Chevron

human energy®

Best practices to use VBM

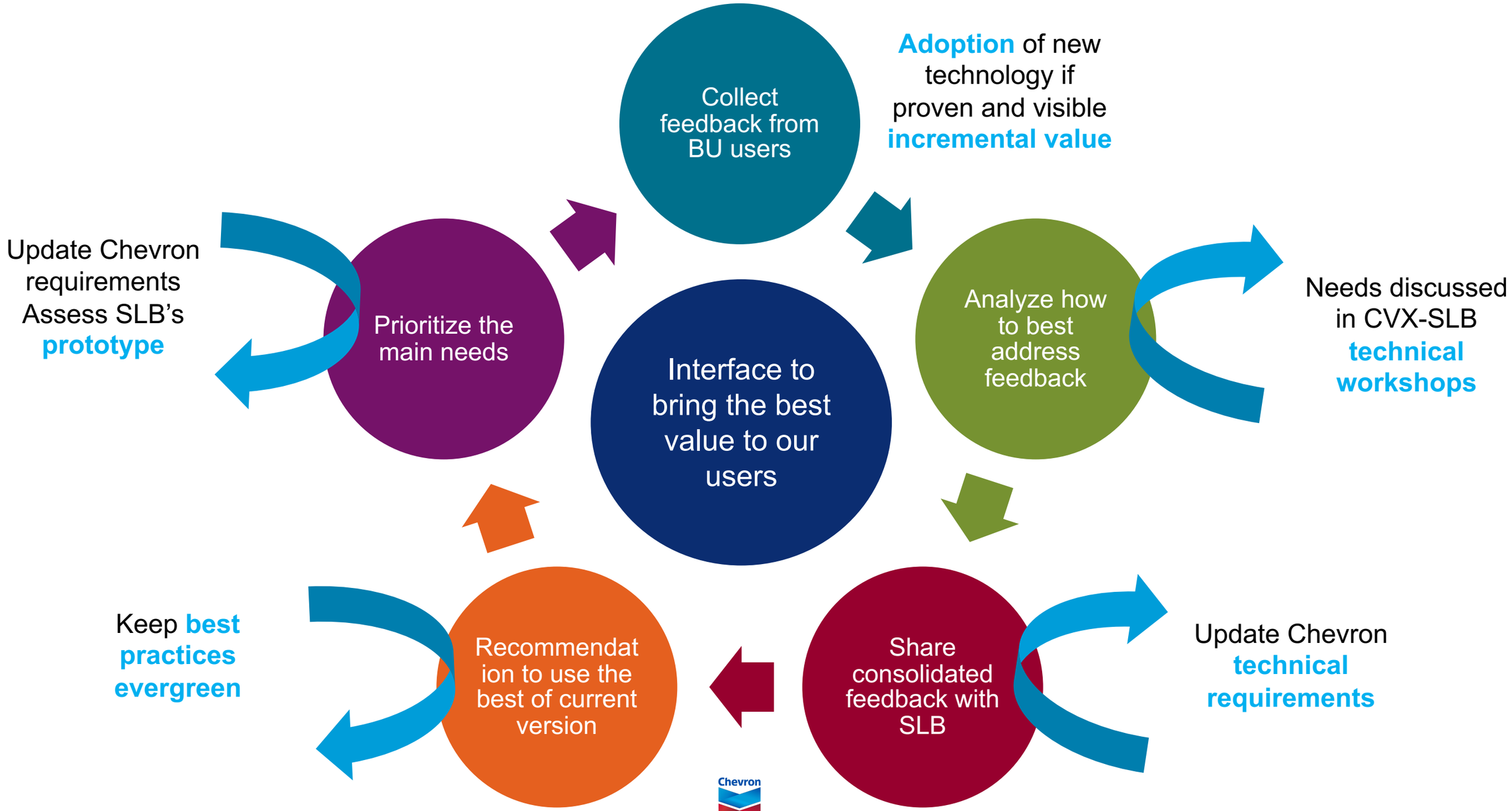
Author: Anne Dutranois
Geomodeler
Presenter: Stan Jayr
Strategist

Monaco, September 2019

Best practices to transform user stories into practical and evergreen user recommendations

- Bringing the best value of the technology to our users through continuous deployment
- Example of collaboration: from targeted requirement ‘efficiently clean up well tops’ to the delivery of the feature integrated in user story for users community
- Deploying new technology: challenges of geo-cellular grids for the user experience
- Conclusion & acknowledgement

