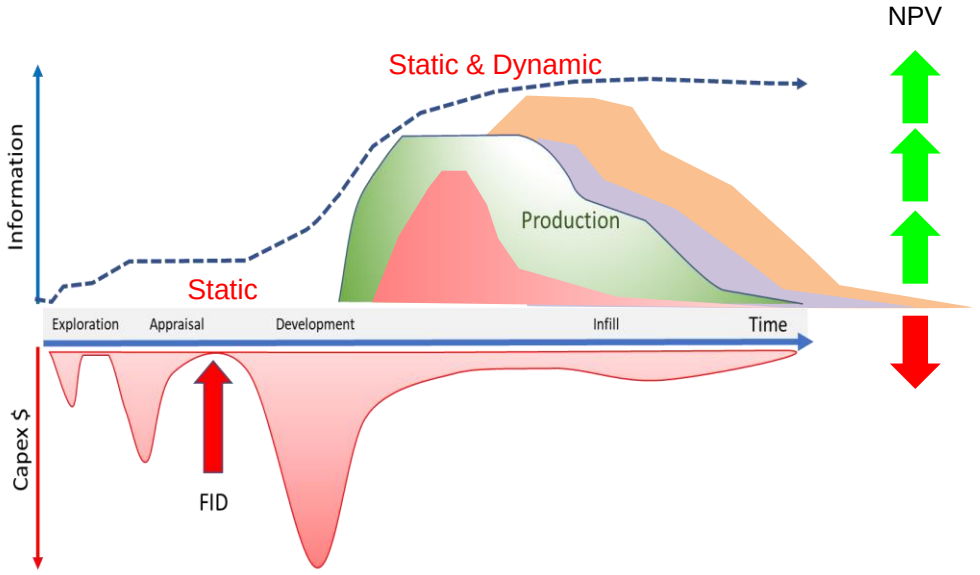
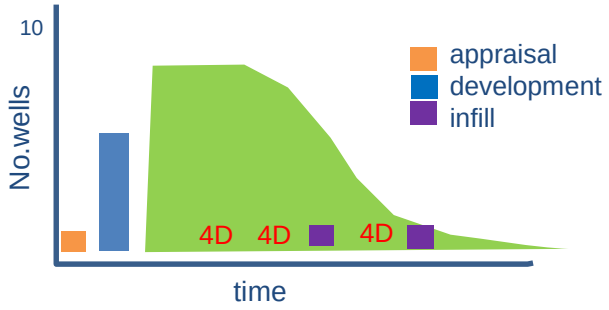
Why plans change – more information…

