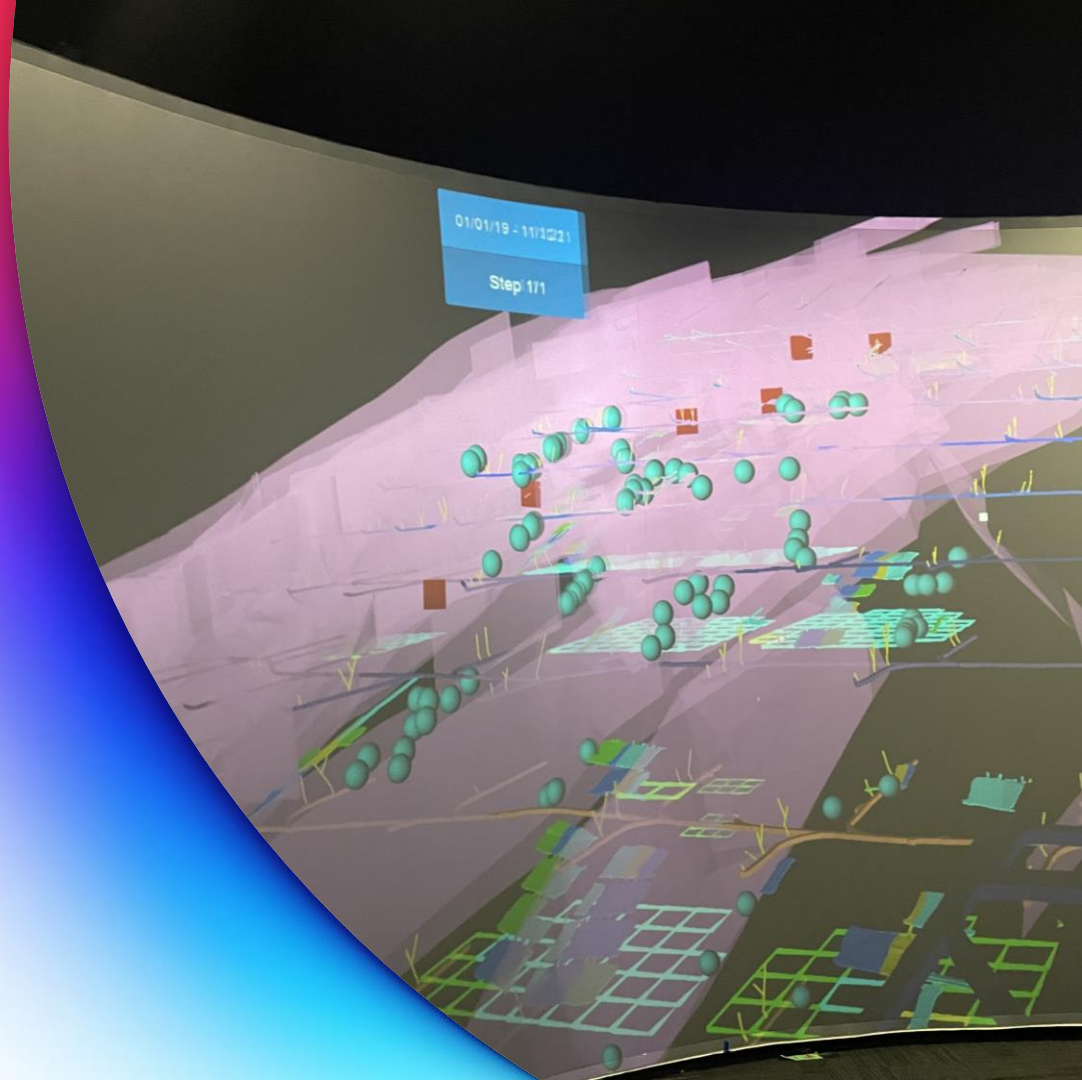
AngloAmerican

Development of a Digital Management Plan for underground mines using AI algorithms to forecast potential fall of ground area