5 keys to maximize impact thru continuous deployment



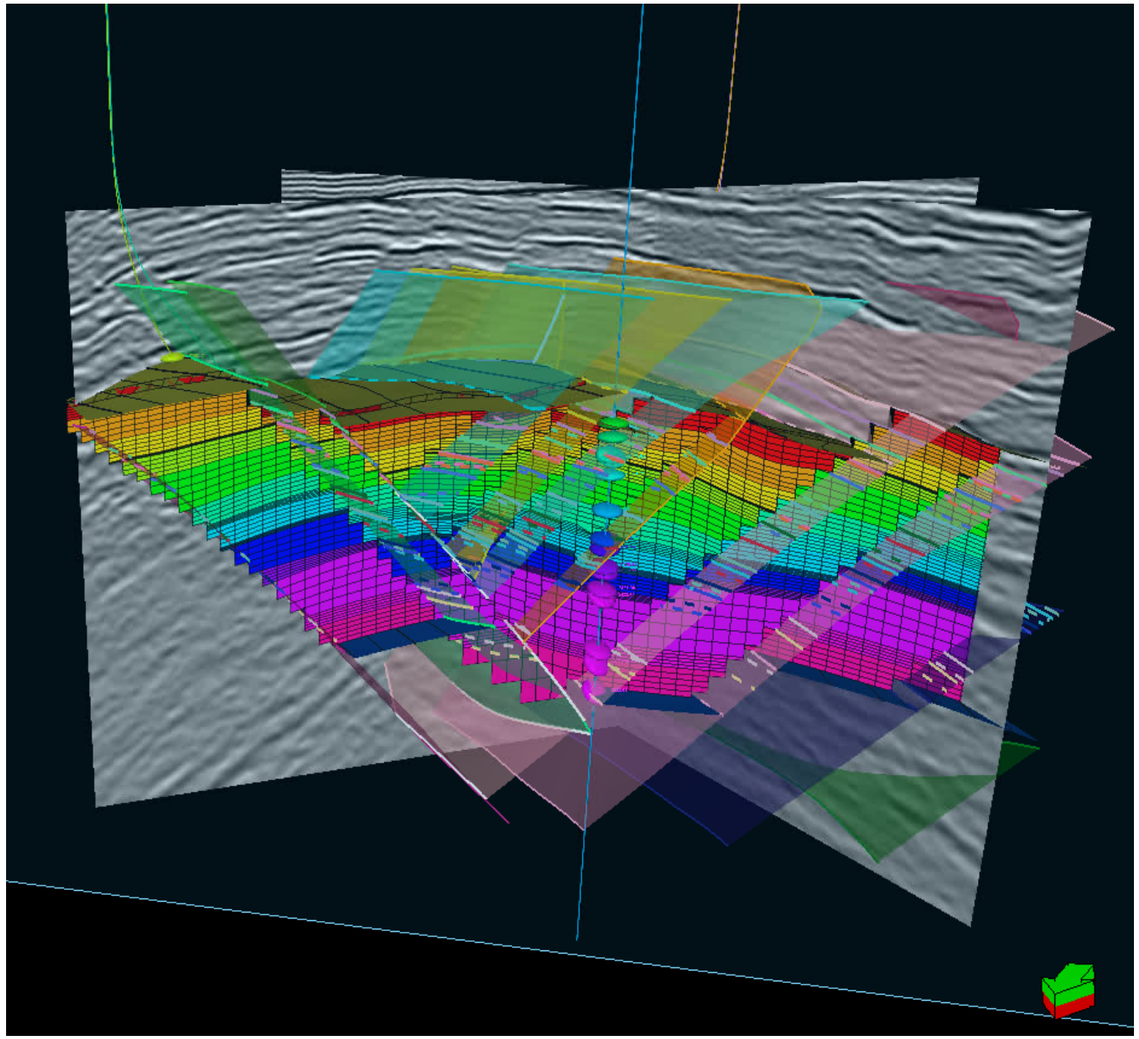
Chevron

VBM increases accuracy of geological models

Volume based modeling (VBM) technology:

- **Effective field development plans** use **clear understanding of the subsurface.** An **accurate and uncompromised geological model** is a critical input but has historically required some simplification for simulation.

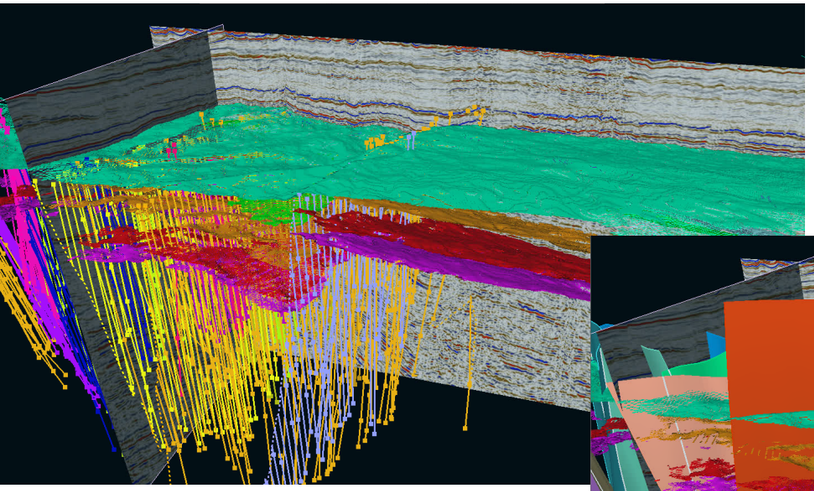
- **Structurally and stratigraphically complex reservoirs** can now be modeled with greater accuracy in the Petrel E&P software platform and **sent directly** to our next-generation INTERSECT **high-resolution reservoir simulator without compromising on geological detail**.



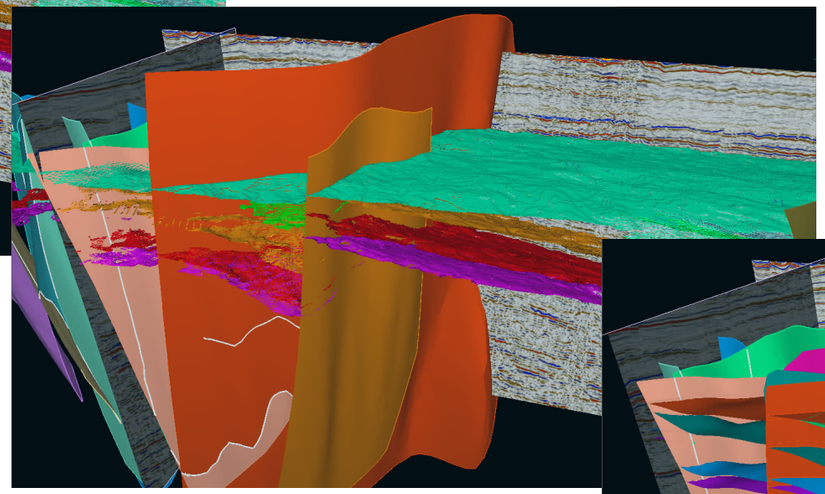
https://www.software.slb.com/products/petrel/petrel-geology-and-modeling/structural-framework-builder