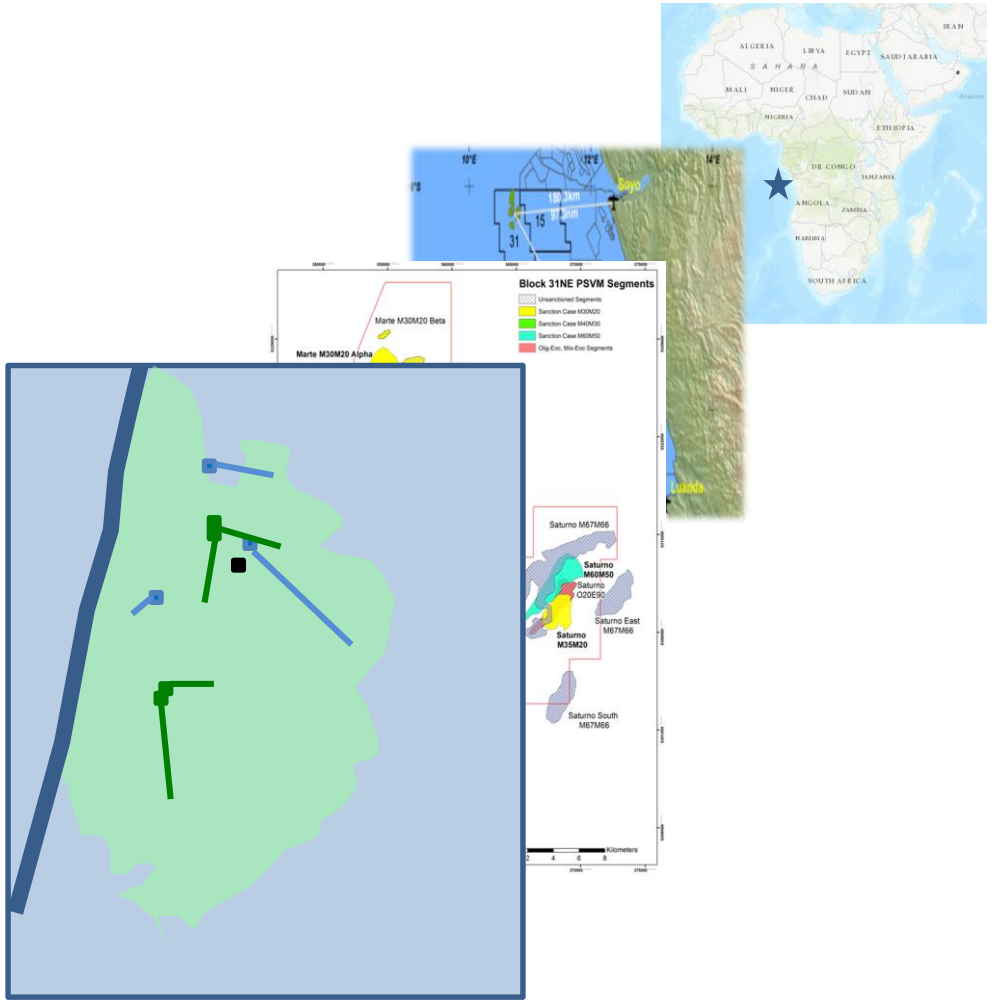
- We make the biggest decisions (eg FID) with only a small amount of the total information available
- This involves selecting a plan that Project engineering builds (facility, flowlines, well locations etc.)
- Project NPV range is still large, with negative outcomes still possible
- Driver to maximise NPV and minimise uncertainty range
- As new wells are drilled, the project plan can become obsolete almost immediately
- So, change is inevitable, but how do we manage and control it successfully and rapidly?



Where optimisation is difficult

- An example: Marte Field, Angola
  - Deepwater (2000m), 100nm offshore
  - 1000mbml
  - 1 discovery well
  - Subsea manifolds installed prior to development drilling
  - 4 producers, 3 injectors
  - New wells >$100m, 20-45mbopd each
  - 4D seismic used to target possible infill wells





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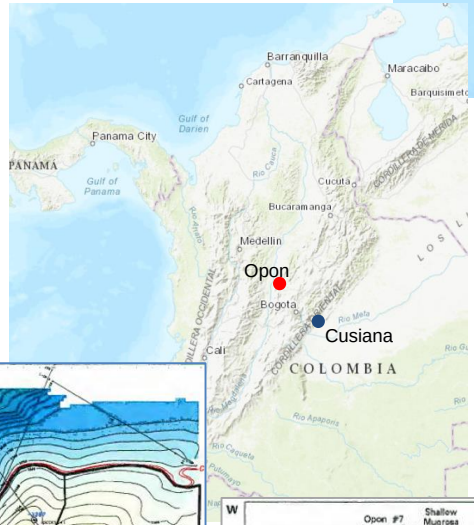
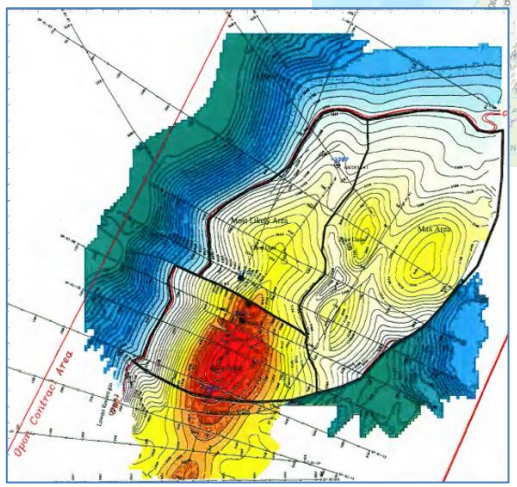
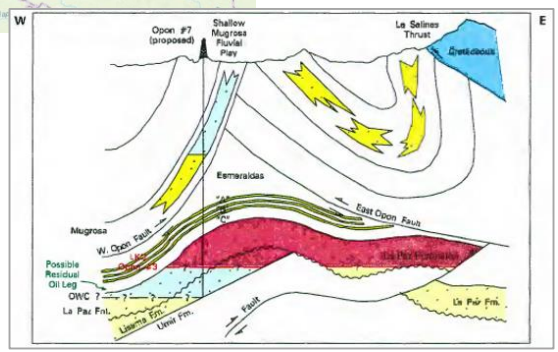
Where it can go wrong: Opon Field, Colombia

