Standardizing Reservoir Modeling Best Practices in Petrel

Successful Implementation of Automated Quality Control Tools

REPSOL

Agenda

1. Timeline
2. Static modeling quality control challenges
3. Business requirements
4. Technical solution
5. Results

Repsol Compromiso Cero Emisiones Netas 2050

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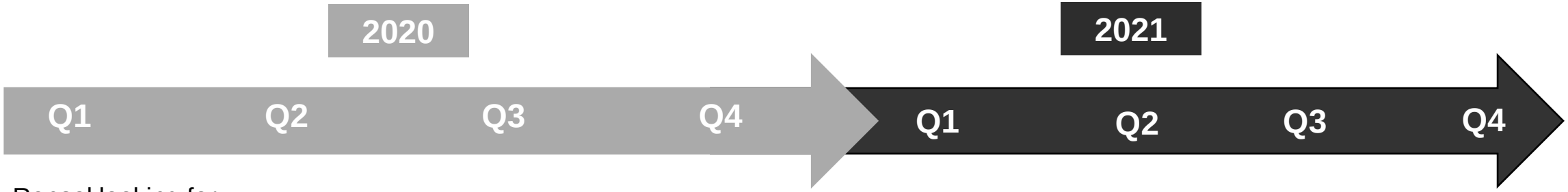
TIMELINE



Repsol looking for solution to tedious QC of Geoscience Data & Models

Had heard about GURU guided workflows

SLB Initially proposed solution with GURU Guided Workflows

but then expanded this solution to customization of tests within the **"Petrel Test & Report Manager"**

Development of Plugin

STATIC MODELING QUALITY CONTROL CHALLENGES

1. TIME-CONSUMING MANUAL TASKS, SEEKING TO STANDARDIZE PROCESSES TO REDUCE USER BIAS

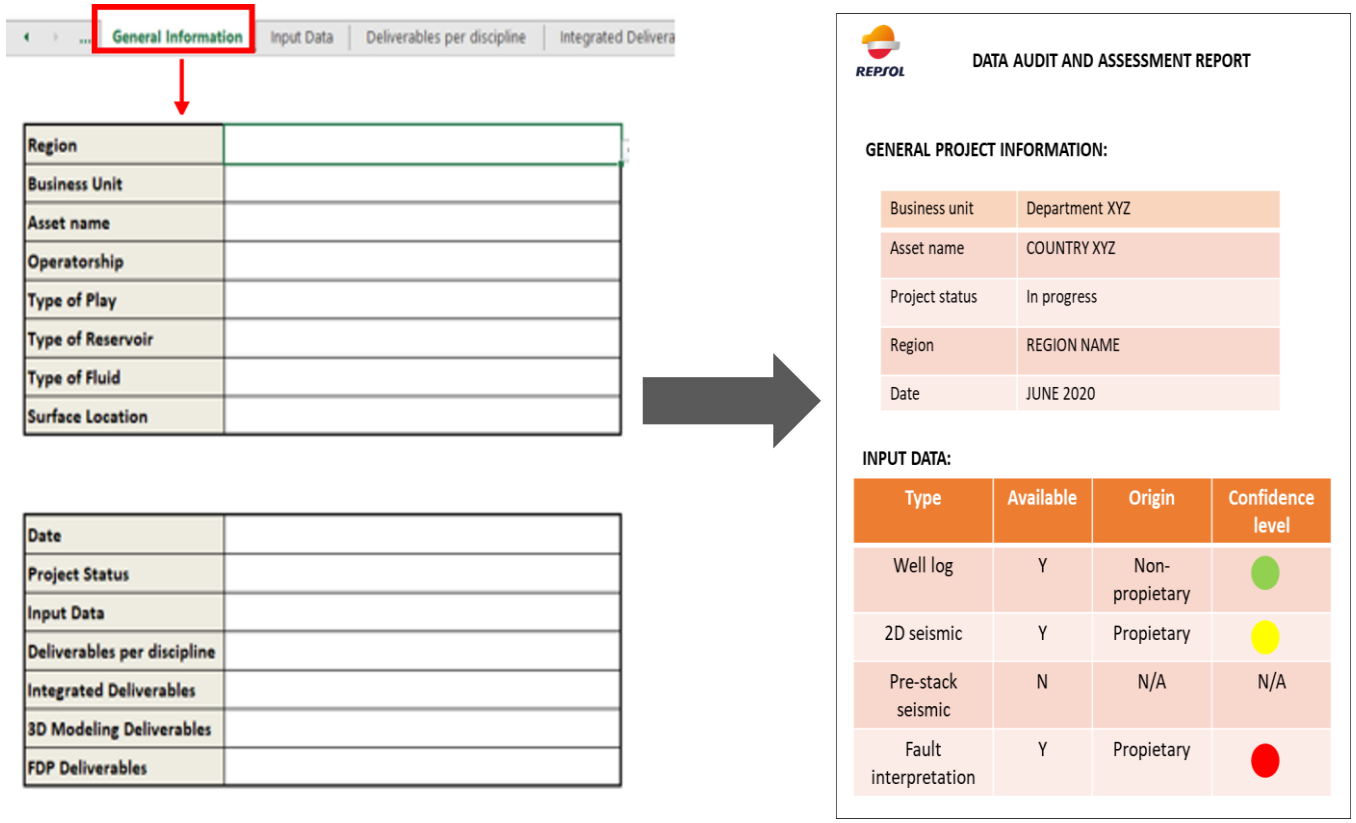
2. CAPTURING AND PRESENTING THE RESULTS OF THE QC PROCESS FOLLOWING THE REPSOL GUIDELINES