Any associated trademarks are owned by and courtesy of Schlumberger

Best practices to use VBM efficiently

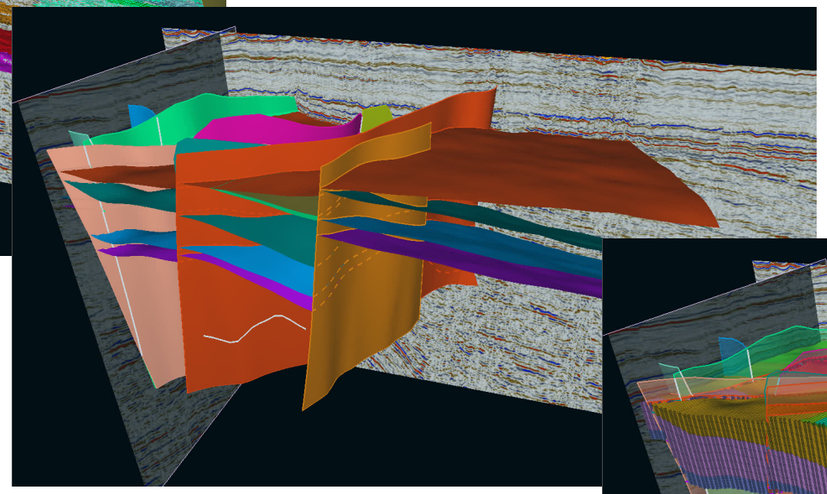


VBM is **more sensitive to imperfect data**
Ideally: fairly densely picked data, which may have an impact on projects timeline

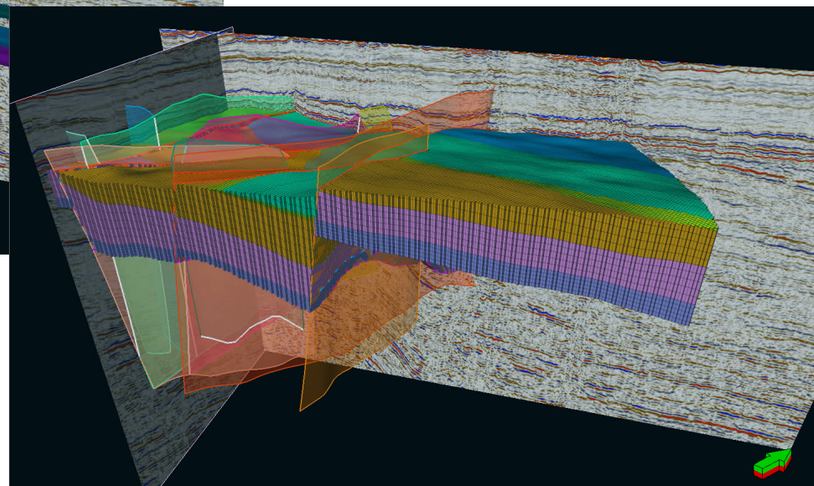


VBM requires **thorough QC**
Steps are sequential and may require computation time to run: decrease number of iterations by validating each step

VBM requires **memory and large computation time when refining volume** (not linear)

