# Cake & Discuss The Grid

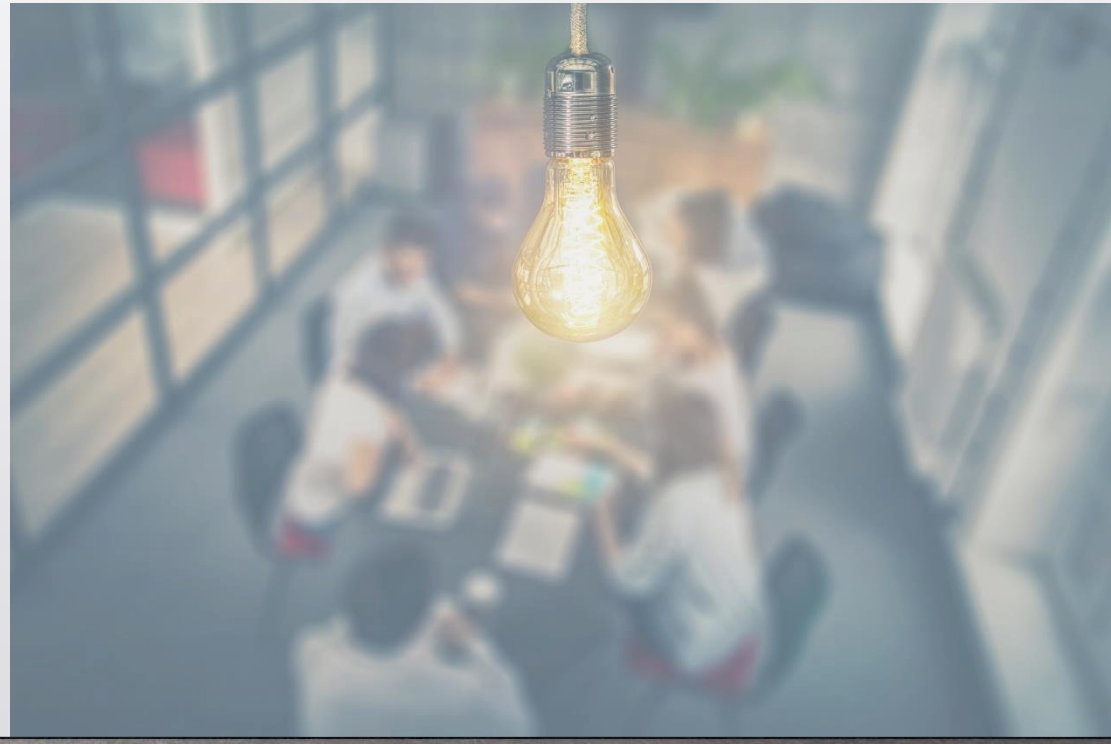
Organization Committee

Sonja Kuhlmann

Marine Seignole

Olso facilitator

Camilla Oftebro



# HSE & Other Practicalities

# Welcome to "Cake & Discuss"

- *13 April: The Structural Framework*
- **22 August: The Grid**
- 7 November

Session 3
The Property Model

Session 4
The Uncertainty Study

# Welcome to “Cake & Discuss”

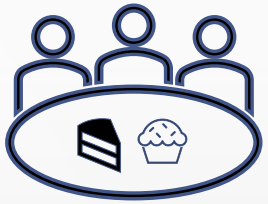
- Fundamental spirit of FORCE
  - Cooperative forum
  - Facilitate cooperation within the industry

- Group discussions
  - Discussion based on impulse talk
  - Small group: Mix of experience and expertise
  - Summary session

# How this works

- Divide audience into groups
- Get to know your group
- Each group chooses a discussion keeper
- “Impulse” talks round today's topic
- Discussion time after talk
  - Have you seen this?/What’s your best practice? ….
- Round the room: each group present findings (first round introduce your group)
- In total 3 impulse talks and follow-up discussion in groups and presentation to other groups
- Closeout and time to mingle and talk
- Enjoy food and drinks throughout the afternoon

| Time | Duration | Activity |
|---|---|---|
| 12:30-12:50 | 20 min | Sort groups<br>Intro to concept<br>Guidelines |
| 12:50-13:15 | 25 min (10+15) | Get to know your group<br>Choose discussion leader<br>Presentations “who is here today” |
| 13:15-13:20 | 5 min | 1. “Impulse” talk |
| 13:20-14:00 | 40 min (20+15+5) | Group discussion<br>Presentations and overall discussion |
| 14:00-14:05 | 5 min | 2. “Impulse” talk |
| 14:05-14:45 | 40 min (20+15+5) | Group discussion<br>Presentations and overall discussion |
| 14:45-14:50 | 5 min | 3. “Impulse” talk |
| 14:50-15:30 | 40 min(20+15+5) | Group discussion<br>Presentations and overall discussion |
| 15:30-15:50 | 20 min | Closeout / feedback |



# The groups

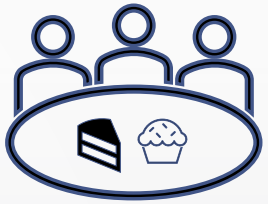
| Group 1 | Group 2 | Group 3 | Group 4/5 |
|---|---|---|---|
| Anniken | Chris | Ayman | Andreas |
| Carlos | Fredrik | Dylan | Camilla |
| Malgorzata | Silje | Sarah | Jamie |
| Sabahattin | Stine | Øystein | Joanna |
| Natalie | Thomas | | Kenneth |
| | | | Laslo |

# Choose a discussion keeper

- Role:
  - Make sure everybody in the group gets talking time
  - Time keeping
  - Make sure the key ideas are on the flip chart
  - Find a presenter to other groups- 1 presenter per impulse talk
  - When problems are raised
    - -> probe for solutions
    - -> keep the discussion going
  - TAKE A PICTURE OF YOUR FLIP CHART / SHARE YOUR PPT
    - Send it to marine.seignole@akerbp.com

# The Grid - Impulse talk topics

- Fit for purpose?
- RE perspective: stair-stepped grids
- Geomechanical grids



# Impulse talk 1

# Fit for purpose?

- What is the purpose?
  - **The** field model?
  - Ever green model?


- What fit mean
  - Size - scale
  - Complexity
  - Timeline

- Modeling for comfort ?