- Commitment to major project (power plant, gas sales) based on early appraisal well results
- High cost land wells
  - Very complex overburden
- Complicated reservoir
  - High pore pressure and WBS (22ppg emw)
  - Poor reservoir quality: <6% porosity, <1md matrix permeability
  - High initial well rates achieved
- Fracture dominated system, not carried in downside case or mitigation plan
- Fractures closed on production, wells died
- Project abandoned

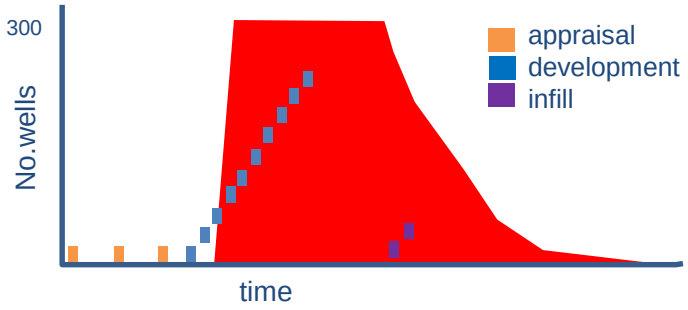




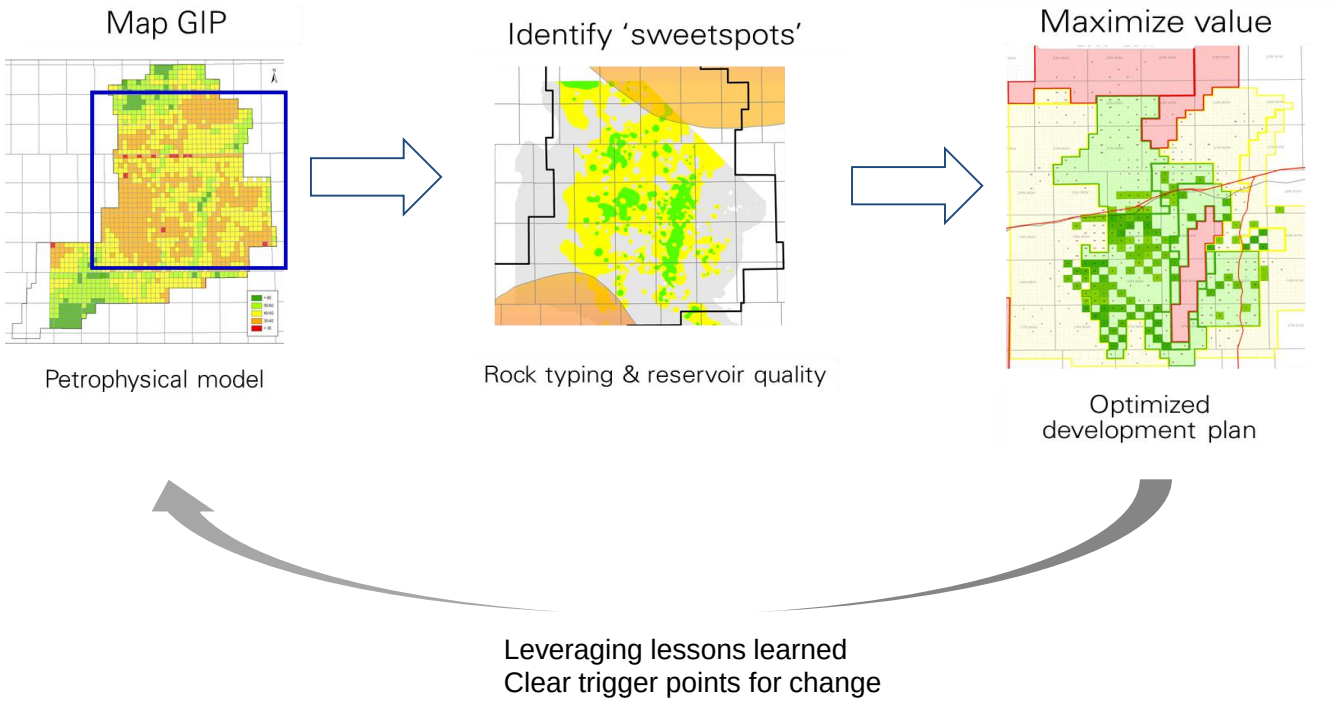


Where it's possible: Khazzan, Oman

- >4000km^2
- Unlocking 10Tcf of tight gas,
- 1st phase (Khazzan) 1 bcf/d in 2018
- 2nd phase (Ghazeer) +0.5 b/d 2021
- 300+ wells
- Phased development
  - 70 wells drilled for First Gas in 2017
  - 40% of surface infrastructure at FG
  - Drilling through to 2030