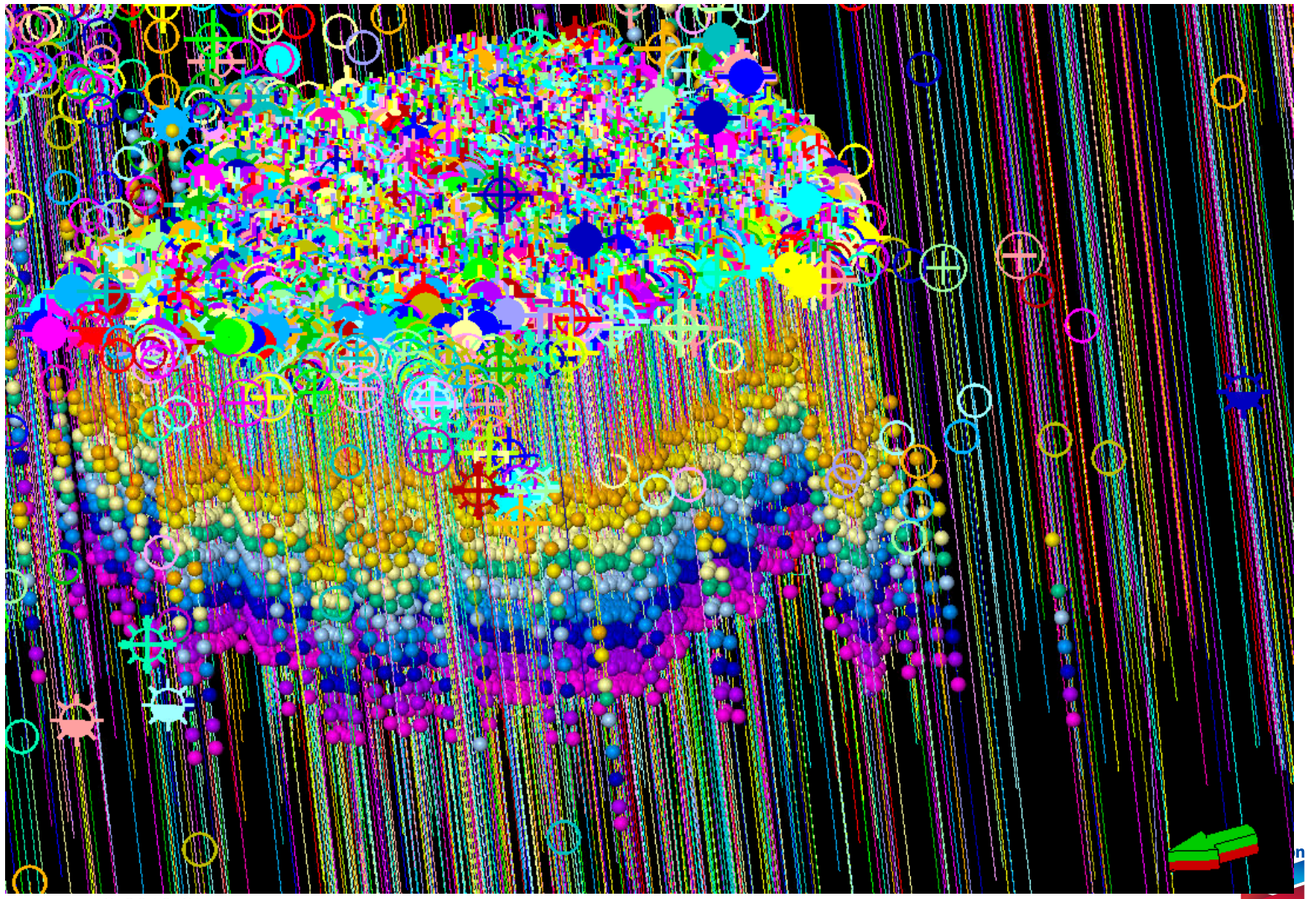


VBM steps **requires less user interaction but offers less flexibility** (options and editing tools)



Focusing collaboration on value adding tools

What is the problem?

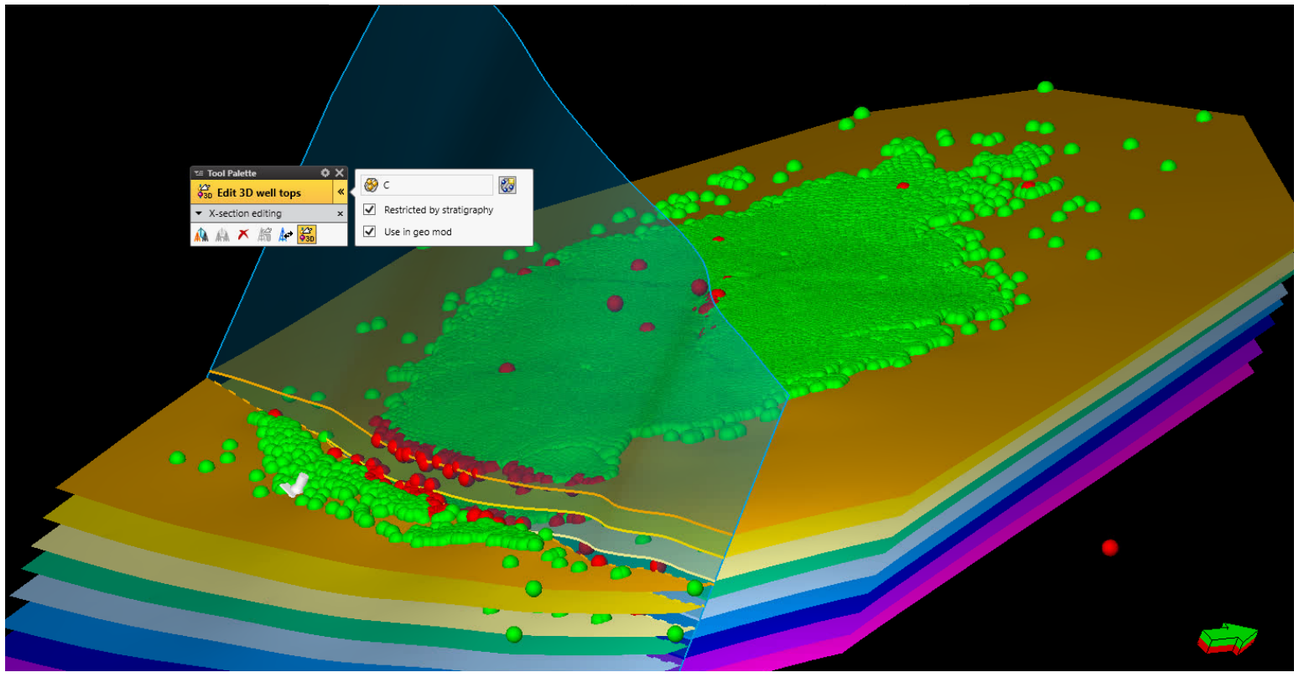


Well tops are usually considered hard data for structural modeling: bad well tops will lead to noticeable artifacts.
VBM is sensitive to the quality of the input.
Cleaning up well tops is tedious: click-intensive and time consuming.

Focusing collaboration on value adding tools

What is the problem?

What is the best solution to resolve the problem?



Looking for a flexible way to clean up well tops:

- Can use automated methods
- Can be refined using manual tools

'Used in geomod' is now an attribute on well tops.