Dewaldt van Rooyen

26 June 2025

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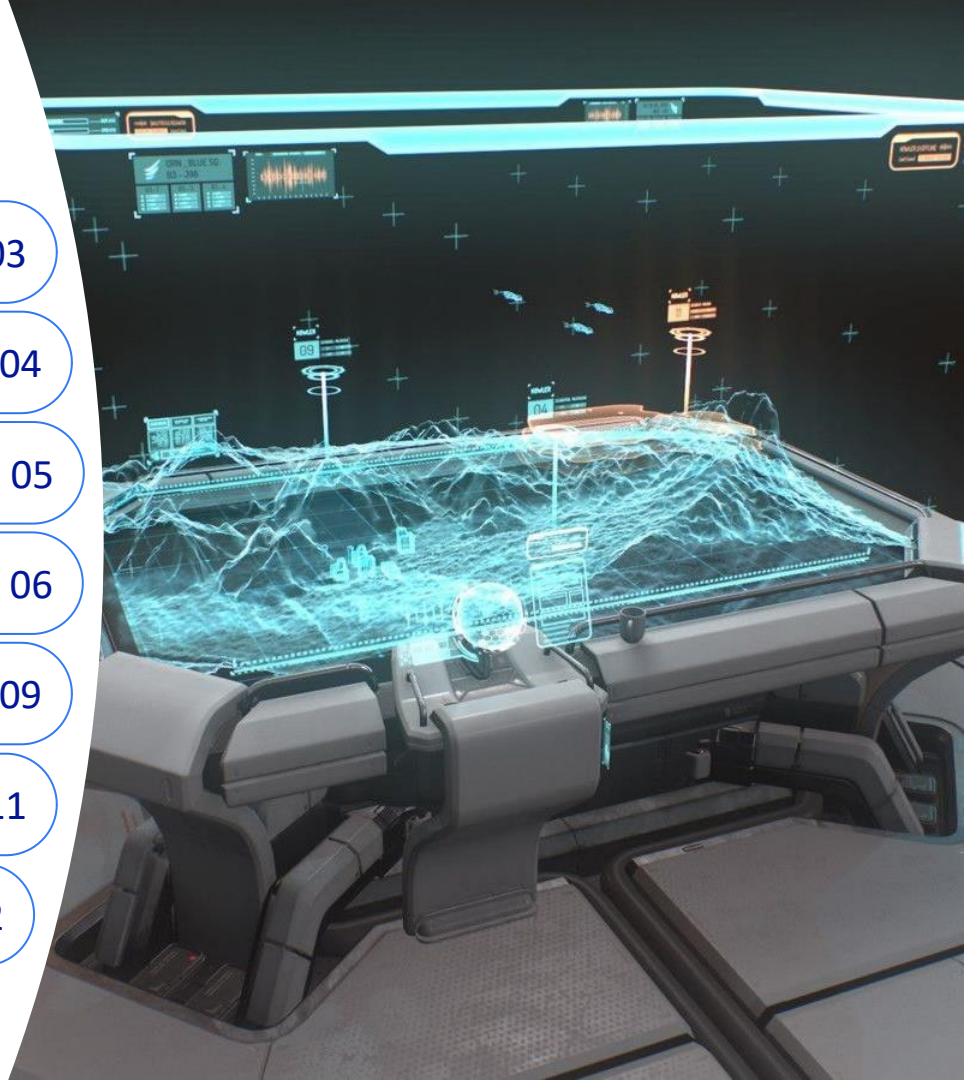


Ground Control Management

Ground Control

Ability to Predict & influence the behaviour
of rock in a mining Environment.

Having due regard for the safety of the workforce and the required serviceability & design life of the mine.

District

Portion of a mine with similar anomalies and geological conditions exist.

Give a unique set of identifiable rock-related hazards and strategies to min the risk resulting from mining by analyzing data.

Plan

District are visualized on a 2 D Scale of 1 in 2,500 plan on good quality transparent draughting material

Challenge

Operational Geotechnical data streams

Monthly Underground Data Collections

- 32 000 Compliance data points
- 36 000 Panel hazard ratings
- Fall of Ground data
- Instrumentation Monitoring data
- Mapping

