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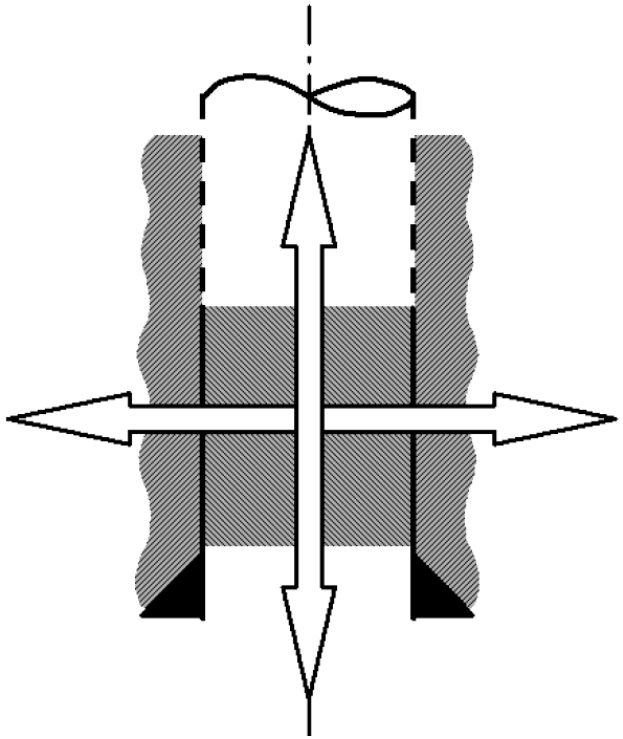
Machine Learning Assisted Cement Integrity Evaluation During Plugging and Abandonment Operations

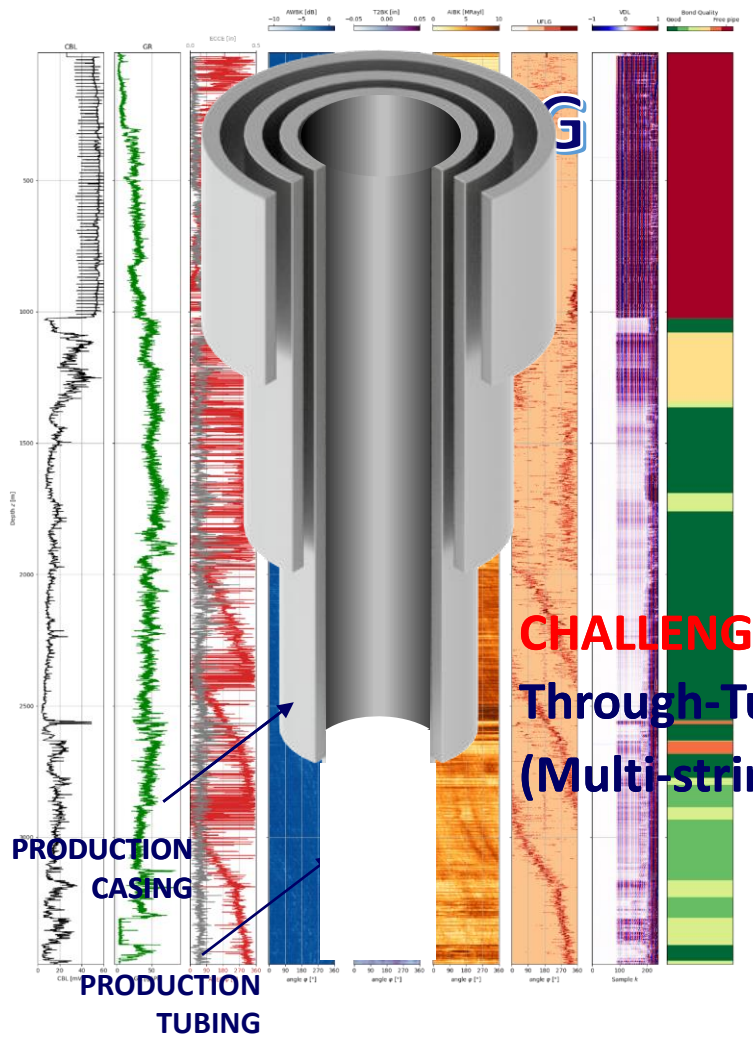
Aberdeen, June 6th, 2023

How it started?