3. TO DEVELOP A TOOL THAT INSTANTANEOUSLY RUN AND GENERATE HIGH-QUALITY REPORTS ACCORDING TO REPSOL STANDARDS

BUSINESS REQUIREMENTS

Data audit and assessment tools

- Development of a tool that **automates** and guides the end-user on the elaboration of the 3D static models audit, assessment and report generation

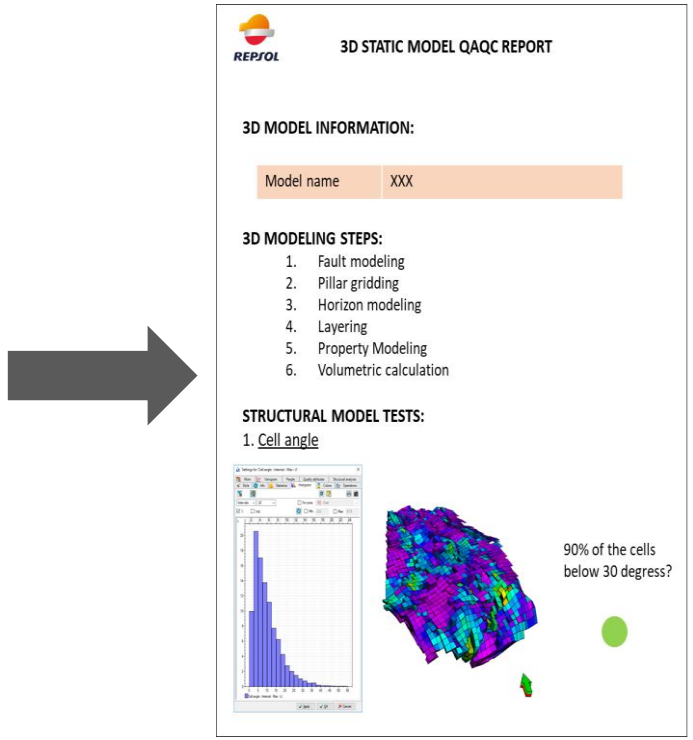


BUSINESS REQUIREMENTS

QAQC 3D static models

- QAQC 3D static models following the methodology defined by Repsol and,
- To generate a final report including a summary of the main modelling steps followed by the geomodeler and the results of the QAQC analysis

QAQC 3D static models
QAQC tests definition for each model construction step
Input data tests
Structural model tests
3D properties tests
Facies
Petrophysics (Phi, Perm, rock type, Sw)
NTG
Volumetrics
Define KPIs for model acceptance (traffic lights)
Quality report design/sketch/outline
QAQC tests outline
Modeling steps outline
Results outline
Quality report build

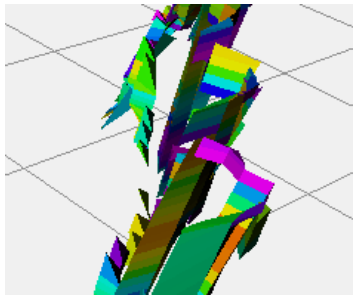


BUSINESS REQUIREMENTS

Type of QCQA Tests

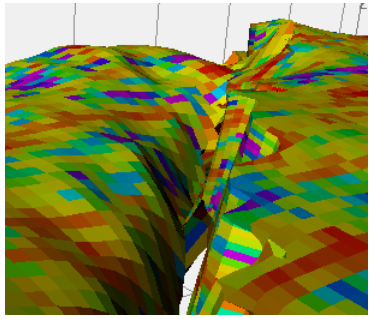
Cell size analysis

QC to honor hard data : Cell size: it should be smaller than average/minimum well spacing.



Fault trajectory/throws

Analyze consistency of the fault trajectory and fault throws for each horizon along the fault (for every surface and fault)

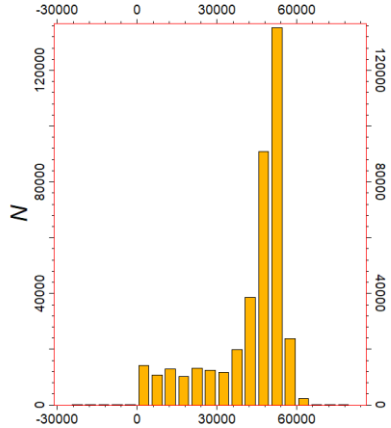


Sw property ranges

Check for realistic bounds of the calculated properties (0-40%; not below Sw; not negative values)

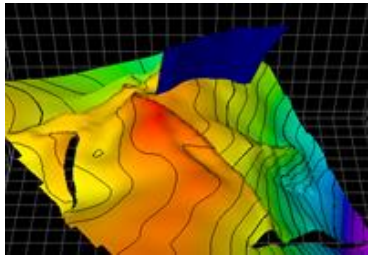
Poro realizations statistics

Calculate 3D property standard deviation from all the stochastic realizations (at least 30) and generate average maps per zone