Mine plan

- Geographical Block Models
- Mine Planning and Layouts

Exploration

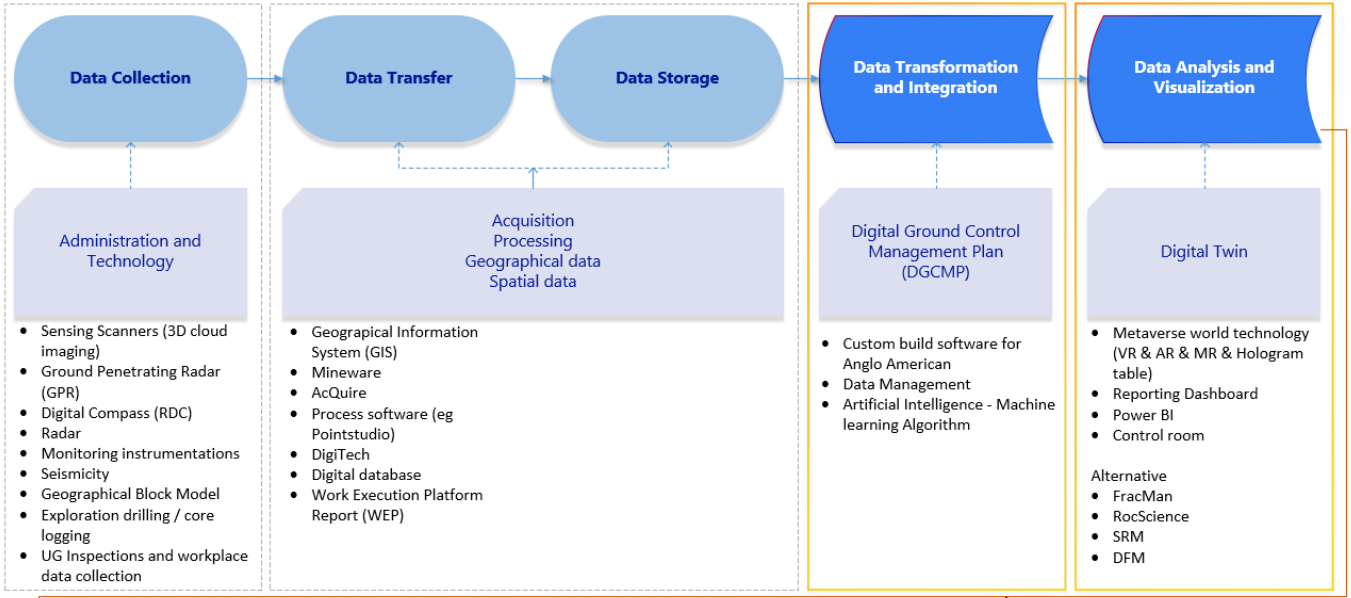
- Drilling
- Core logging

These data, often stored in different formats such as Excel spreadsheets, PDF documents, Word files, and imaging files.

Separated data types limit's ability to run timely, multidimensional analyses - hinders the ability to implement informed efficiency and accuracy decision-making strategies on a more frequent basis – especially under constrained recourses

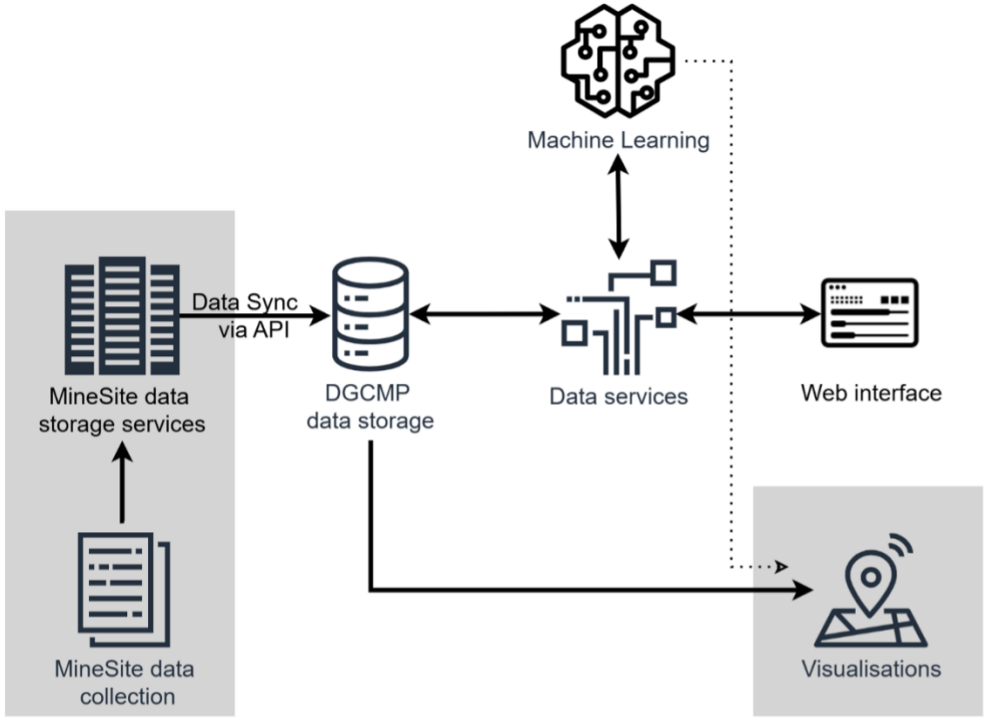
Solution

Explored the potential of integrating geotechnical data into a unified analysis tool by leveraging Machine Learning (ML) methods (Overarching Artificial Intelligence (AI))