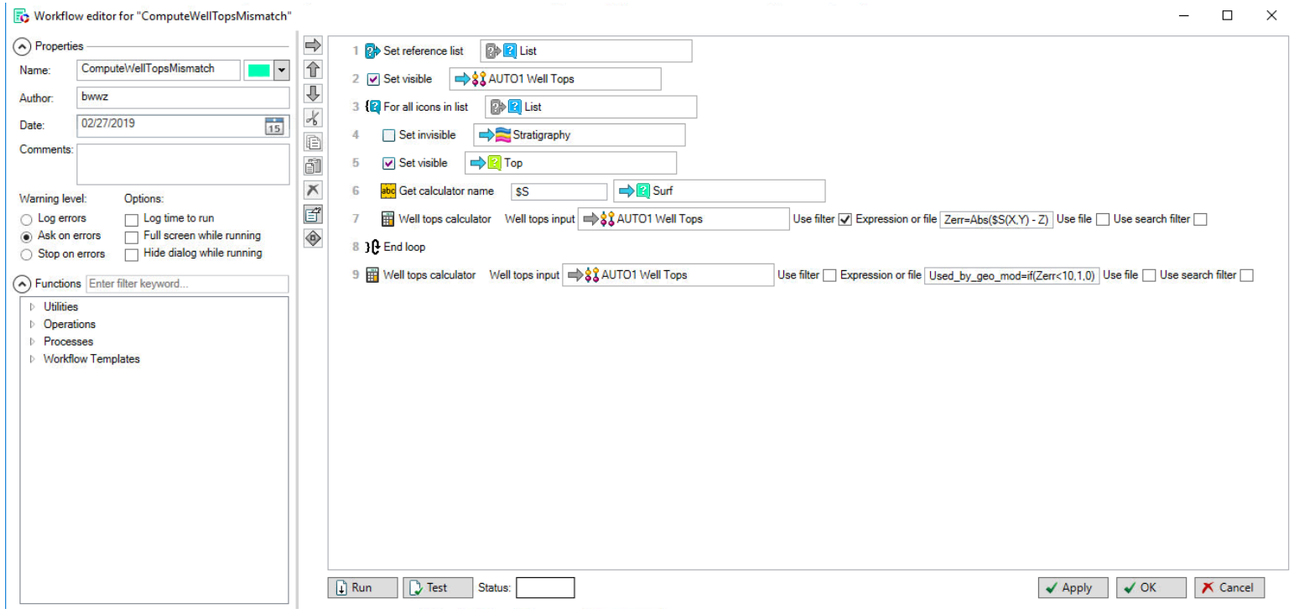
✓ Can be interactively displayed in the viewer, including filtering
✓ Can be used in Calculator
✓ Can be manually edited in the viewer

Focusing collaboration on value adding tools

What is the problem?

What is the best solution to resolve the problem?

How to optimize the implementation delivered for end users?