Fine vs Upscaled grid Volume statistics

QC after upscaling includes a comparison between the fine grid and upscaled models by reservoirs, by blocks and by totals for of the following resultant properties: • Bulk volume (BV) • Pore volume (PV) • Hydrocarbon PV (HCPV) • Hydrocarbon in place (HCIP)



HCPV maps

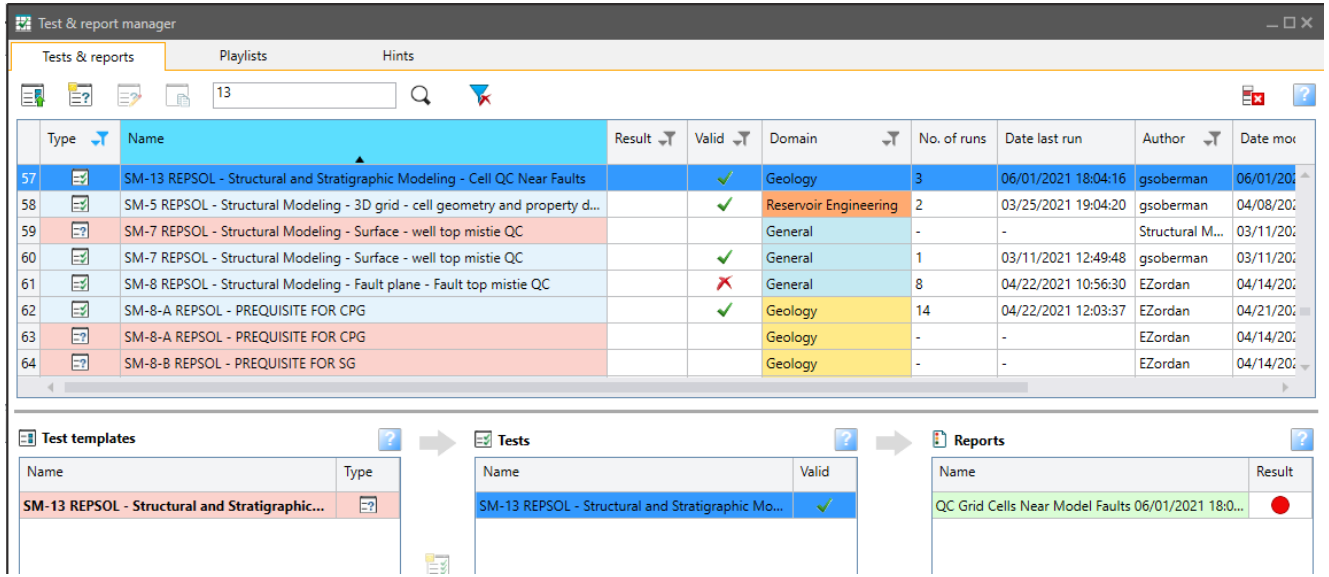
Generate HCPV maps (Gross x NTG x Porosity x SHC). Can get Hydrocarbons, Gas, Oil, or Oil & Gas depending on inputs

TECHNICAL SOLUTION

Petrel tools

Petrel Test & Report Manager

- Proposed solution that exists as part of Petrel
- Offering a versatile & customizable solution for running QC tests
- Intuitive to run
- Validation of inputs item types