# Group - Notes

- TAKE A PICTURE OF YOUR FLIP CHART
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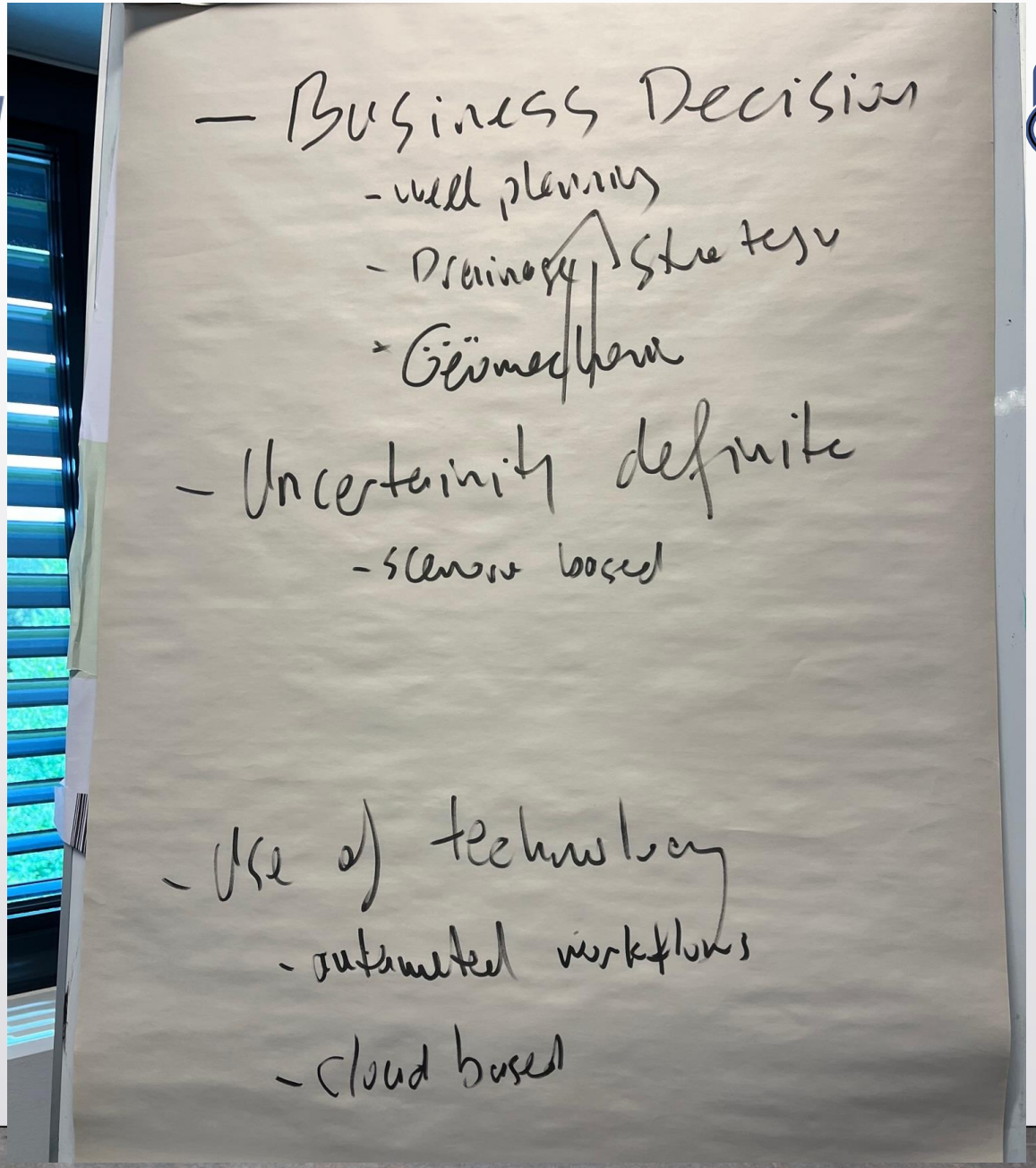
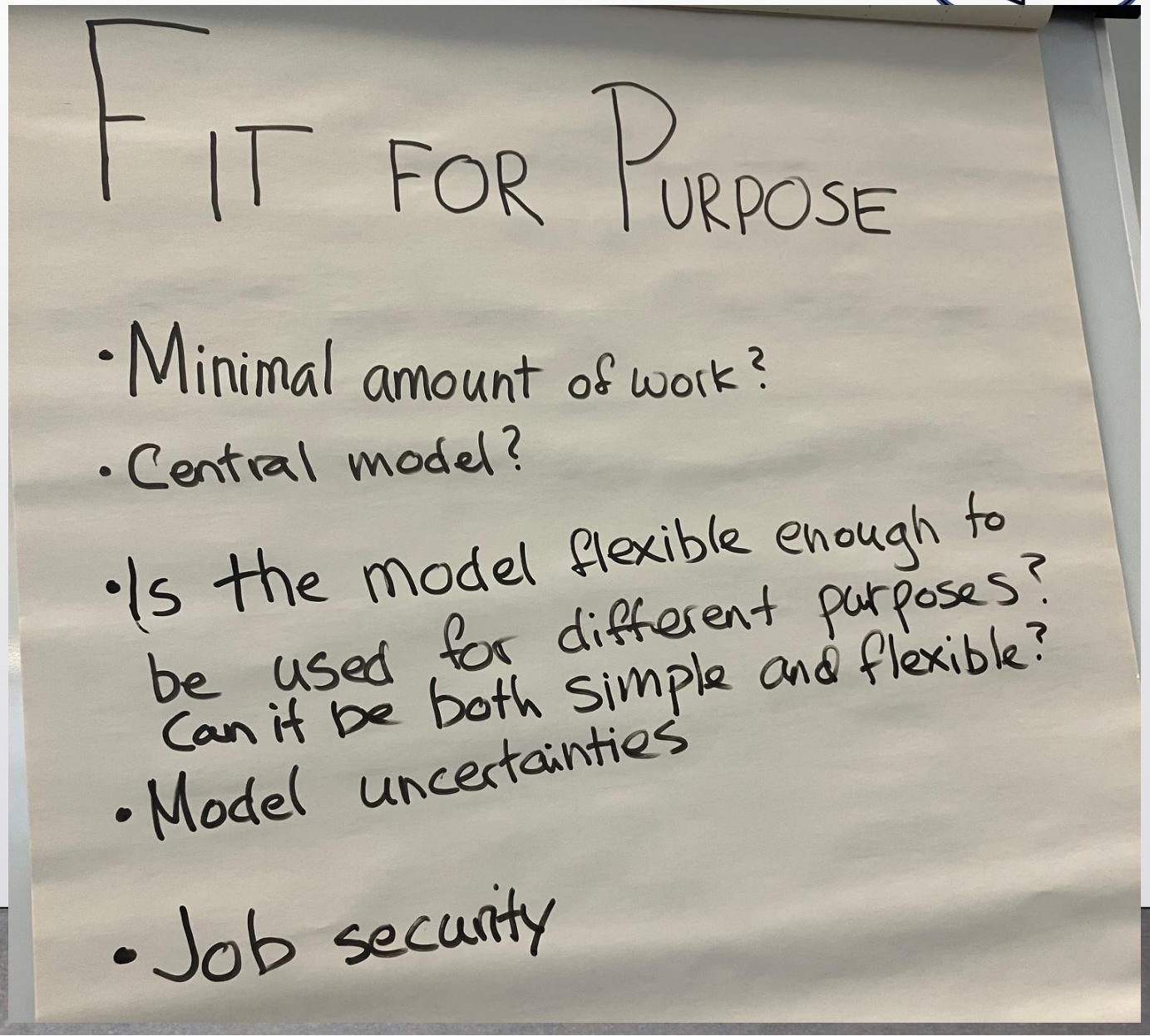
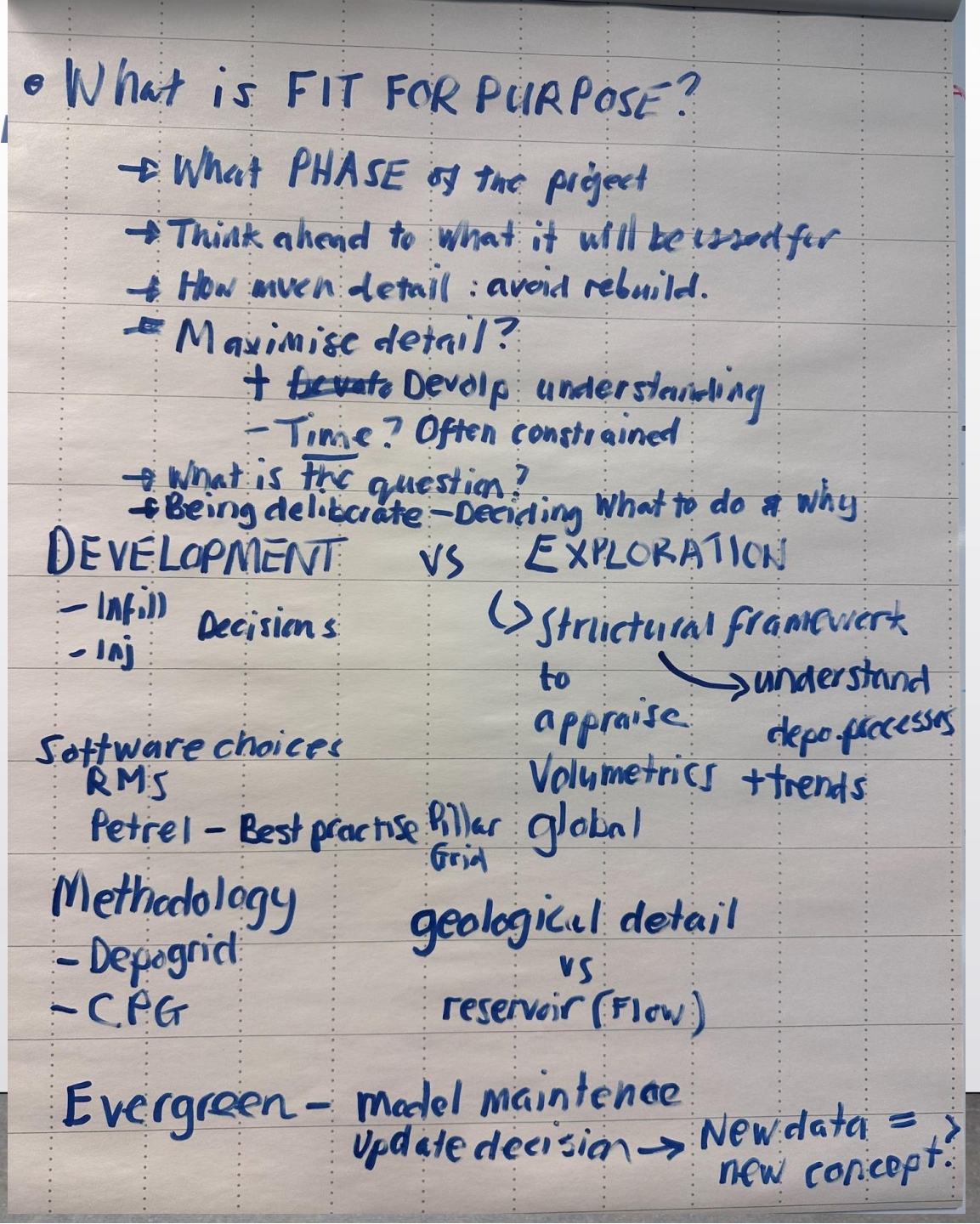
# group1


– Business Decision
- well planning
- Strategy
- Geometheria
– Uncertainity definite
- scenario based
– Use of technology
- automated workflows
- cloud based