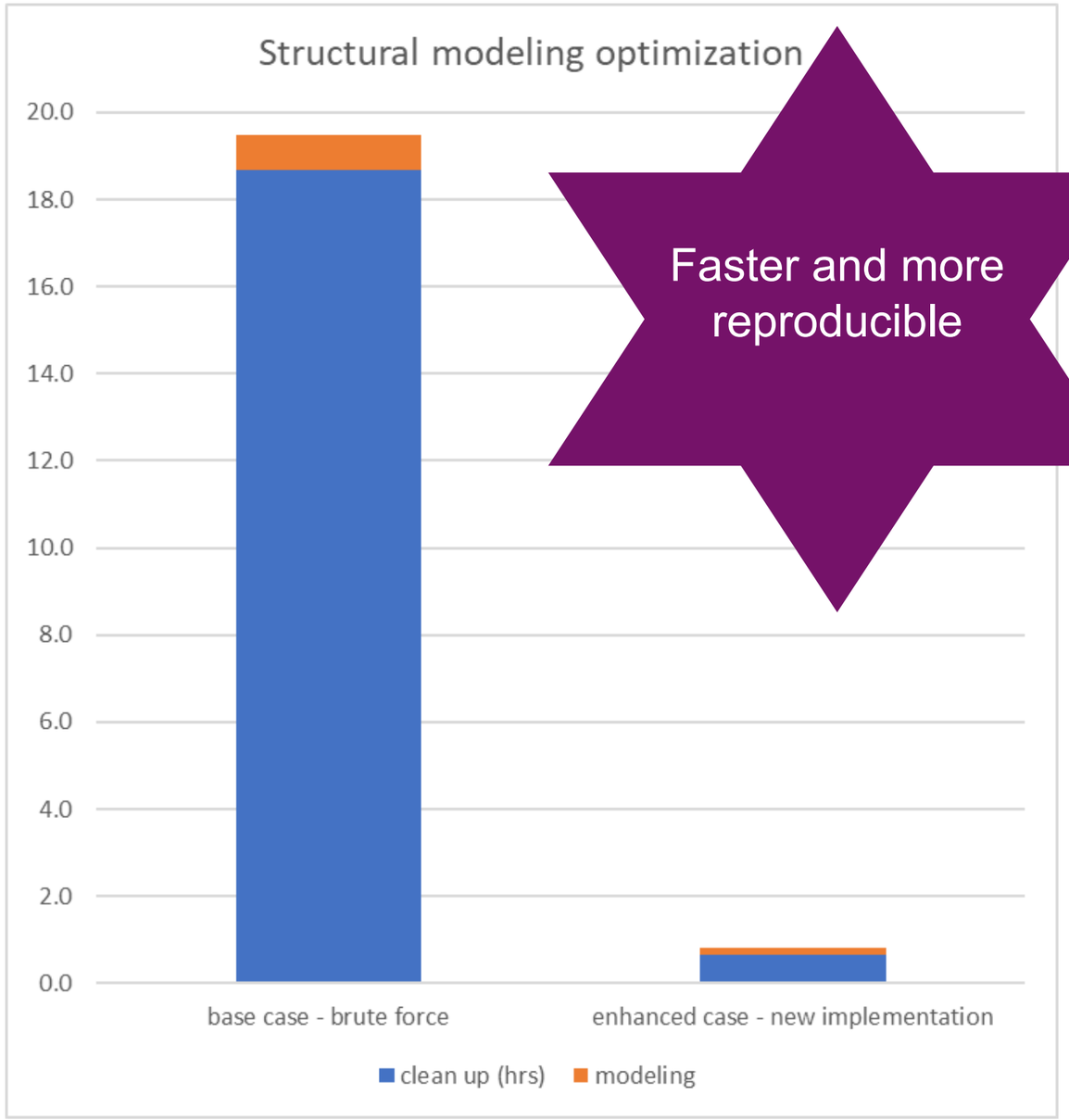


To make this available to users:

- Identify the best flow (automatic detection of bad points first, then list available tools for manual selection, highlighting use cases)
- Produce workflows
- Document process

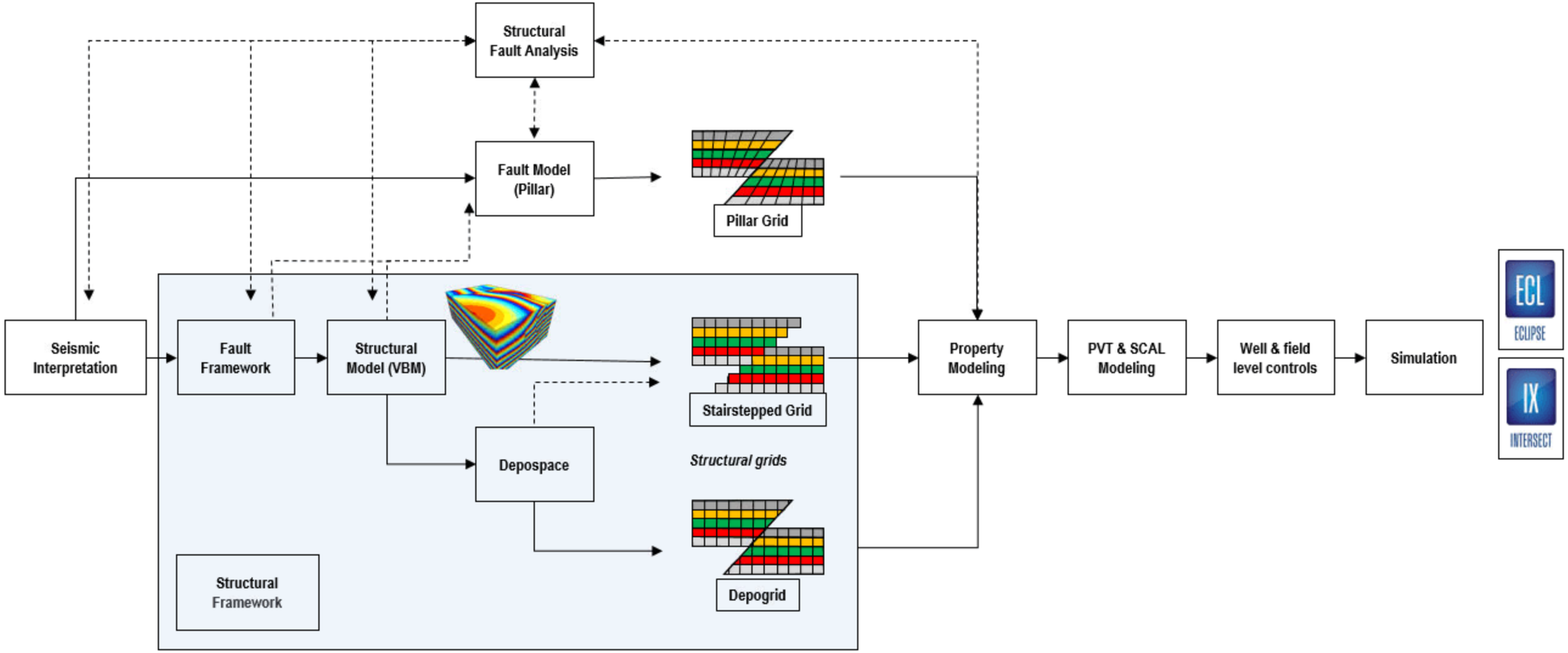
Focusing collaboration on value adding tools

- Some numbers:
  - ~24 000 wells
  - 9 horizon tops
  - ~175 000 well tops
  - ~1500 well tops are ‘ignored’ in the final model
- Clean up:
  - Manual selection: ~45 s/well
  - Automated selection: ~10 min in total. Deals with 90+% of ‘bad’ tops
- Modeling:
  - Use well tops as ‘well tops’ (hard constraints): 6 min+4 min
  - Use well tops as ‘input’ (soft constraints): 2.5 min+1 min



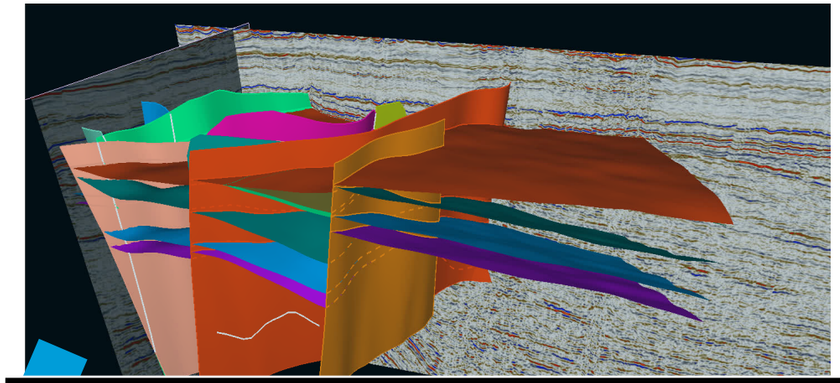
Understanding user experience when deploying new technology