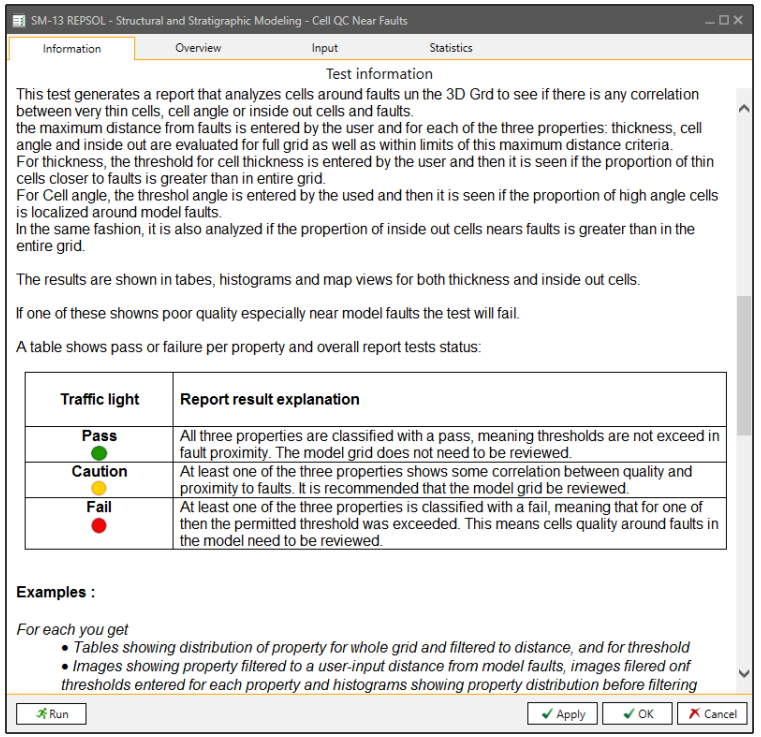


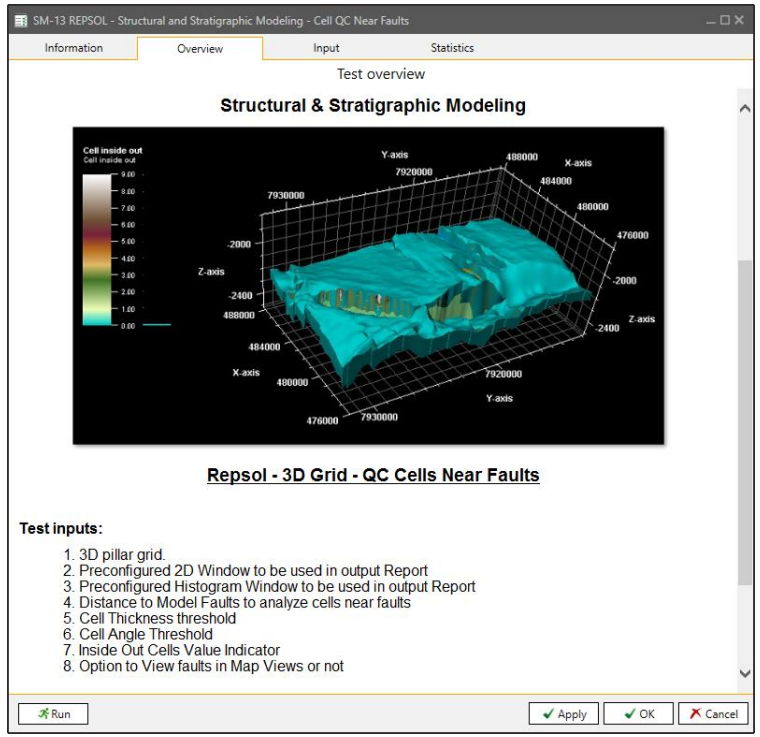
TECHNICAL SOLUTION

Petrel tools

Petrel Test & Report Manager

- Tabs with Information and Overview
- Customized with Instructions
- REPSOL logo
- Images
- Tables
- Descriptions
- Keys for traffic lights
- …





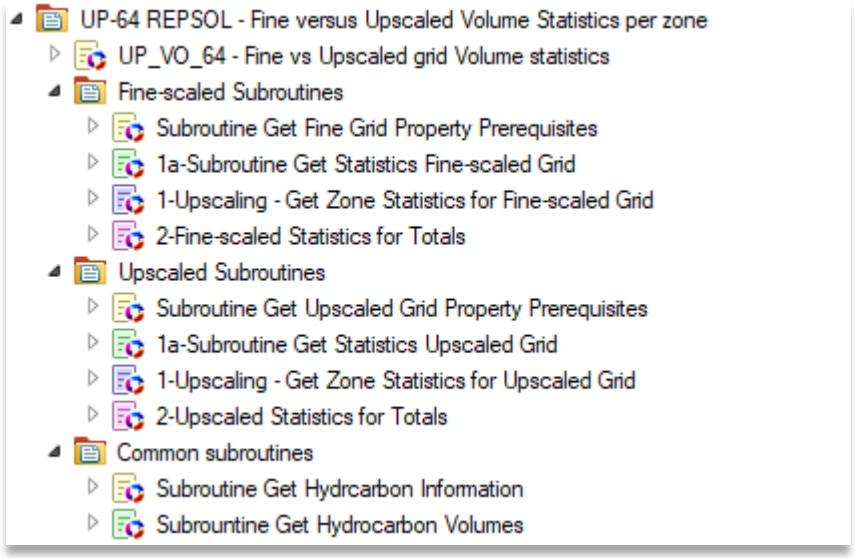
TECHNICAL SOLUTION

Petrel tools

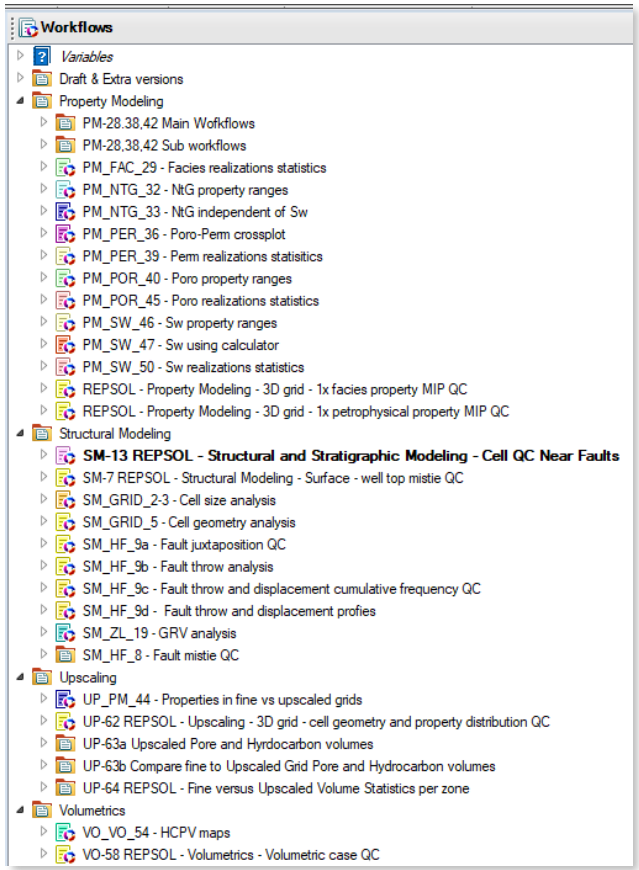
Workflows behind scenes:

- Grouped by domain
- Long complex workflows (hundreds of lines)
- Subroutines
- Able to carry QC operations on major part of Petrel Inputs and Models

Test with Subroutines



Workflows in Structured folders

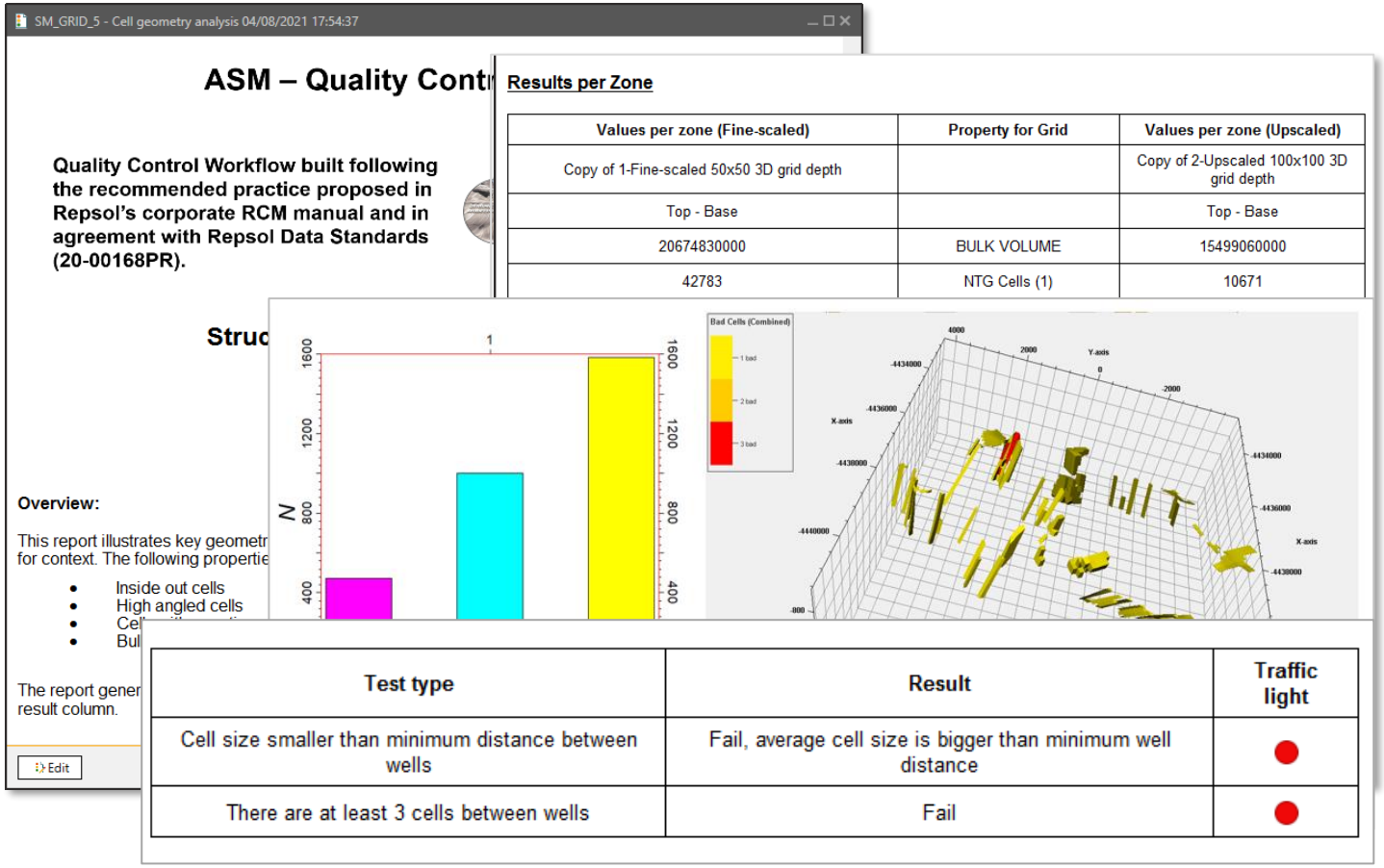


TECHNICAL SOLUTION

Petrel tools

Complex workflows run behind tests with infinite possibilities

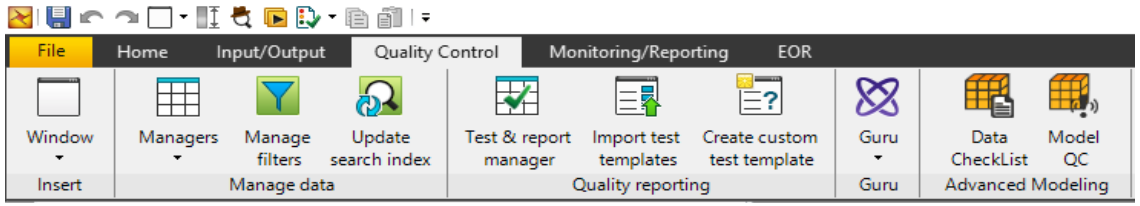
- Run modeling
- QC Models
- Get Statistics
- Filter displays
- Create Cross plots
- Create Histograms
- Display data in 2D, 3D and Maps
- Filter through zones
- Generation of customized, structured and detailed reports
- Incorporation of test traffic lights based on thresholds