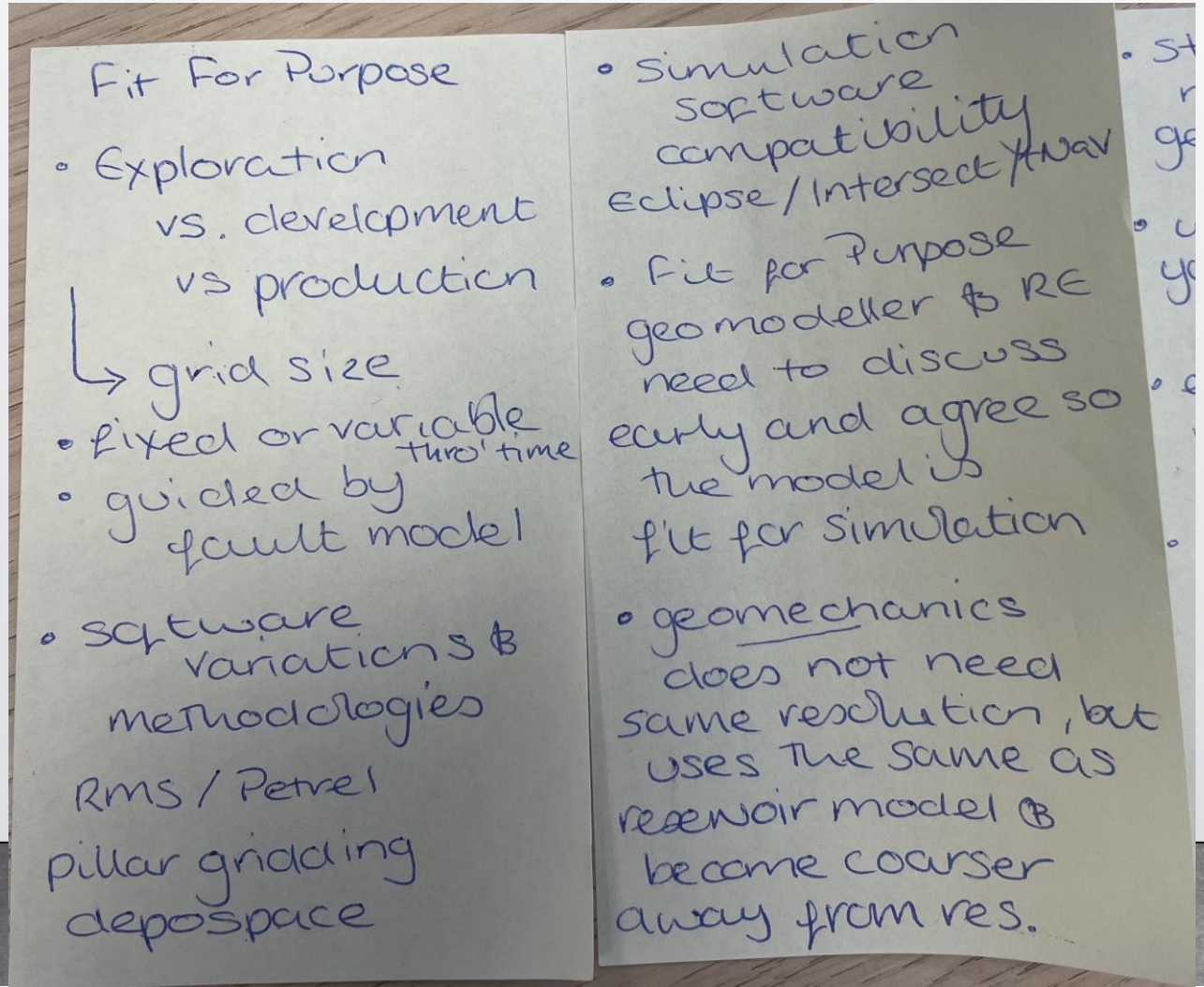
# Group 2

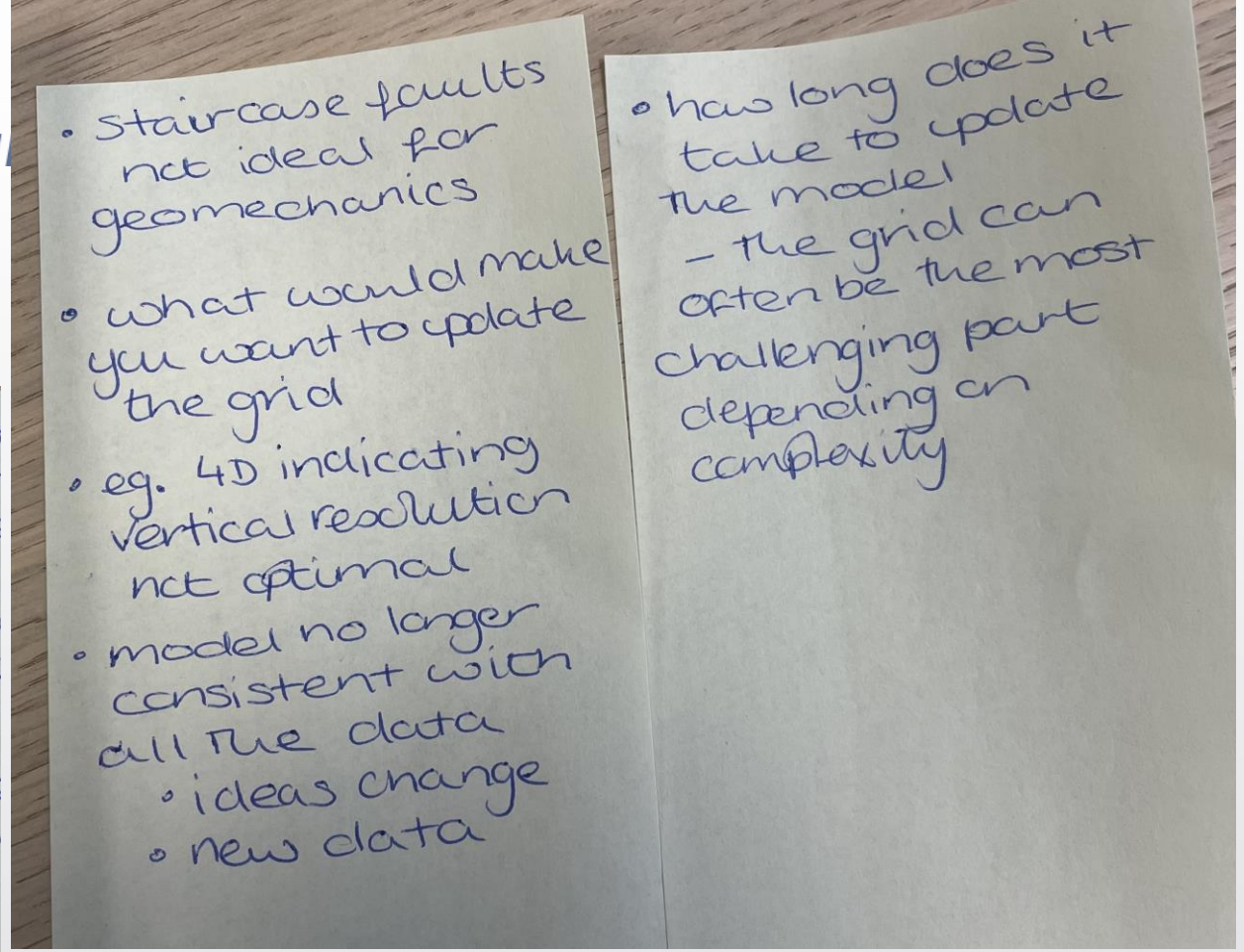

FIT FOR PURPOSE
• Minimal amount of work?
• Central model?
• Is the model flexible enough to be used for different purposes? Can it be both simple and flexible?
• Model uncertainties
• Job security

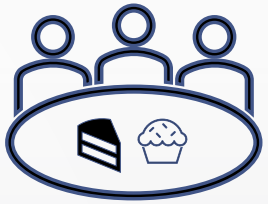
# Group 3


What is FIT FOR PURPOSE?
What PHASE of the project
Think ahead to what it will be used for
How much detail : avoid rebuild.
Maximise detail?
+ Develop understanding
- Time? Often constrained
What is the question?
Being deliberate - Deciding what to do & why
DEVELOPMENT vs EXPLORATION
- Infill
- Inj
Decisions
Structural framework
to
appraise
Volumetrics
understand
depo processes
+trends
Software choices
RMS
Petrel - Best practise
Pillar Grid
global
Methodology
- Depogrid
- CPG
geological detail
vs
reservoir (Flow)
Evergreen - model maintenace
Update decision
New data = new concept?

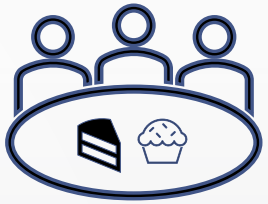
# Group4


Fit For Purpose
• Exploration
vs. development
vs production
↳ grid size
• fixed or variable thro' time
• guided by fault model
• software variations & methodologies
RMS / Petrel
pillar gridding
depospace
• simulation software compatibility
eclipse / Intersect / Nav
• Fit for Purpose
geomodeller & RE
need to discuss
early and agree so
the model is
fit for simulation
• geomechanics
does not need
same resolution, but
uses the same as
reservoir model &
become coarser
away from res.