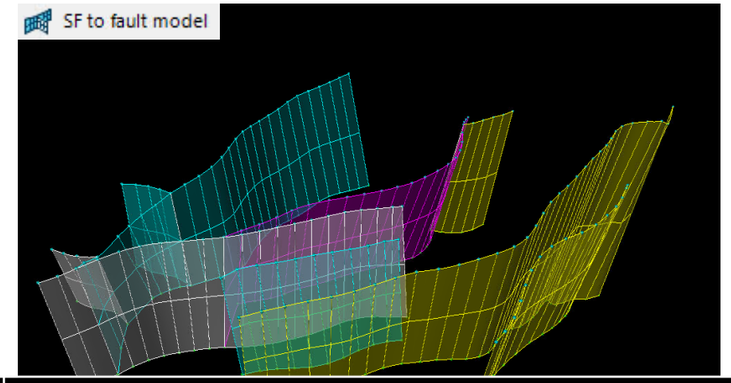
Figure 1. Structural modeling and gridding workflows.

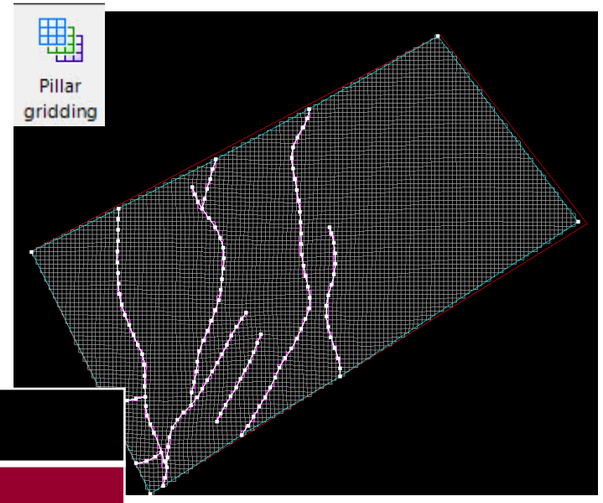


Chevron

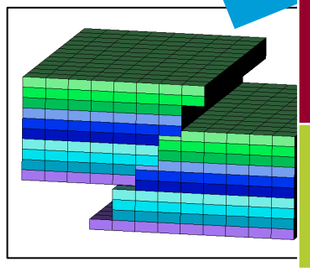
Understanding user experience when deploying new technology

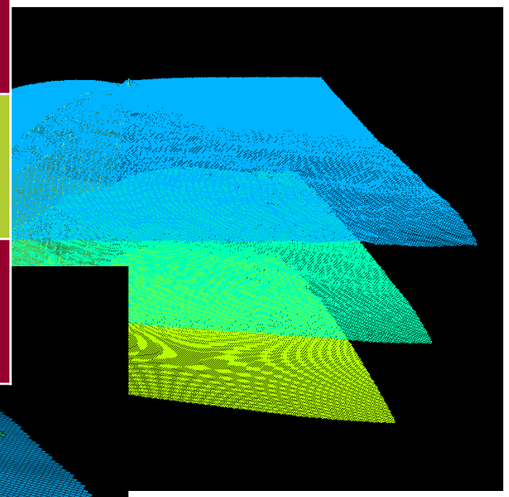


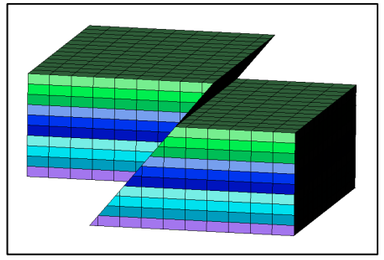


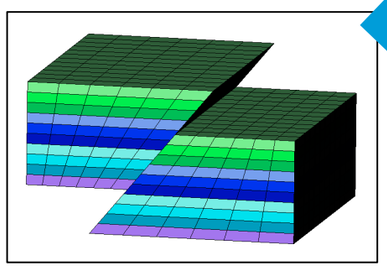


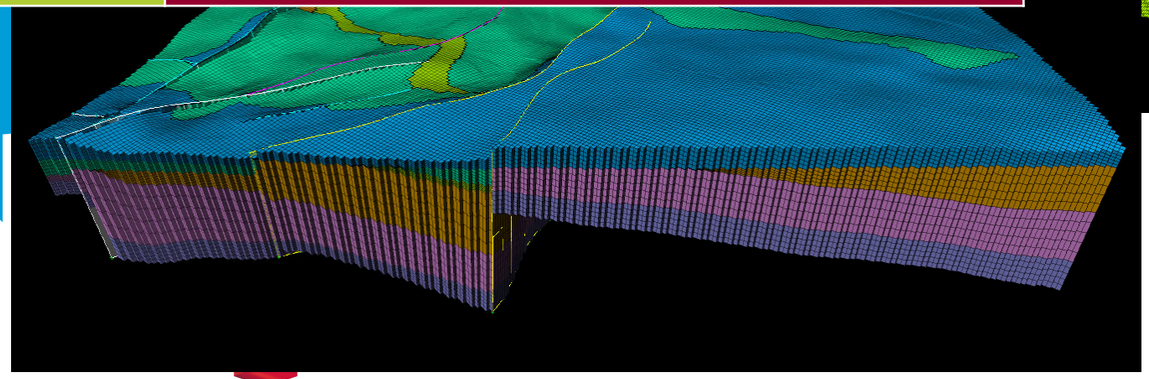
Stairstepped grids	Pillar grids
Few user interaction	Editing is required; error-prone: cannot be automated easily
Not compatible with all processes, little editing option	Mature and well supported across applications
Deals with complex configurations	Can represent only simplified geology, may imply distortion