*"Permanently plugged wells shall be abandoned with an **eternal perspective**[1] …"*

- Casing cement shall be verified to ensure a vertical and horizontal seal;
- If casing cement is ***verified by logging***, minimum 30 m cumulative interval with acceptable bonding is required to act as a permanent external barrier.





[1] NORSOK Standard D-010, 2013

How it started?

There is room for improvements in the cement integrity assessment

Current process

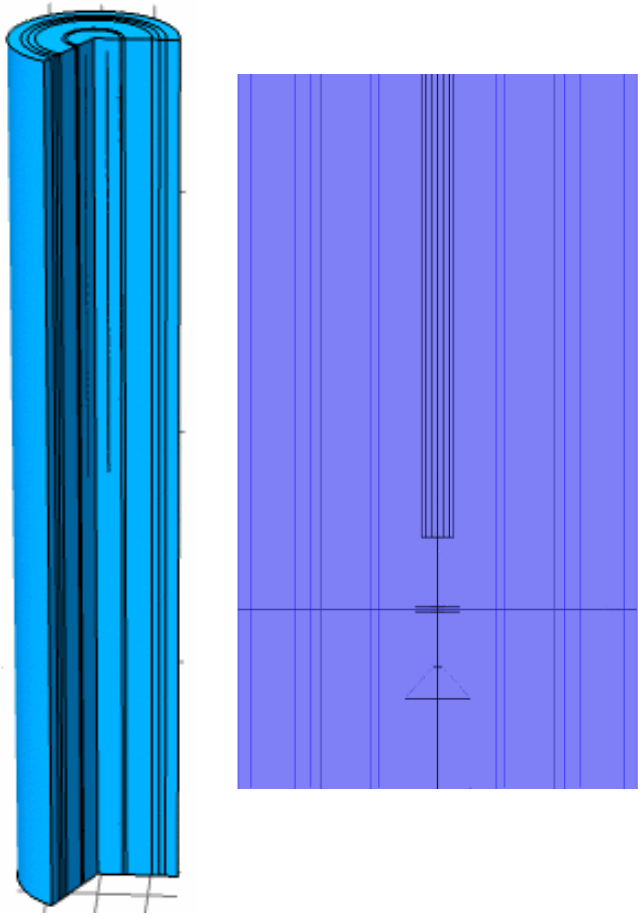
Interpretation relies on the expertise of the specialist and hence subject to variability.