• staircase faults
not ideal for
geomechanics
• what would make
you want to update
the grid
• eg. 4D indicating
vertical resolution
not optimal
• model no longer
consistent with
all the data
• ideas change
• new data
• how long does it
take to update
the model
– the grid can
often be the most
challenging part
depending on
complexity

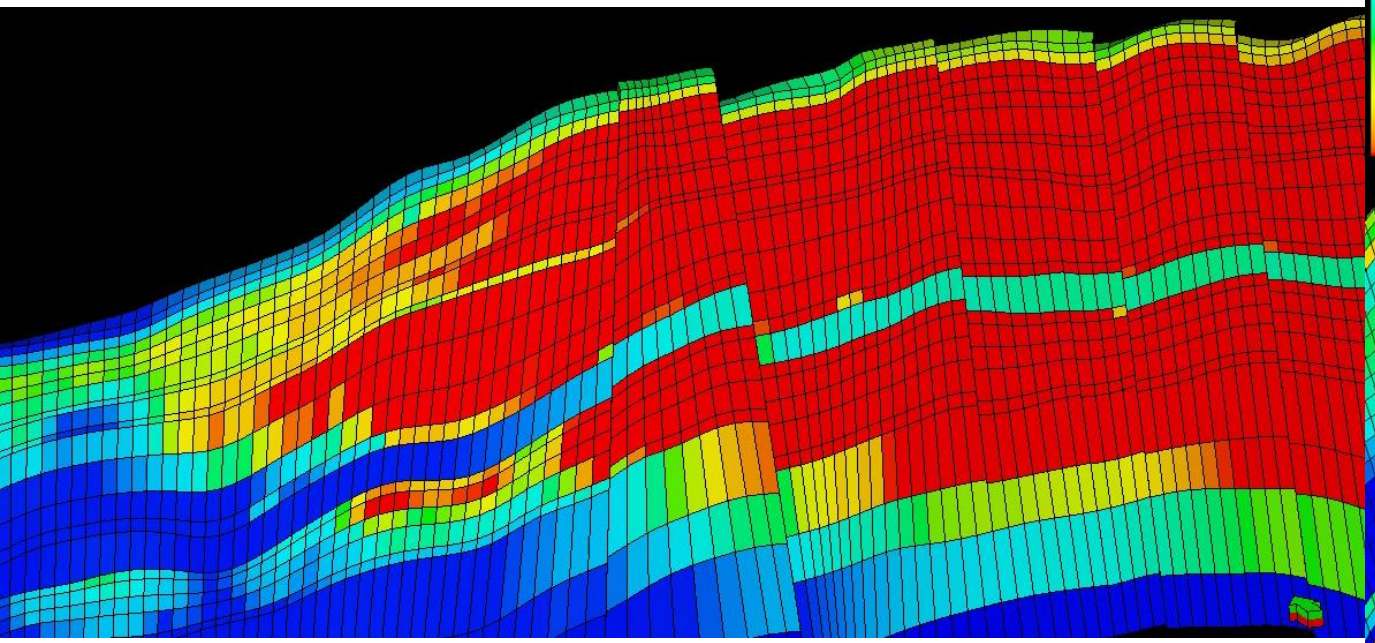


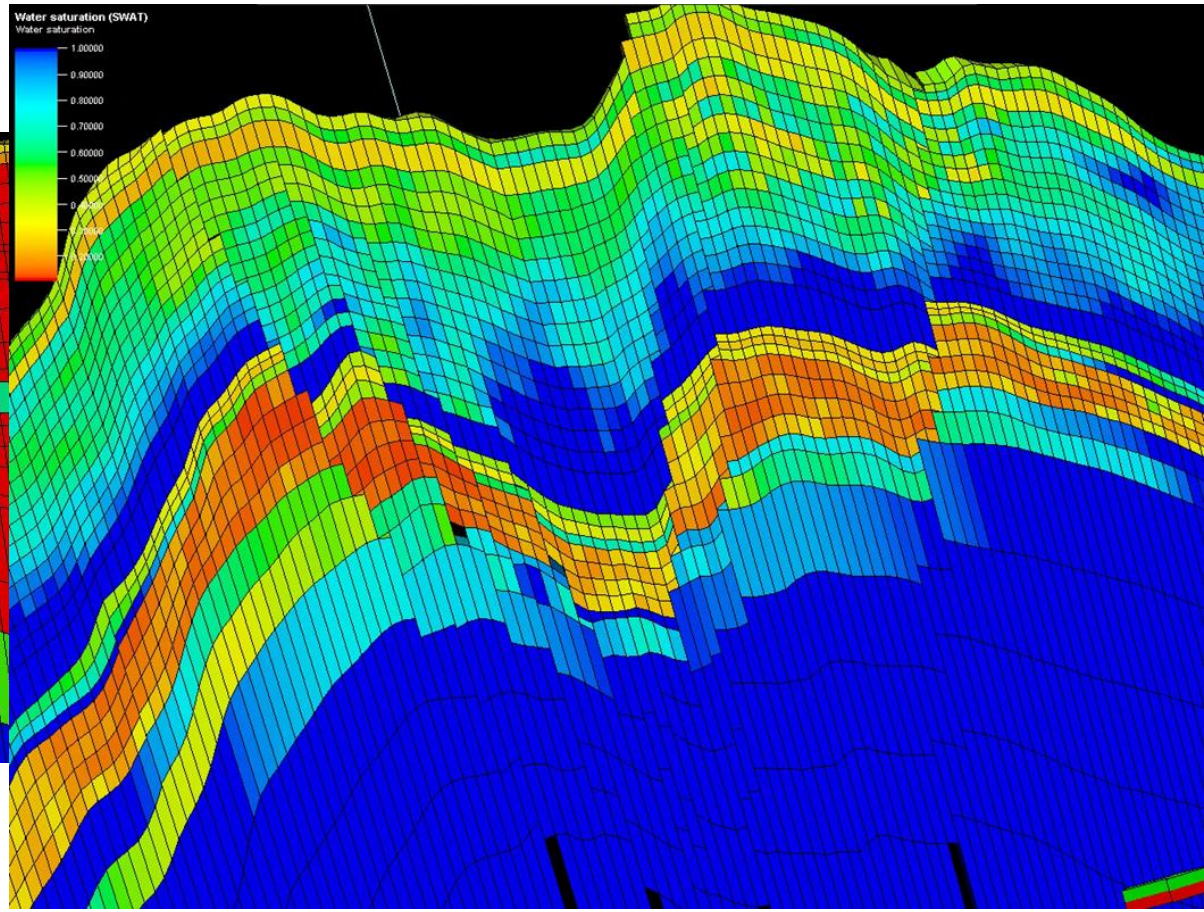
# Impulse talk 2

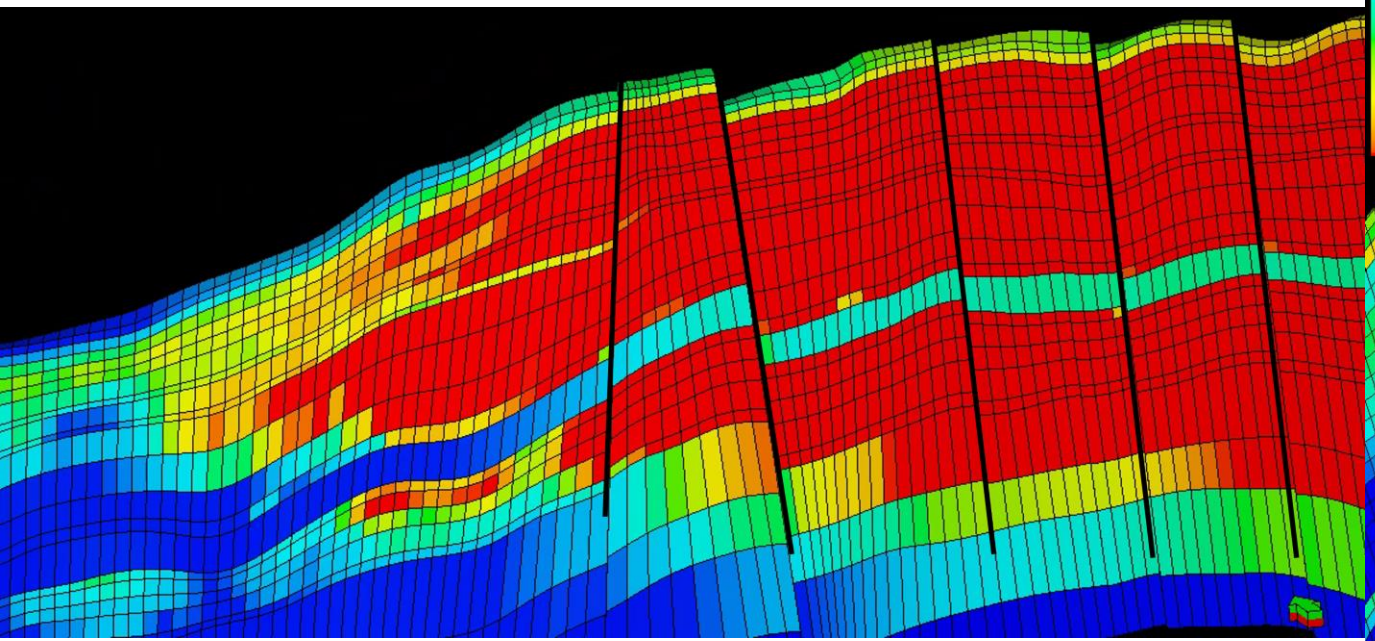


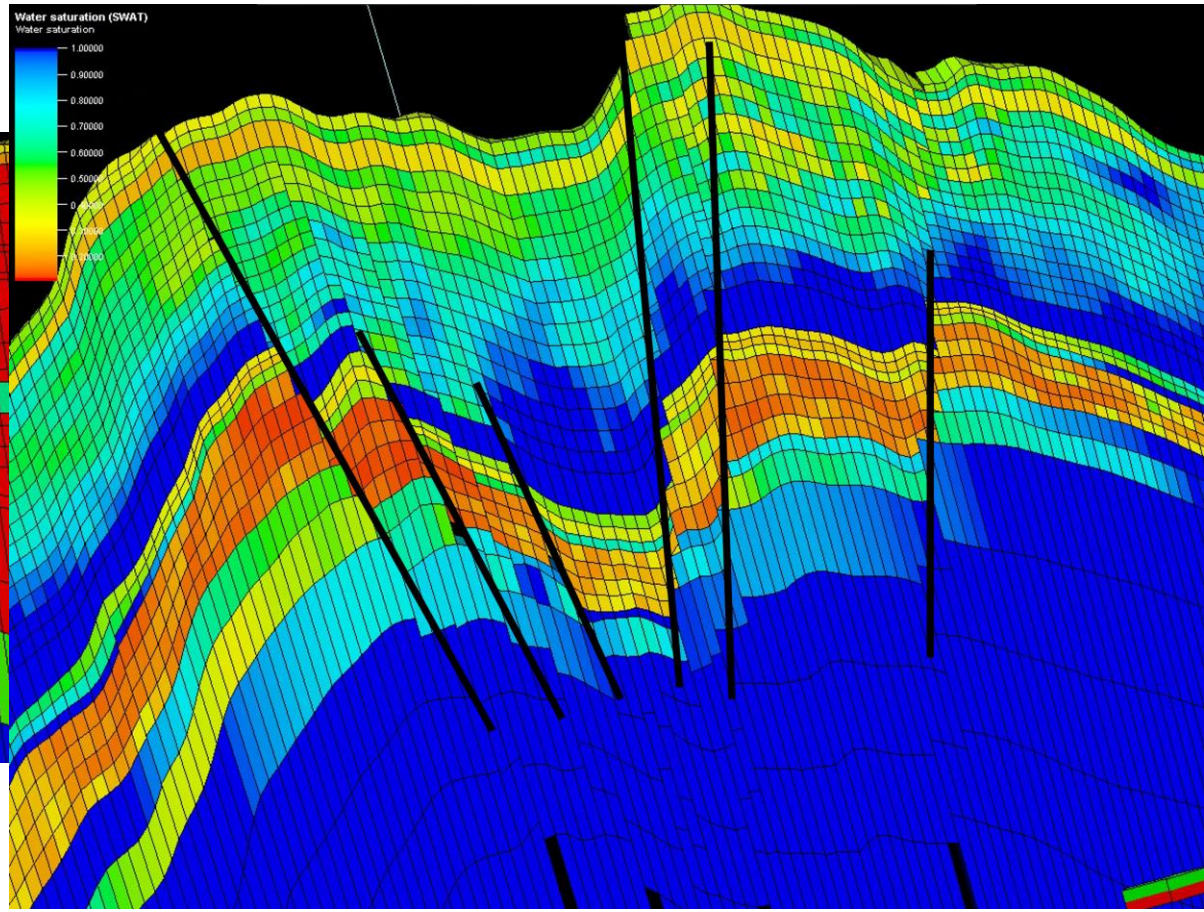
# RE perspective

- Stair-stepped faults

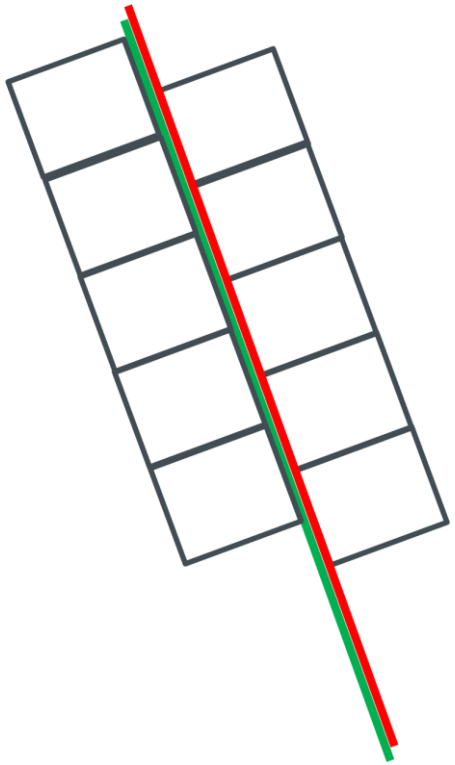



Water saturation (SWAT)
Water saturation