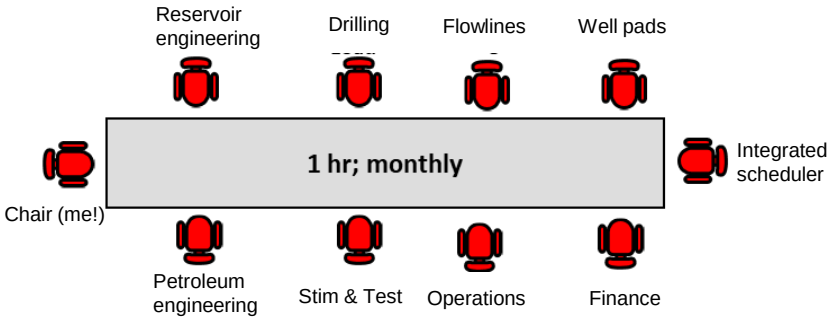


Unconventional Resource Project Cycle

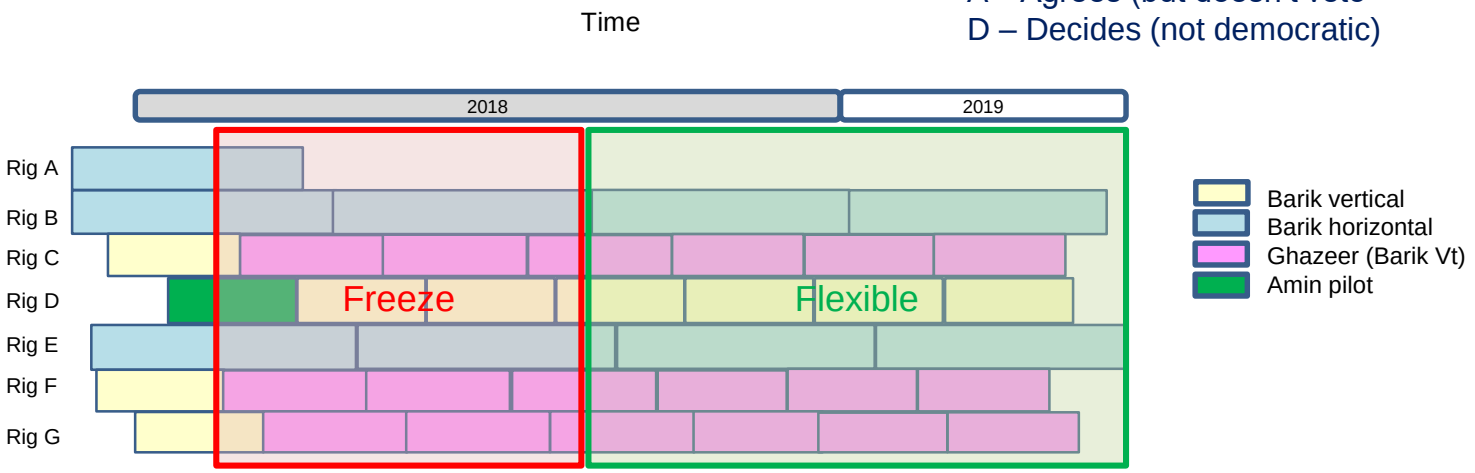


The concept of flexible freeze…

- Cross-functional review of the rig and S&T schedules
  - Cross-disciplinary representation (subsurface, drilling, projects, finance, operations)