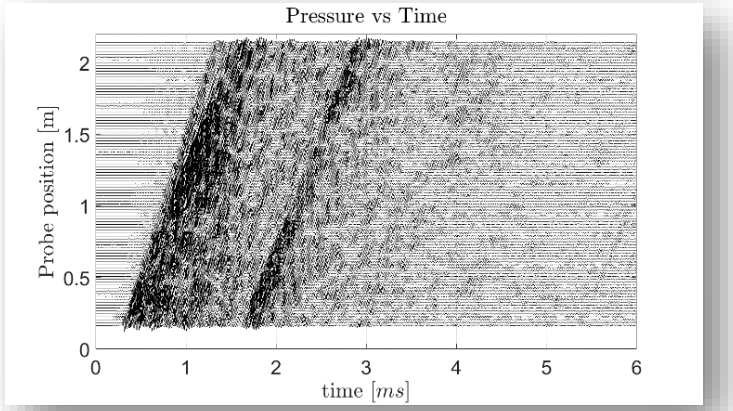
Consequences

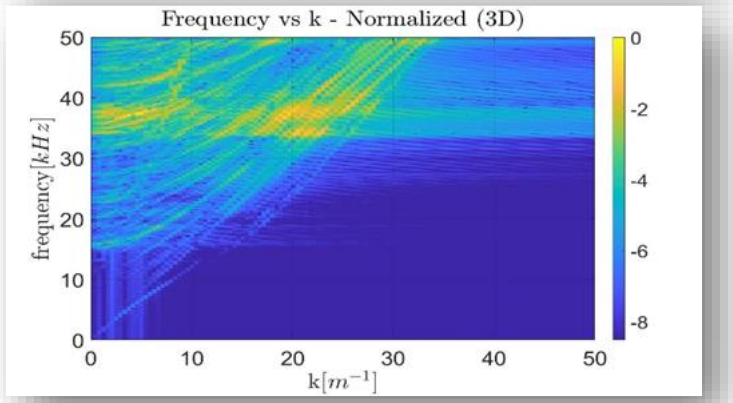
- Human Dependent
- Error Prone
- Time Consuming

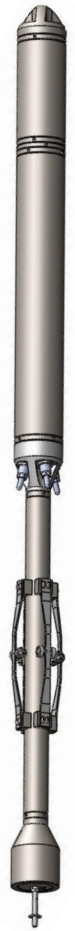
BACKGROUND: TTiLT

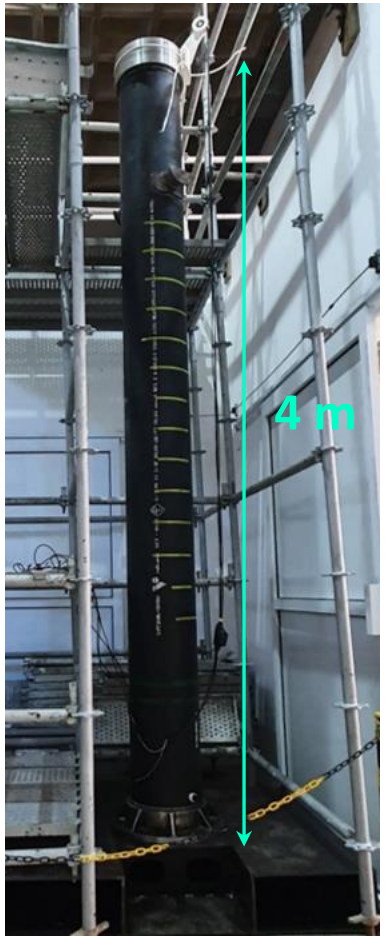
Develop a logging tool for the assessment of cement quality through multiple strings of casing (July, 2019 to June, 2022)