1.00000
0.90000
0.80000
0.70000
0.60000
0.50000




Water saturation (SWAT)
Water saturation
1.00000
0.90000
0.80000
0.70000
0.60000
0.50000

## Pillar



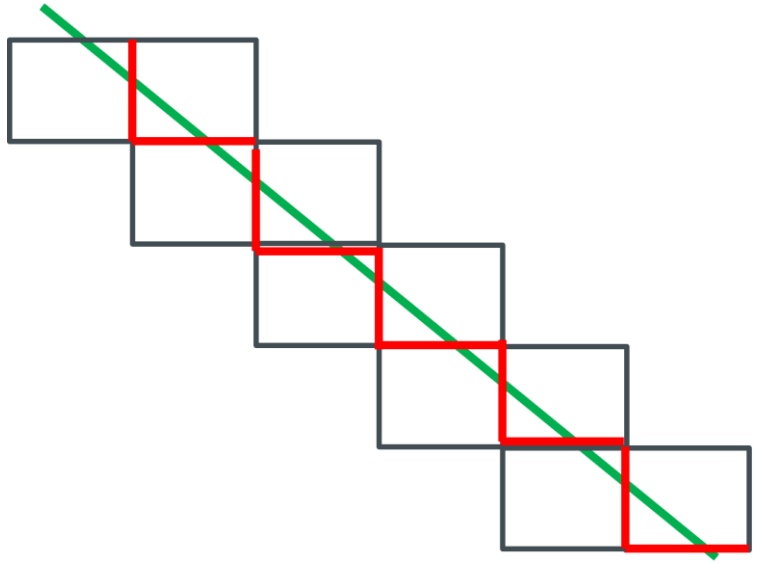
Transmissibility simplified:

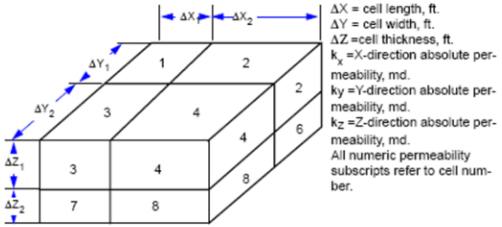
$$Tx = \frac{Kx * Ax}{Lx}$$

$$Ty = \frac{Ky * Ay}{Ly}$$

$$Tz = \frac{Kz * Az}{Lz}$$

## Stair-step

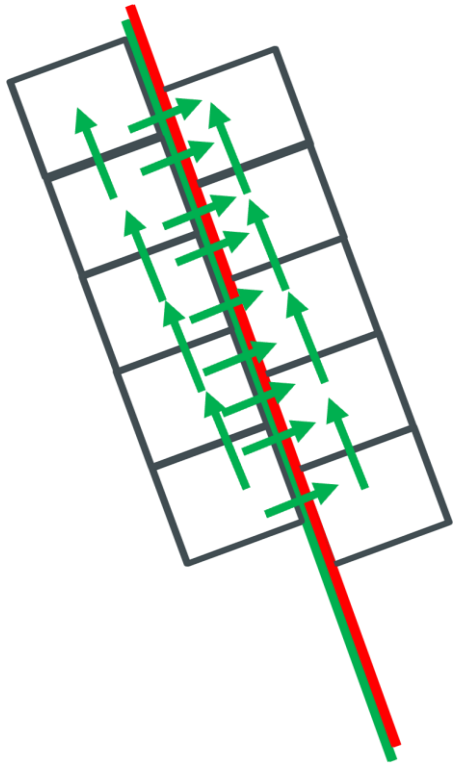





$$AX(2) = \frac{0.00633 K_{x1} K_{x2} \Delta Y_1 \Delta Z_1}{(5.61458)(0.5)(K_{x1}\Delta X_2 + K_{x2}\Delta X_1)}$$

$$AZ(8) = \frac{0.00633 K_{z4} K_{z8} \Delta X_2 \Delta Y_2}{(5.61458)(0.5)(K_{z4}\Delta Z_2 + K_{z8}\Delta Z_1)}$$