- All teams agree to a rolling 6-month freeze, except for operational expediency
  - avoid last minute pad construction
  - Maintain an appropriate well planning cadence, avoid rush
- Beyond 6 months is open to optimisation

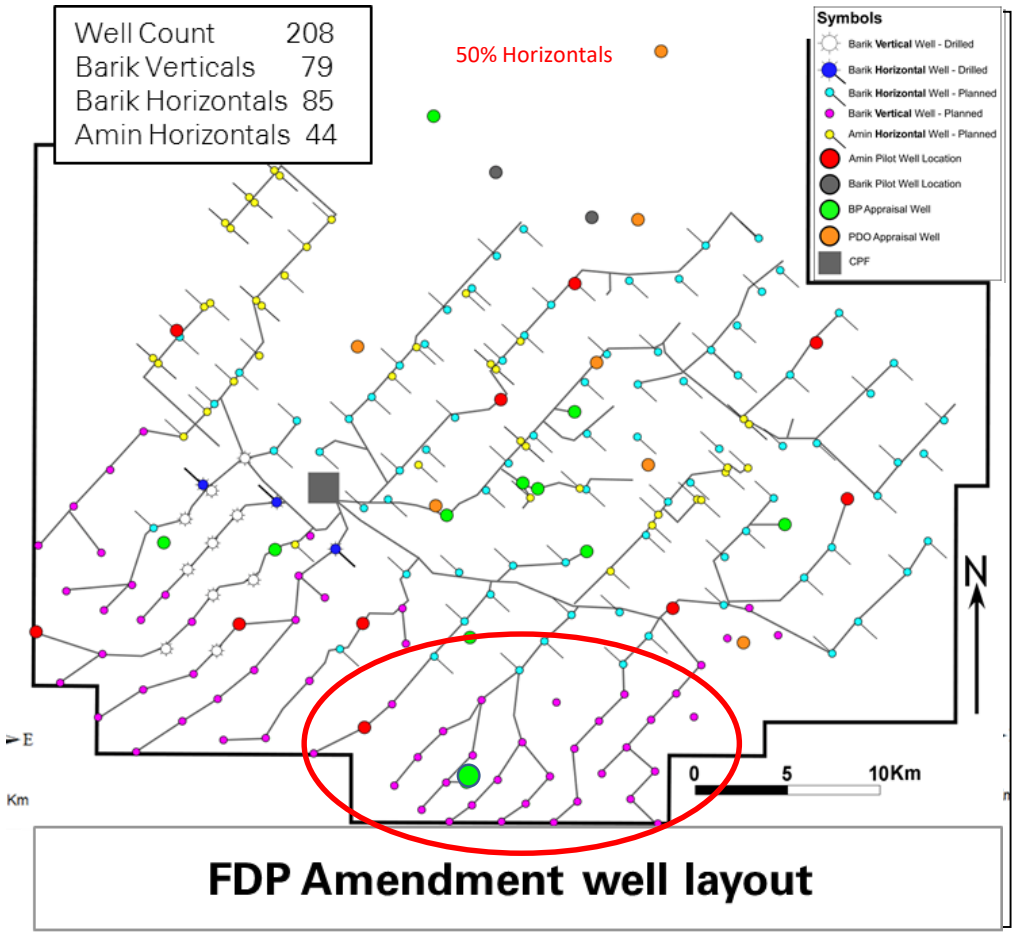


R –Recommends
A – Agrees (but doesn't veto
D – Decides (not democratic)