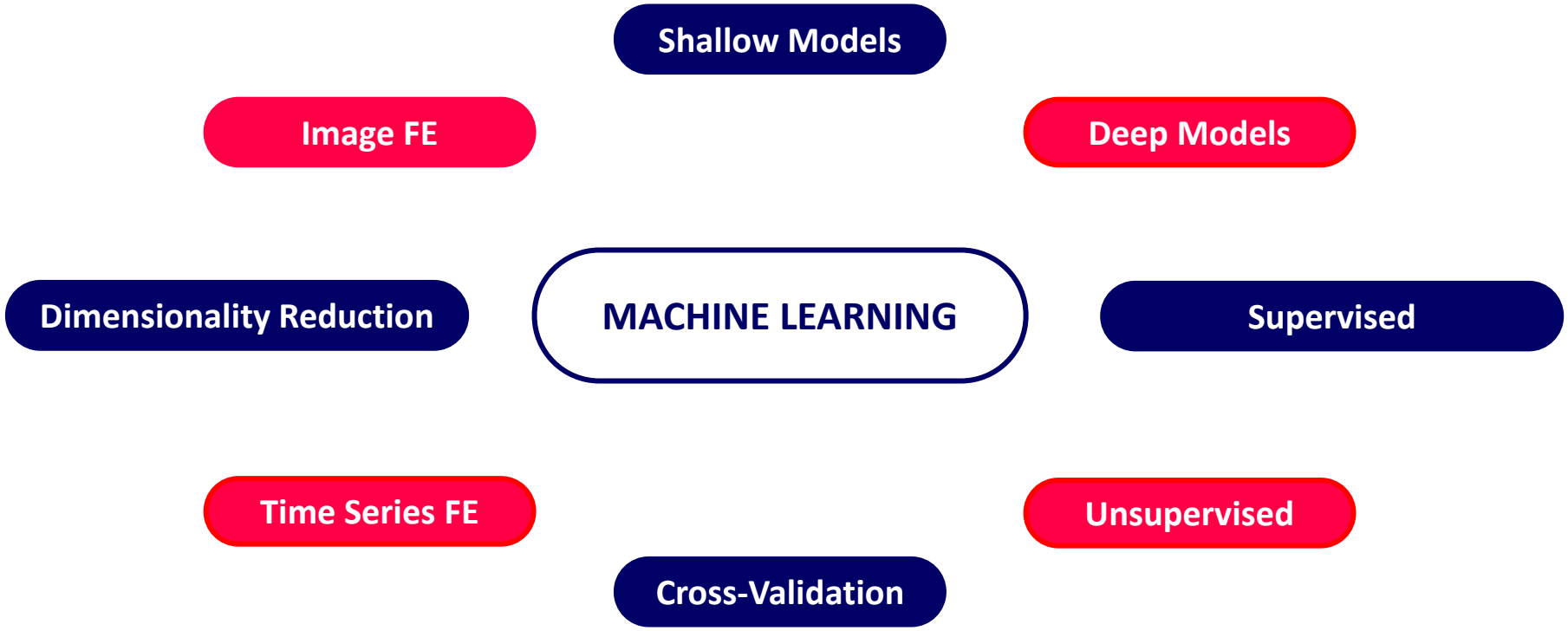




NUMERICAL SIMULATION **SYNTHETIC DATA** **TOOL** **LAB SETUP**

BACKGROUND: TTiLT

MACHINE LEARNING TECHNICS: *detecting, classifying & estimating severity of flaws in the cement sheath* (*based on synthetic data: numerical & experimental*)



BACKGROUND: TTiLT

Final outcomes of the Project's first phase

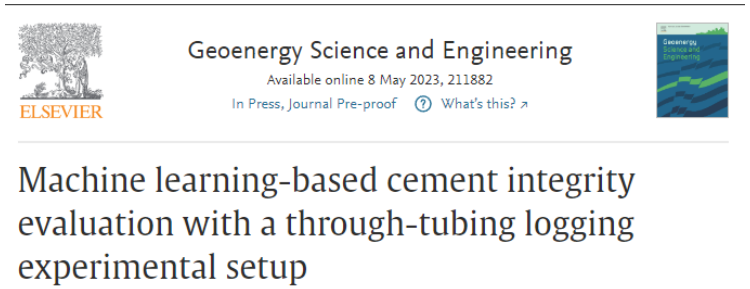
Patents

PATENTED

BR102021018581A2

BR1020220146861

Publications



Awards

prêmioanp
DE INOVAÇÃO TECNOLÓGICA
2020

World Oil AWARDS
2022 FINALIST
Best Well Intervention Technology Award

WHY?

AI can improve the P&A process beyond the cement integrity evaluation

RISK BASED REGULATIONS

Different approaches on P&A are welcome by regulators

P&A DESIGN DILEMMA

No high quality data enough to change the approach

HUMAN BASED INTERPRETATION

Data interpretation in P&A is complex, biased and human-dependent

“WITHOUT AI TO QUICKLY SIMULATED SCENARIOS, P&A DESIGN WILL ALWAYS BE THE SAME”

How? P&A Software Platform

P&A assistant

Machine learning based, software platform to assist analysts in the interpretation of well logging data and the operator to optimize planning and management of P&A campaigns

Decision-Support Software

Based on **Active Learning**, benefiting from a dedicated database and interaction with experts

Reliability & Accuracy

Results gain robustness from **interaction with an expert** and **improve continuously** as the platform is used

Transparency & Verifiability

Based on **interpretable machine learning** models, results can be cross checked, audited and authenticated