**Pillar**



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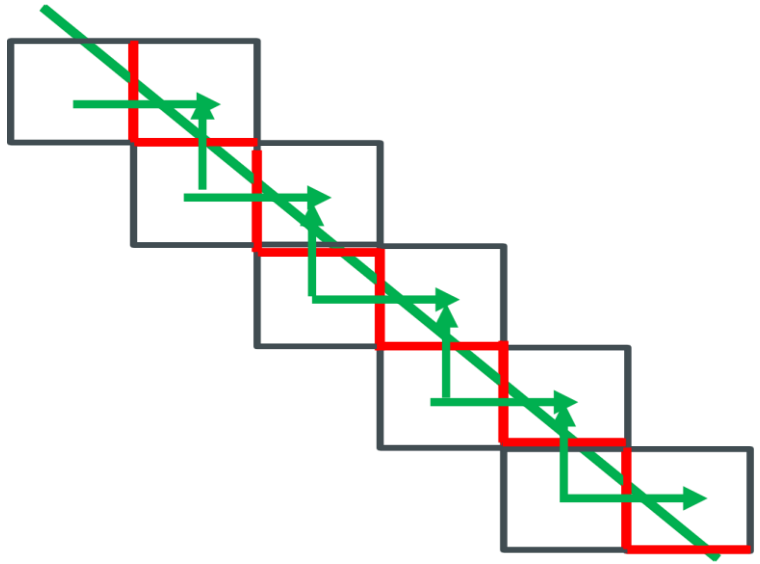

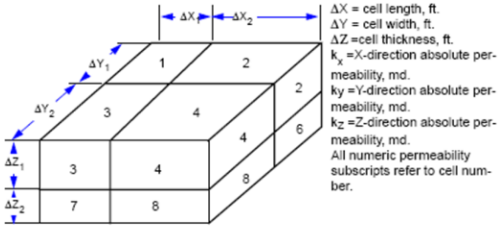


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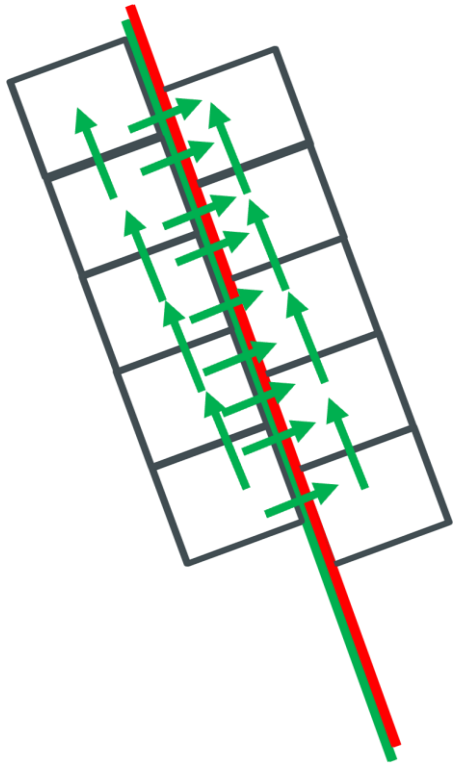
## Pillar

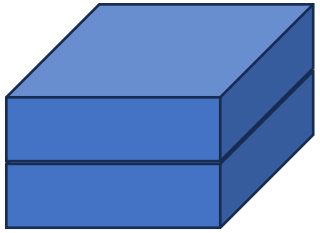


Transmissibility simplified:

$$Tx = \frac{Kx * dy * dz}{dx}$$

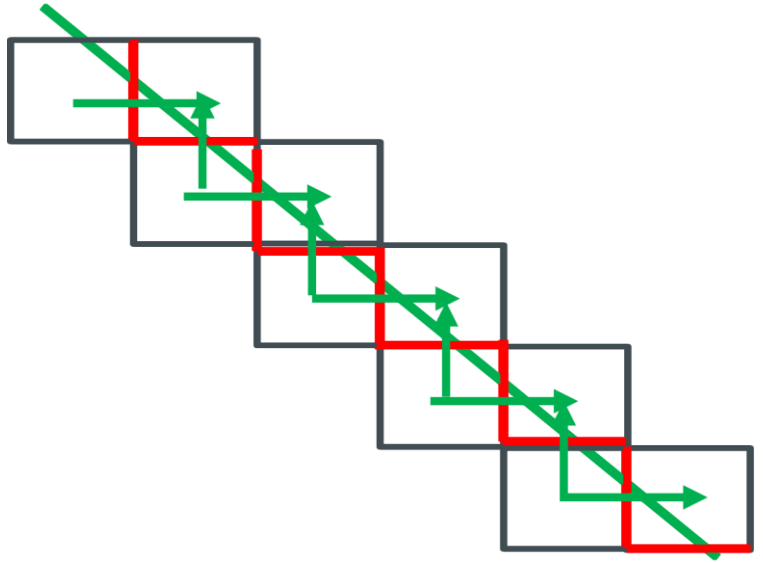
$$Ty = \frac{Ky * dx * dz}{dy}$$

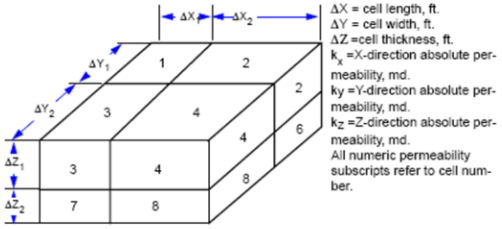
$$Tz = \frac{Kz * dx * dz}{dz}$$



kx=ky=kz= 1 md
dx = Lx = 50 ft
dy = Ly = 50 ft
dz = Lz = 10 ft

## Stair-step



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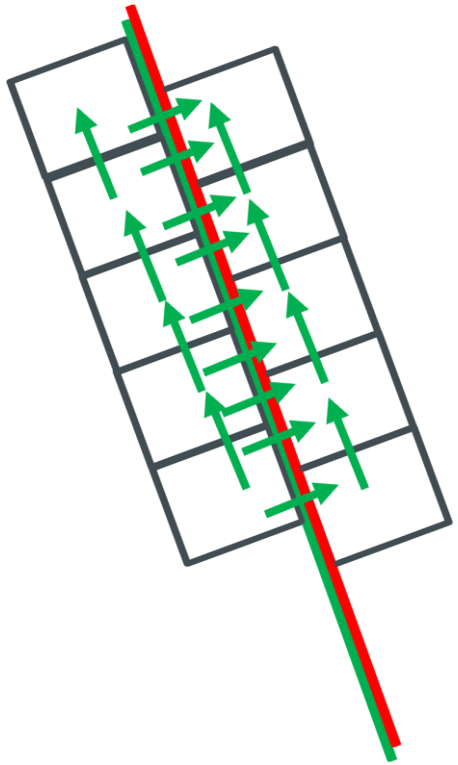
## Pillar

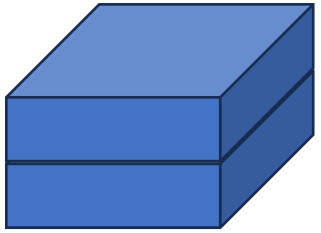


Transmissibility simplified:

$$Tx = \frac{1 * 50 * 10}{50}$$

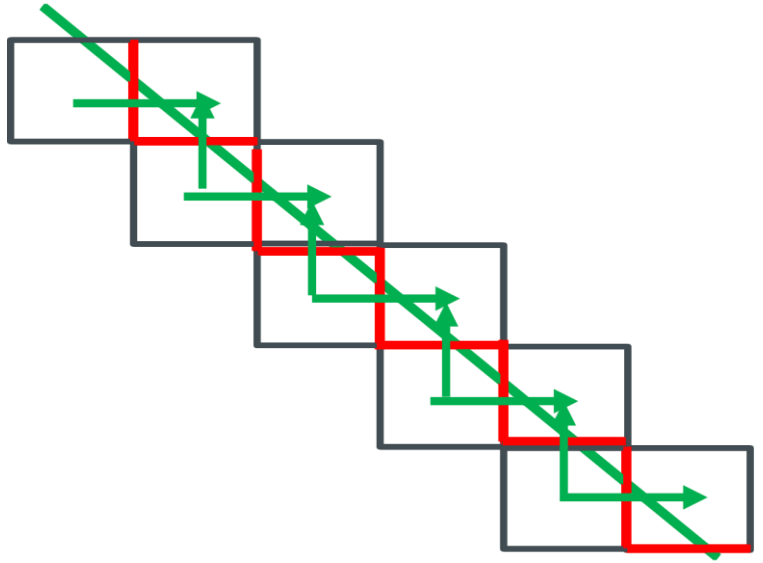
$$Ty = \frac{1 * 50 * 10}{50}$$

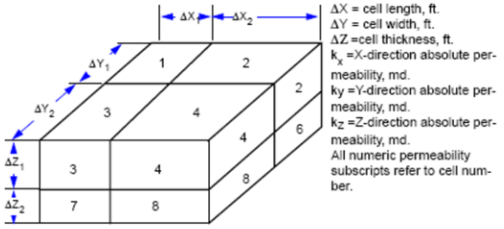
$$Tz = \frac{1 * 50 * 50}{10}$$



kx=ky=kz= 1 md
dx = Lx = 50 ft
dy = Ly = 50 ft
dz = Lz = 10 ft

## Stair-step



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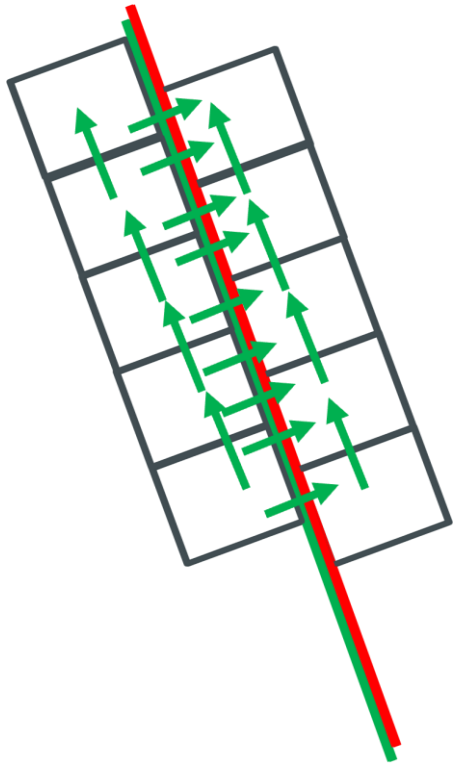
**Pillar**