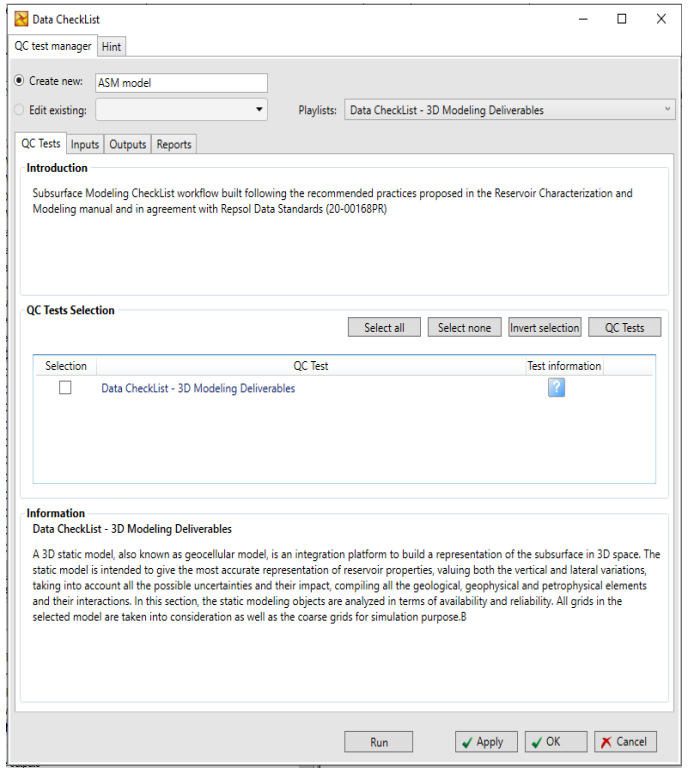


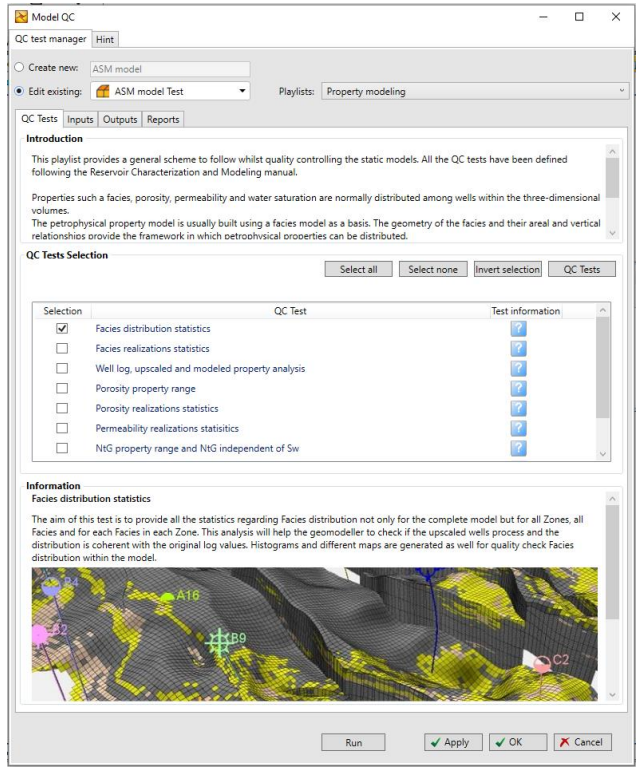
TECHNICAL SOLUTION
Plugin

Plugin for Petrel

- Instigated the idea to develop a Plug-in for Petrel
- To develop a plugin that allows the launching of multiple QC tests with a single click
- The plugin uses the modules Petrel Test & Report Manager and code implemented in the workflows
- Use of json configuration files for plugin maintenance that facilitates agile fixes and updates
- Integrated with GURU customized content