Time Saving

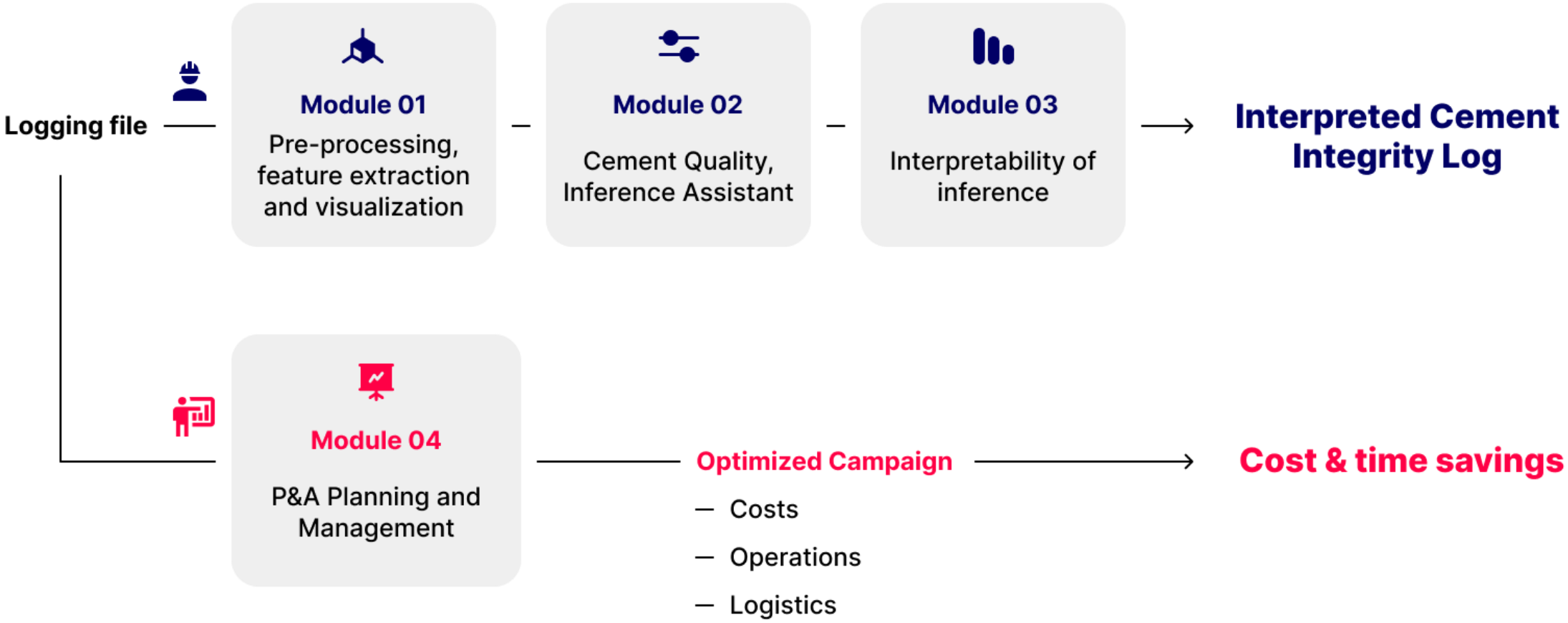
Faster interpretation of logging data as Well as planning & management of P&A campaigns

User-Friendly Interactive Interface

An **intuitive graphical interface** enabling users to explore different scenarios and select most suitable one

Data Flow

The modular software will provide not only ML-assisted log interpretations but also optimized P&A campaigns.



Final Considerations

P&A
assistant

Where we are now

- Building database infrastructure;
- Developing the modules that compound the software (Back-end);
- Starting the development of the Front-end;

Challenges

- Gather quality and representative data to compose the dataset;
- Deal with log file formats;
- Deal with data from different tools;
- Balance the expectations of the market, users, and regulators

Next steps

- Add more data to the database;
- Models' refining;
- Search for partners for validating and/or testing the product;
- Search for partners for collaborations;

we are on it!

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