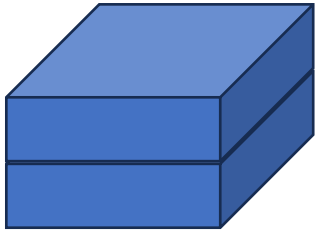


Transmissibility simplified:

$$Tx = 10\ md.ft$$

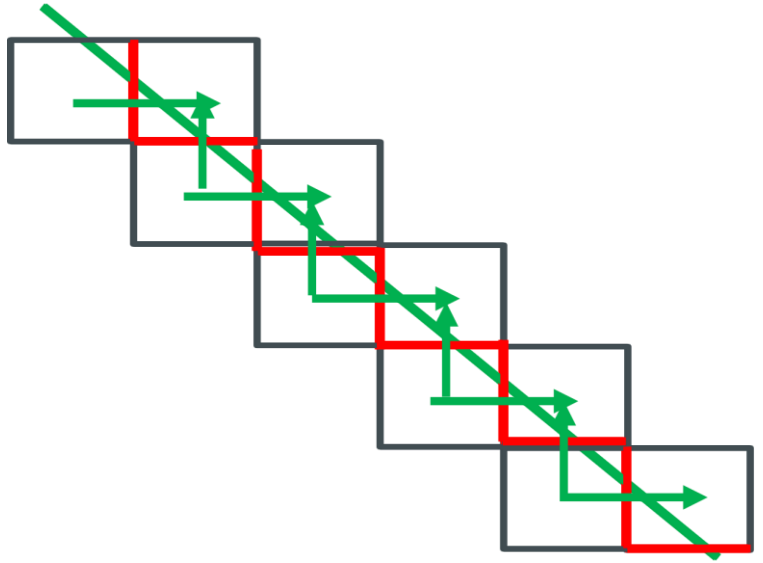
$$Ty = 10\ md.ft$$

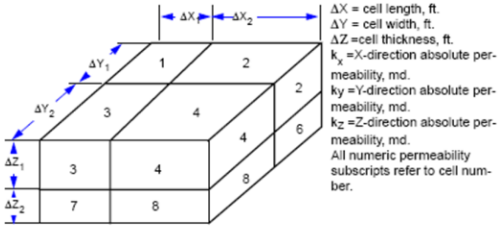
$$Tz = 250\ md.ft$$



kx=ky=kz= 1 md
dx = Lx = 50 ft
dy = Ly = 50 ft
dz = Lz = 10 ft

**Stair-step**



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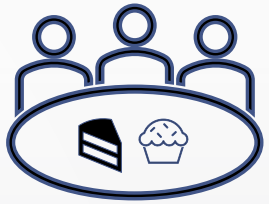
*Stair steps makes it more difficult to understand the dynamic behaviour of a fault*



- Simplifying is not good for geo-mechanical modelling
- Why staircase faulting? Do you need it?
- Build your model with pillar faults and do necessary simplifications to the faults
- What is the error using staircase faulting in dynamic model/history matching

# Group - Notes

- TAKE A PICTURE OF YOUR FLIP CHART
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# Group 1

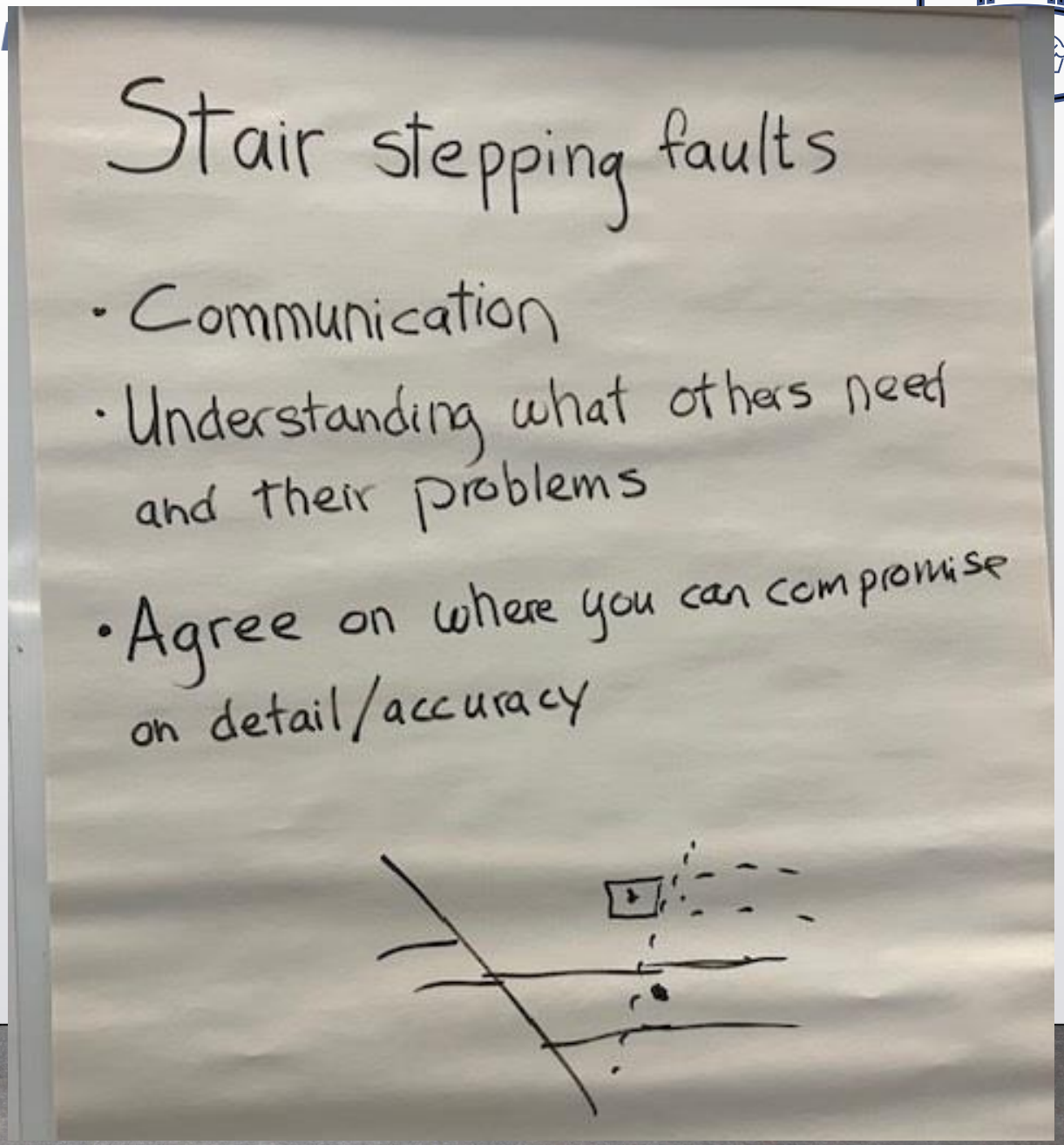
(1) Stair step (and zig zag) related to software efficiency from 20 years ago! Is it necessary today?