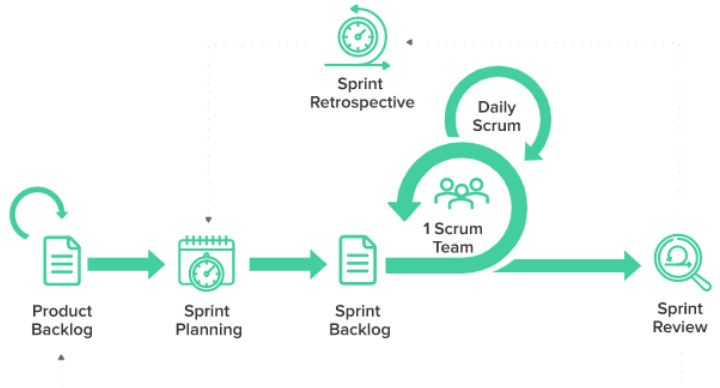


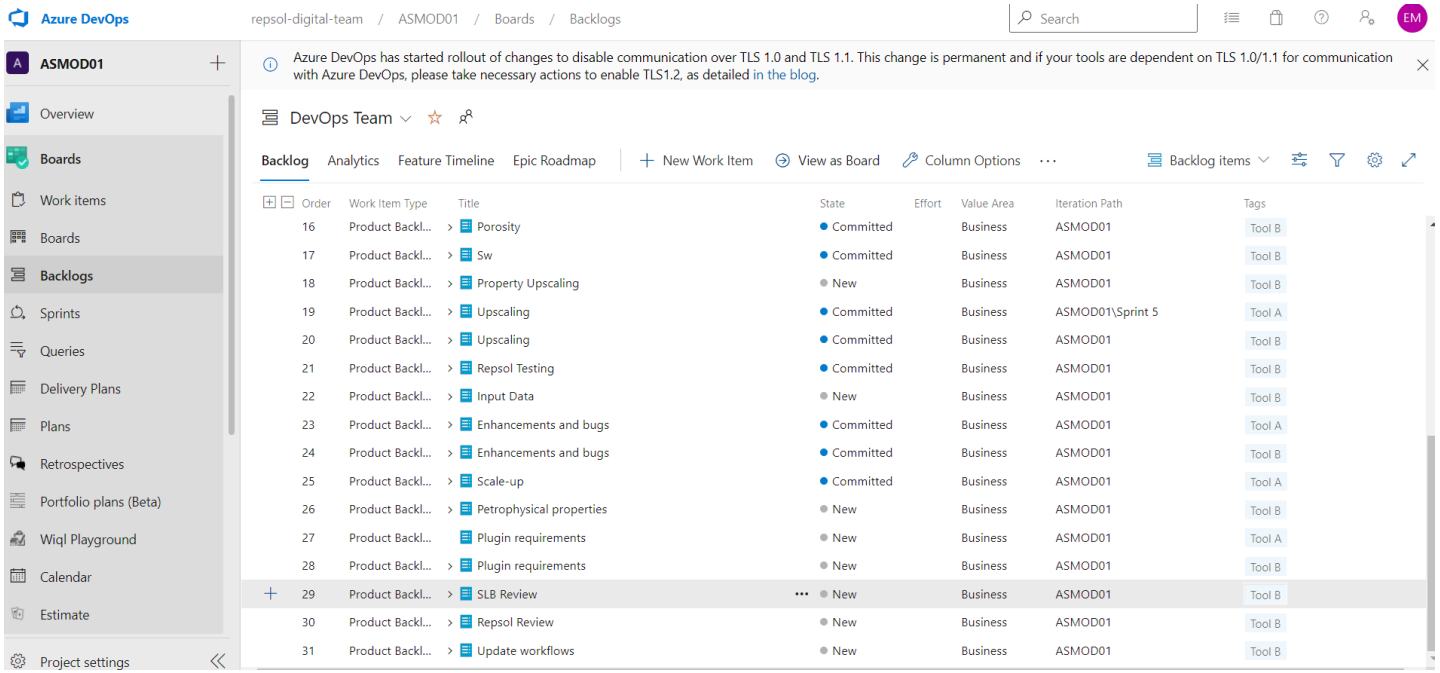


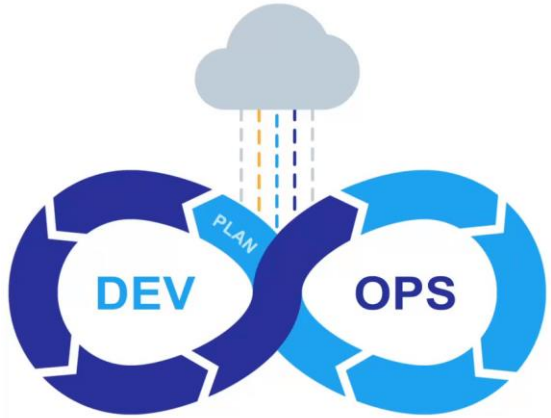
TECHNICAL SOLUTION
Development methodology

DevOps

- Agile methodology implemented with DevOps QC Models
- Daily, Sprint Retrospectives and Reviews Filter displays







TECHNICAL SOLUTION

Summary

Had heard about GURU guided workflows.

SLB Initially proposed solution with GURU Guided Workflows,

but then expanded this solution to customization of tests within the **"Petrel Test & Report Manager".**