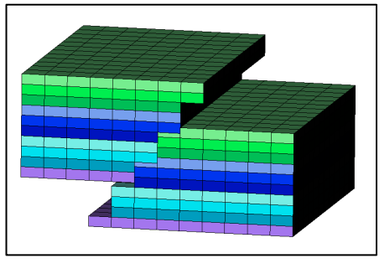


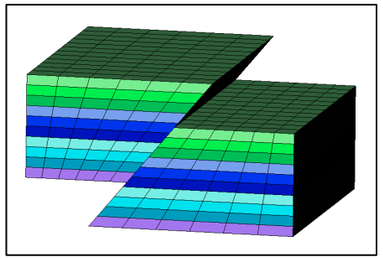


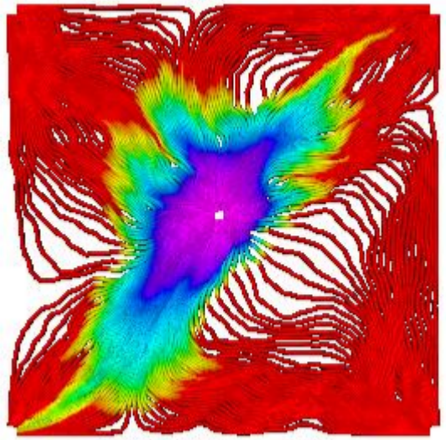
Courtesy of Chevron Petrel Help

QC is key

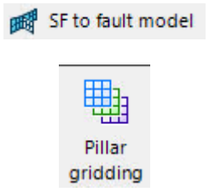
- Thoroughly check the **VBM structural model**
- **Visually inspect** the grid produced in Petrel
- **Confirm expected dynamic behavior** with streamlines/flow simulator

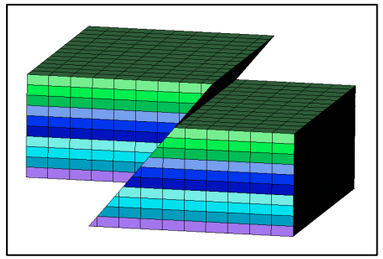






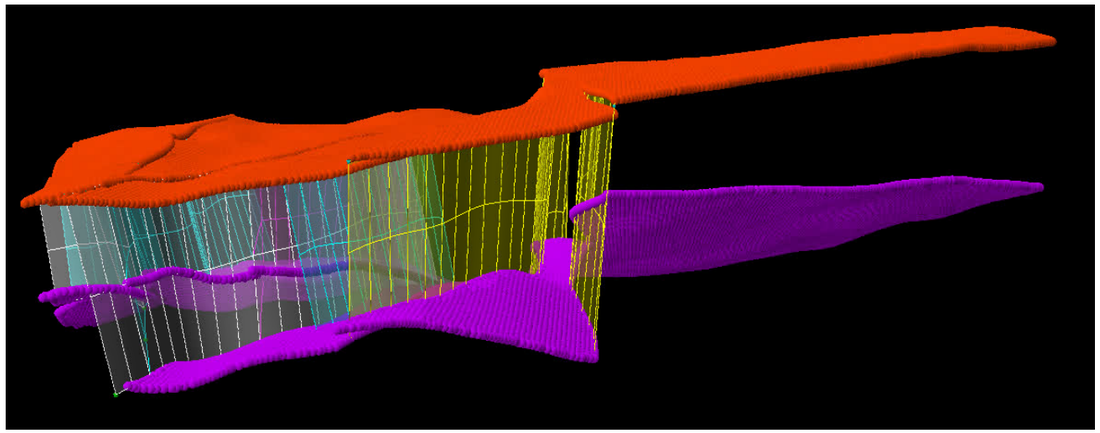
Courtesy of Alvaro Rey and Suksang Kang





All the steps need to be checked:

- **Simplify your VBM structural model**: remove crossing, dying faults, ‘verticalize’ dipping faults in contact with others, possibly removing faults with small displacement
- **Create and edit pillars**: pillars only between top and bottom. Edit edge of the faults. Check skeletons.
- Make sure the distance around the faults is large enough to account for possible **horizon points ‘on the wrong side’**, especially after editing pillars. Minimum curvature may provide better results.
- **Visually inspect** the grid produced in Petrel
- **Confirm expected dynamic behavior** with streamlines/flow simulator



Opening thoughts

VBM is a fundamental technology which could have a wider footprint

- Pillar grids are still the recommended default
- Needs to be **less 'modeler oriented'**
  - Less parameters
  - More editing tools
  - Strong core supporting sparser interpretation
- Continue **integration with dynamic workflows**
  - **Open API**
  - Leveraging INTERSECT power
- Progress **integration with modern digital methods**
  - Leveraging the cloud: reduce computation time/impact on users?
  - Automatic set up to use interpretation coming from machine learning algorithms
  - Integration on DELFI platform

Acknowledgements

Thank you :

- to my Chevron colleagues: Tom Specht, Maisha Amaru, Sebastien Bombarde, Petrel Help, the Reservoir & Production Engineering group
- to the Schlumberger team: Martyn Beardsell, the VBM team and the others who helped me build Petrel knowledge