Resoptima

OVERCOMING THE SEVEN WASTES OF RESERVOIR MODELLING PROJECTS
Potential of improved reservoir management

**How do we unlock additional 1 trillion barrels of oil equivalents?**

1. Maximizing reservoir potential
   2–5% increase in ultimate recovery

2. Maximizing value from existing wells
   10–15% production increase

3. Maximizing value from new wells
   15% increase in production from infill wells

4. Production network optimization
   5–10% production increase

5. Integrated planning and delivery

6. Performance management and organizational health

7. Technological game changers and key enablers (eg, digital)

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McKinsey & Company

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Reservoir modelling

THE CHALLENGE

Static data
- Seismic surveys
- Well cores
- Well logs
- Geological analogues

Millions of unknowns
- Structure
- Facies
- Petrophysics
- Water saturation
- Rel.perm
- PVT

Dynamic data
- DST
- RFT/PLT
- Production data
- 4D Seismic
Reservoir modelling = inverse problem!

We should not create reservoir models and hope they eventually fit the data (i.e. solve a “forward problem”)…
Reservoir modelling = inverse problem!

...instead data should be used to gain a better understanding of the unknown reservoir properties (i.e. solve the "inverse problem")
The 7 Wastes of Reservoir Modelling Projects

**Non-utilized Talent**
Underutilizing people’s talents, skills, and knowledge

**Defects**
Rework, repetition, scrap and incorrect information

**Loss of Information**
Communication failures and overlooked data

**Overspecialization**
Overspecializing in a particular skill at the cost of competence in complementary skills and holistic experience

**Handoffs and Delays**
Working in silos and wasted time waiting for the next step in the process

**Relearning and Task Switching**
Loss of time, productivity, and quality due to frequent task switching and continual relearning

**Non-Value Adding Features**
Spending time and energy in features and activities that add no significant value and are not worth the investment
Resoptima’s technology solution

A FAST, INTEGRATED AND ITERATIVE APPROACH

Seismic
Well logs
Production data
4D seismic

Assimilate all data
Curate Data
Define Boundaries
Refine concepts

ResX
Uncertainty-centric modelling
Data conditioning

Ensemble of models

Pivot or persist?
Explore opportunities

IRMA
Ensemble Analytics
Decision support
Risk mitigation

Improve understanding
Measure predictability

Field development Opportunities
IOR Prospects
Predictive analytics
Portfolio Insights
Reservoir modelling using ResX:

TRAINING A MULTI-LEVEL GRAPH NETWORK*

- Reservoir physics defines graph relationships
  - Model parameters are easy to interpret
    (no black box!)

- ResX: Training the graph network
  - Fit for purpose machine learning algorithms:
    - Principal Component Analysis
    - Gaussian Process Learning (Kriging++)
    - Metric Learning
    - Stochastic Programming
    - Sparse Regression
    - ++++

*See e.g. Google’s DeepMind project (Battaglia et al. 2018: Relational inductive biases, deep learning, and graph networks)
Technology in Action
DATA TO DECISION INPUT WITHIN 24 HOURS
Technology in Action

DATA TO DECISION INPUT

Challenge:
- North sea field, complex geology
- Client had indications that their models and recoverable volume estimates (PDO) were too optimistic (decline analysis)

Solution:
- First results in less than 24 hours:
  - Complete re-modelling (including grid)
  - Minimum Viable Workflow
- Final results in one week:
  - Explore multiple modelling scenarios (grid, etc.)
  - Future predictions

Results:
- Significantly improved history match (all ensemble members)
- Increased confidence (volume estimates)
Technology in action

OBSERVATIONS

Prior
Technology in action

OBSERVATIONS

Posterior
Concluding remarks

INCREASE SUBSURFACE UNDERSTANDING = KEY TO INCREASED RESERVES

Requires a continuous discovery process!