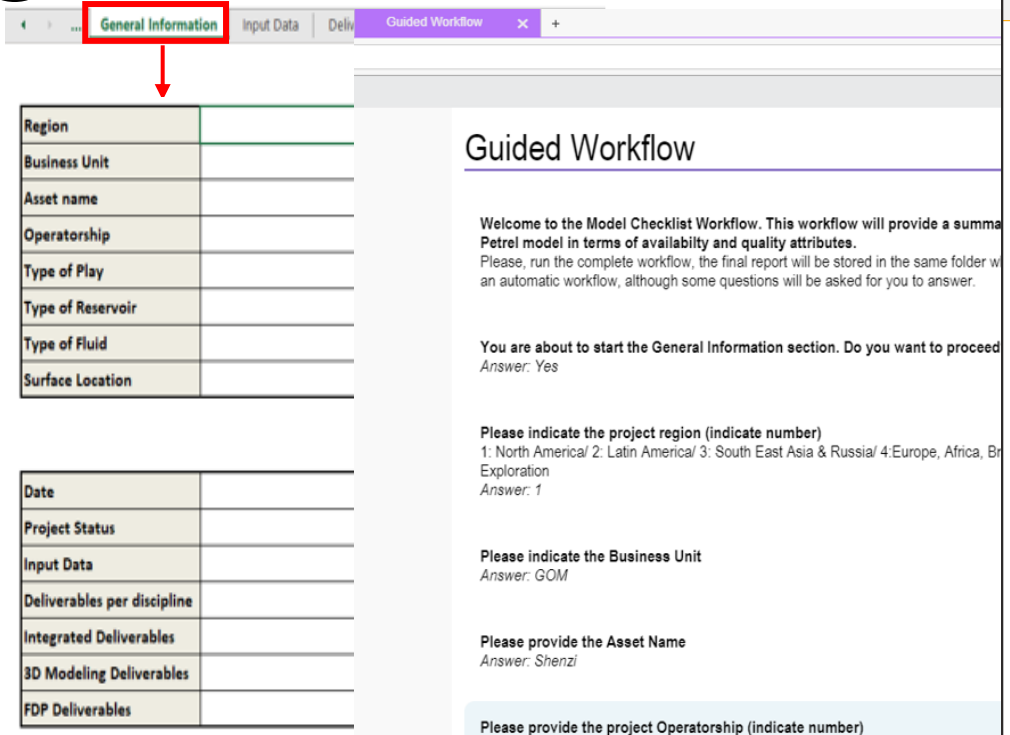
1 REPSOL Excel Checklist

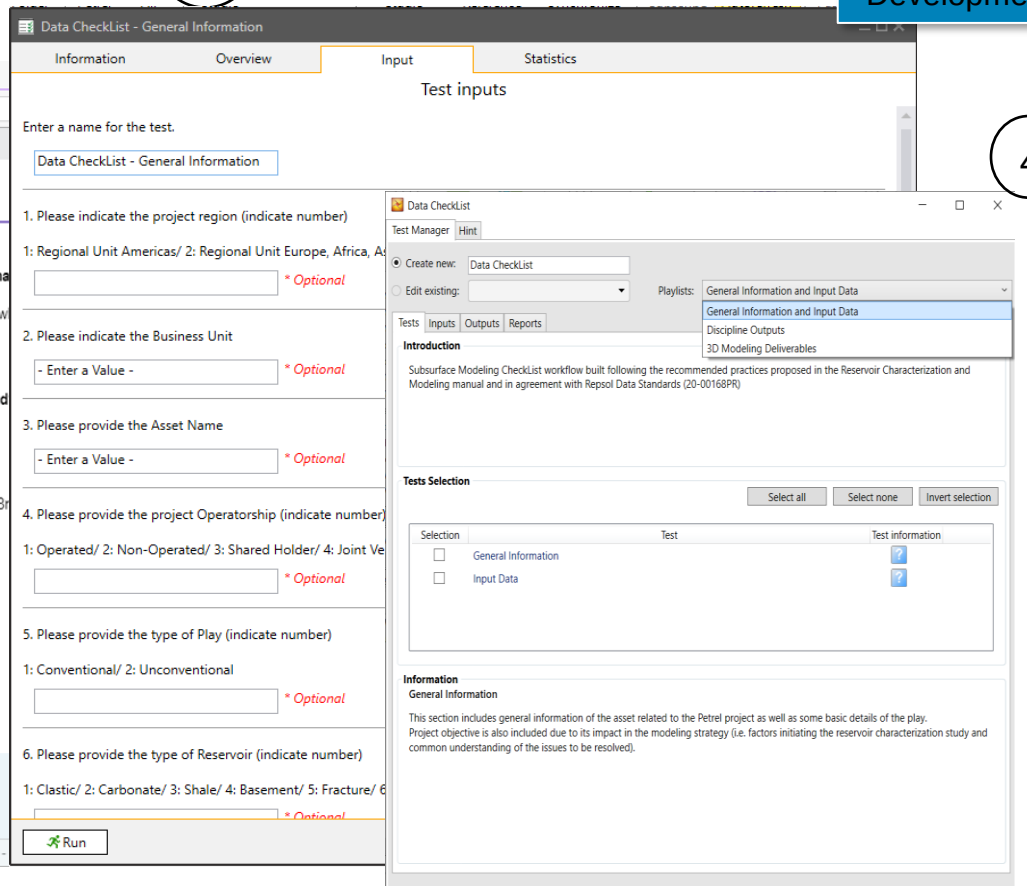
2 Guru

3 Test & Report Manager

Development of Plugin

4 Plugin





Results

- The time-saving and overall consistency in results obtained, have significantly impacted the efficiency and value attained using Petrel
- We are currently adding more multifaceted and crucial tests to the portfolio and expanding to other domains such as three dimensional geomechanics modeling, reservoir simulation and engineering
- The outcome of the project has remarkably improved the entire geomodelling process within Repsol and has a great potential for optimizing the handling of more and more complex scenarios

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