(2) Understanding between geologist and RE from beginning is fundamental

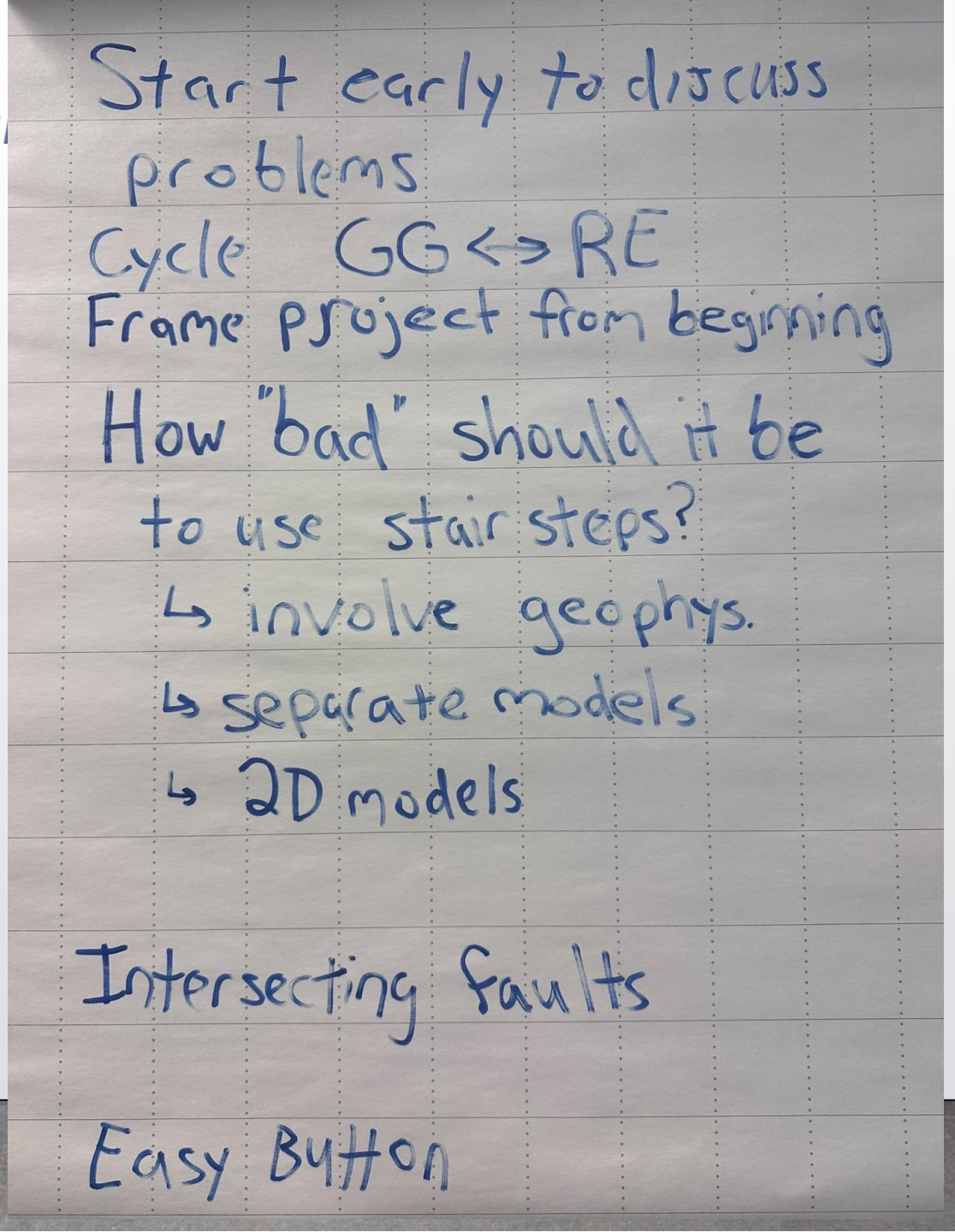
(3) What is the purpose of history matching? Understanding flow vs "matching numbers"

(4) Fault transmissibility is uncertain itself because we lack real data

# Group 2


Stair stepping faults
• Communication
• Understanding what others need and their problems
• Agree on where you can compromise on detail/accuracy

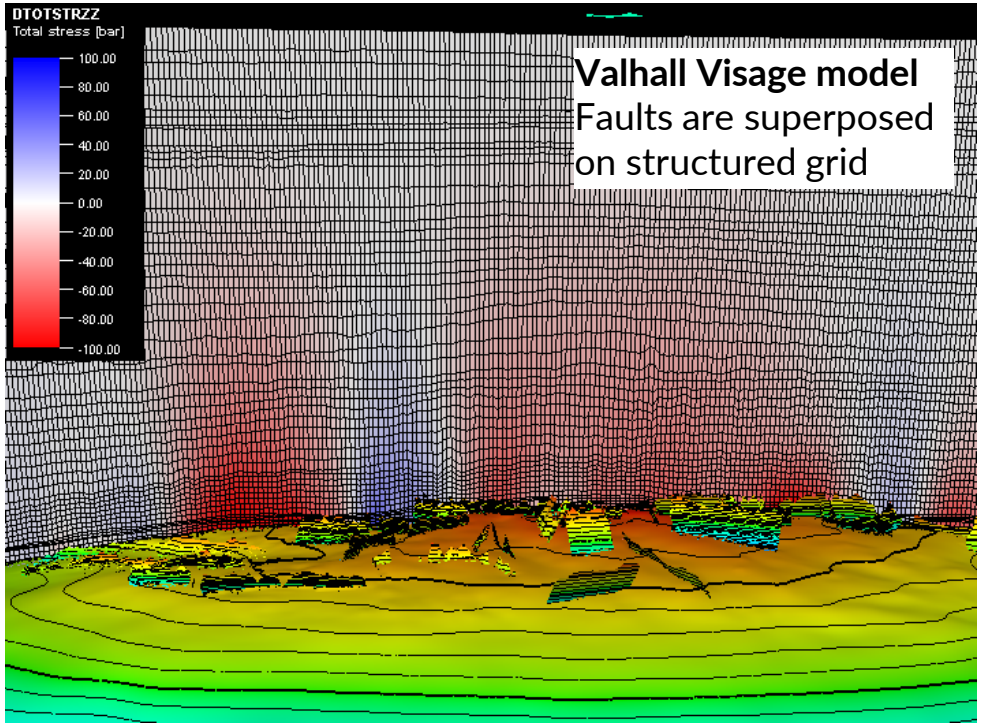
# Group 3


Start early to discuss problems
Cycle GG ↔ RE
Frame project from beginning
How "bad" should it be to use stair steps?
↳ involve geophys.
↳ separate models
↳ 2D models
Intersecting faults
Easy Button

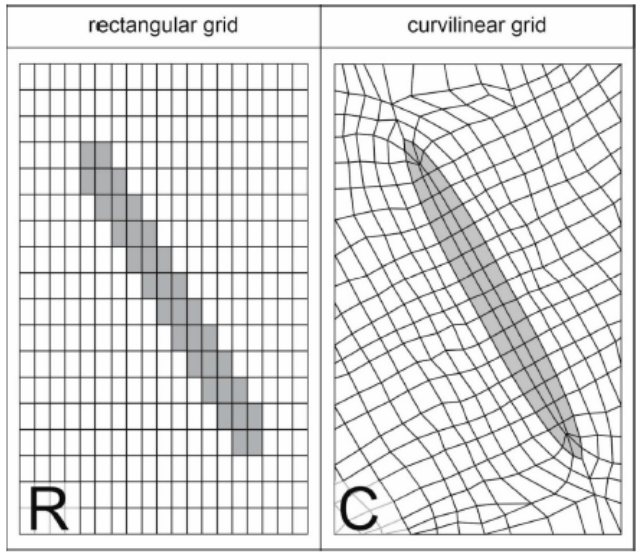
# Impulse talk 3

# Geomechanical grids

- Why do we need geomechanical models?
  - **Well intergrity** issues at high depletion in reservoir and overburden (**chalk reservoirs**, **HPHT**)
  - **Caprock integrity** issues, fault re-activation (**CCS**)
  - Interpretation of **4D seismic**
- Can we use a structured geogrid?
  - Structured grids are practical and efficient
  - Accurate fault modelling requires unstructured grid, but is the accuracy needed?
  - Geomechanical grids include overburden, sideburden, and underburden
- Geomodellers, reservoir engineers, geomechanics engineers interactions
  - When
  - How
  - What input




Unstructured grids for fault modelling




Treffeisen and Henk, 2020

# Group - Notes

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# Feedback

- Format
- Session length
- Satellite location
- Session topics
- Other feedback

# Next dates

- 7 November

Session 3
The Property Model

Session 4
The Uncertainty Study

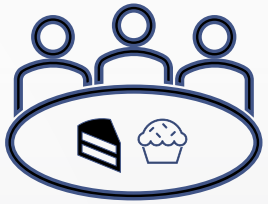
# Feedback

- 16 forms received: 10 Stavanger – 5 Oslo – 1 Teams
- Very consistent feedback from all

- Format
  - All positive: ok (2) / nice (1) / good (5) / like (2) / very good (4) / excellent (2)
  - Participant emphasized that they liked the informal setting
- Session length
  - Majority was ok as it was (1 person found it too long – 2 would be interested in a full day)
  - Suggestion to include some 5min breaks for all
  - A bit rushed at the end
    - Suggestion for time issues: skip the group discussion, and have one in plenum only. Especially for a topic where few have a lot of experience/knowledge

# Feedback

- Satellite location
  - Worked well for participants in Stavanger ("just another group")
  - Participants in Oslo liked it but had a little difficulty to hear everybody in the Stavanger meeting room
- Session topics
  - In general participants found the topics interesting and well chosen
    - One participant was disappointed and wants more focus on how to fix problems
  - It was an opportunity to learn new things
  - Bringing in less typical topics like geomechanics was interesting
    - With little experience in the group it can be difficult in the small group to get discussion started
  - Suggestions to maybe know the topics of the impulse talks at registration



# Feedback

- Other feedback
  - Good forum for discussions
  - Get people from other companies involved
  - Keep going with more sessions and keep hybrid location option
    - Meeting people in person is an important aspect, so joining via teams should be exception
  - The cake was good