Example 1. Optimization during early field development

- Improved seismic imaging of net sand coupled with appraisal and early development well results enabled a significant amendment to the field development plan:
  - 100 fewer wells
  - More, simpler low cost (vertical) wells
  - Revised surface layout
  - 30% reduction in well cost (>$1bn)
  - 17% reduction in opex due to well count reduction & operating efficiencies
- Results also indicated field extended to South – extension to Block 61 (Ghazeer Field)



FDP Amendment well layout

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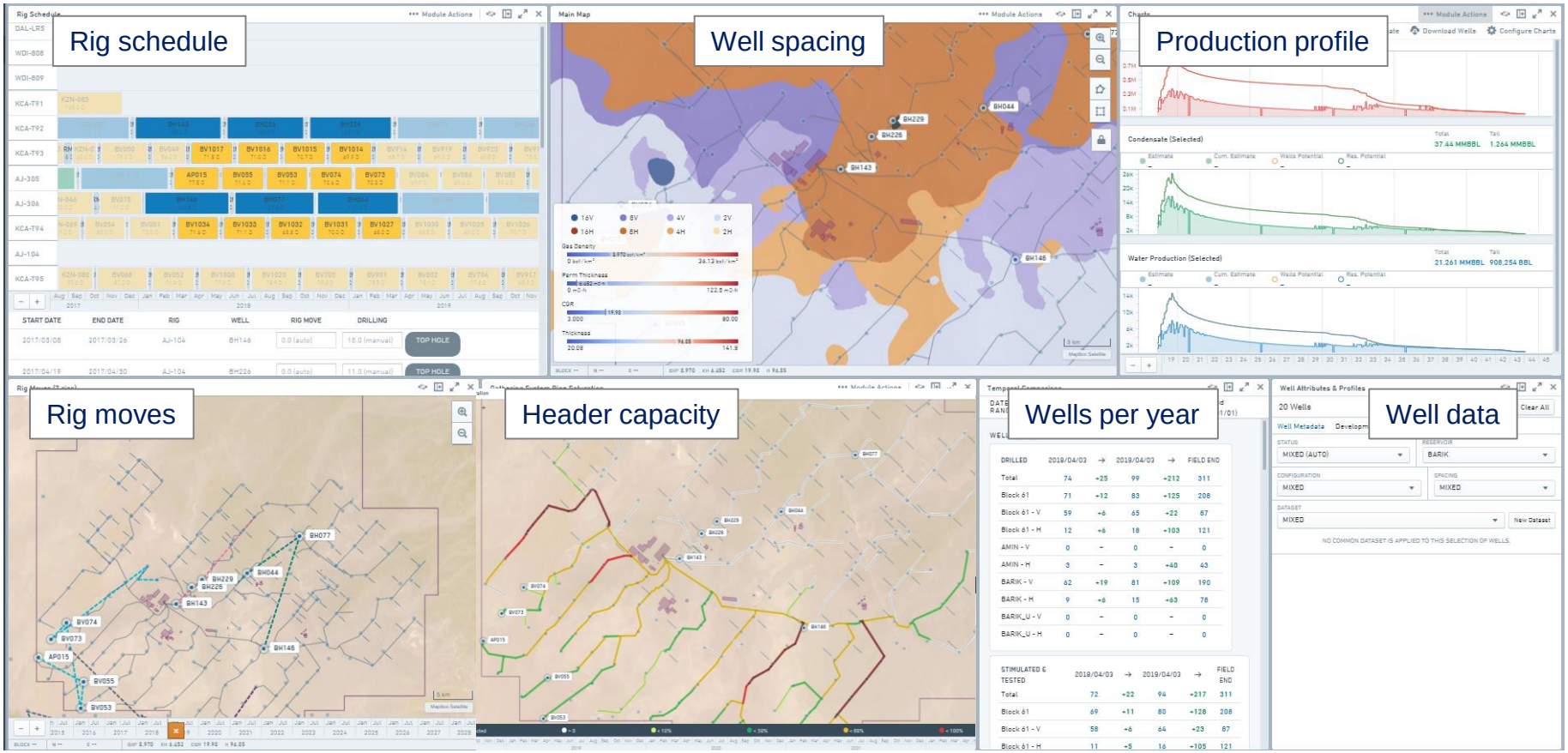
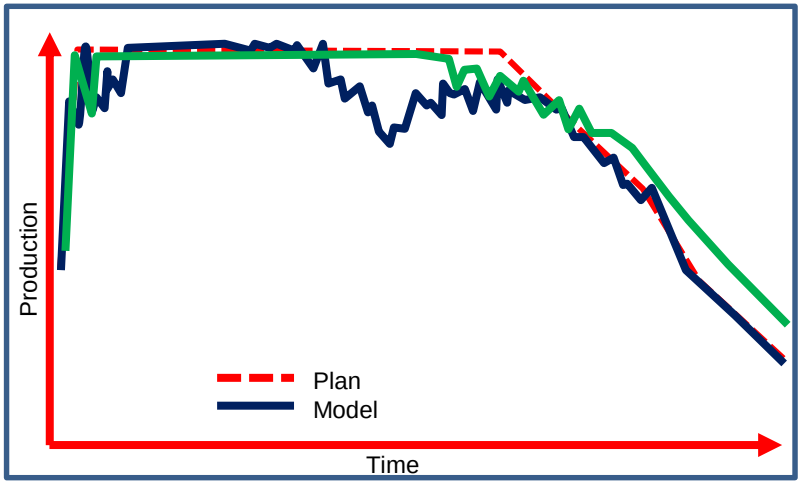
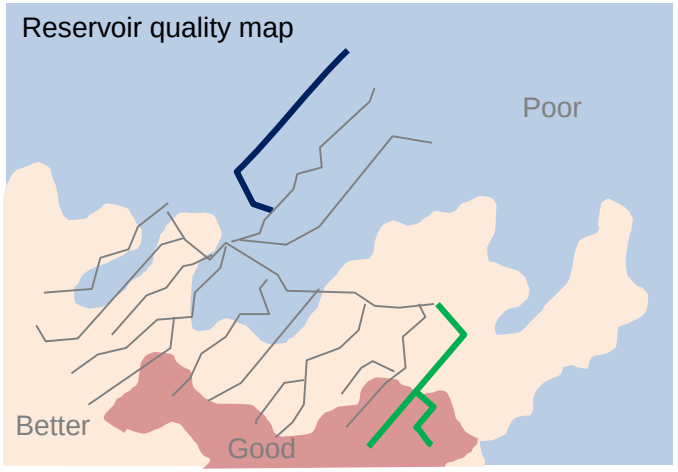
Integrated collaboration tools: decisions from months to minutes



Example 2: Optimisation of header sequence





- Use flow assurance model to assess impact of header sequence on production
- Flow assurance model indicates potential production shortfall

- New reservoir maps used to identify alternative headers
- Header sequence updated honouring line-pipe total tonnage constraints
- Drill sequence checked and revised

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Conclusions

- Ongoing appraisal drives optimisation
- Project change is almost inevitable and necessary to maximise value in response to:
  - Subsurface understanding
  - Dynamic performance
  - Drilling performance
- This never stops!
- Ingredients for success:
  - Cross-functional understanding of the Field Development Plan
  - Clearly defined trigger points (where possible)
  - Open behaviours
  - Simple tools that enable integrated decision making
  - Emerging new thinking about project management (eg SCRUM)
- Cross-functional integration is essential, with clear boundaries defined to ensure change is controlled rather than a path to chaos

Questions?