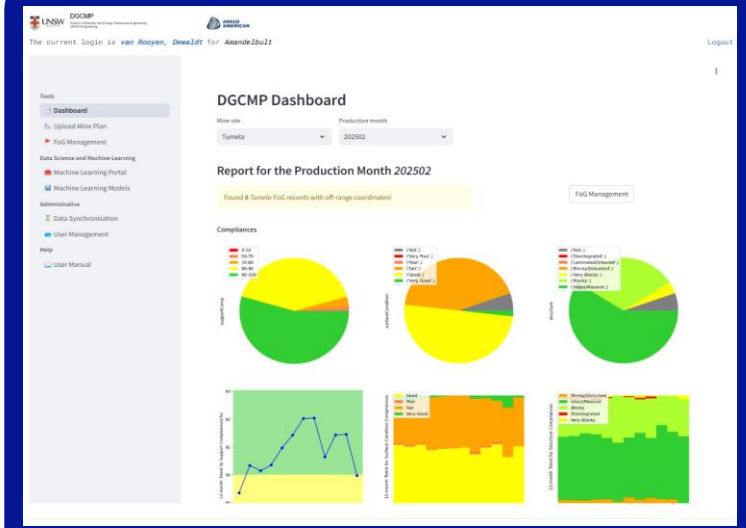
Proof of Concept

System framework

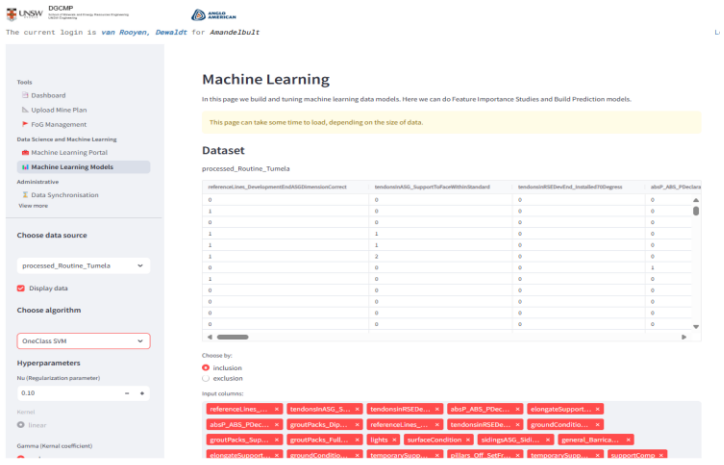


Proof of Concept

Analytical Graphs

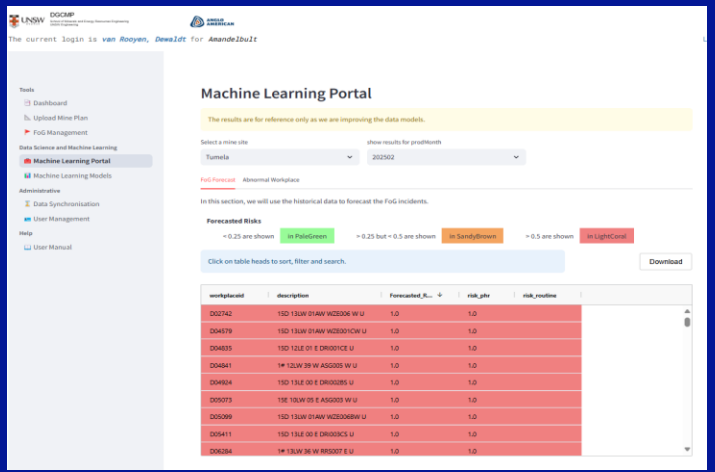


ML



Proof of Concept

ML Result Portal

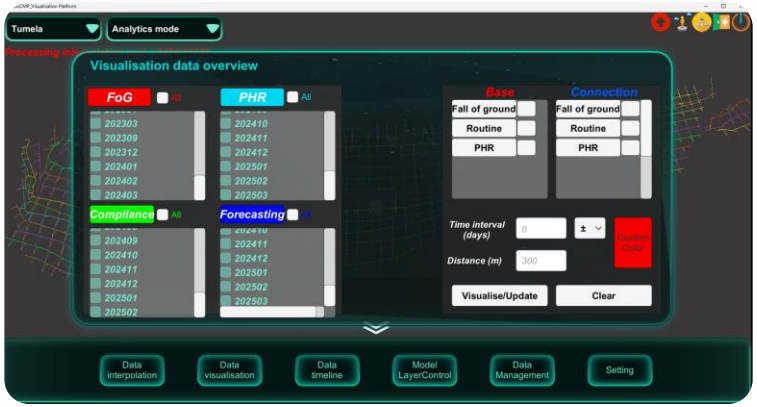


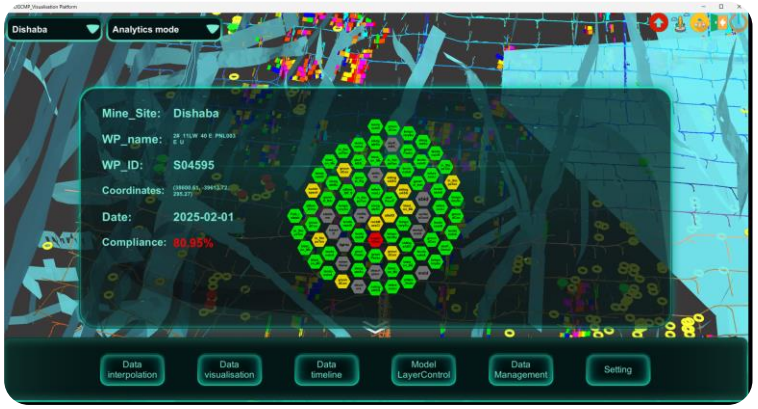
ML Result Export File

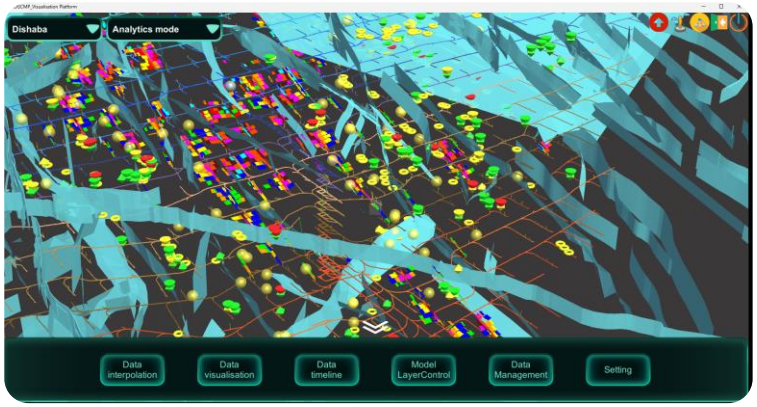
{workplaceid	Description	Forecasted_Risk	risk_phr	risk_routine
S06037	15D 13LW 01AW PNL032LW U	0.8514	0.9865	0.7162
S05864	1# 16LE 13 W PNL003 E U	0.5131	0.9969	0.0292
D06691	1# 14LW 43 W RSE U	0.503	1	0.006
D06819	TL 15LW 29 W X/C011SE U	0.5018	1	0.0036
S06283	1# 10LW 44 W PNL001 W U	0.501	0.9917	0.0103
D04836	15D 13LW 01AW WZE001AW U	0.5007	1	0.0014
S04922	1# 13LW 37 W PNL003 E U	0.5002	0.9899	0.0105
S06541	1# 10LW 45 W LED002 W U	0.475	0.8859	0.0641
S05768	1# 10LW 42 W PNL002 W U	0.4621	0.9205	0.0036
S05660	1# 09LW 42 W PNL004 W U	0.455	0.8985	0.0116
S06658	1# 13LW 29 W PNL009AE U	0.3993	0.0484	0.7503
S06355	1# 09LW 44 W PNL002 W U	0.3605	0.0418	0.6793
D07470	1# 09LW 42 W ASG005 W U	0.1845	0.3456	0.0234
S06441	1# 16LE 13 W PNL004 E U	0.1547	0.1361	0.1733
D07533	1# 16LE 13 W RRS002 E U	0.1419	0.2682	0.0157
D06717	1# 16LE 13 W RRS002 W U	0.1101	0.2155	0.0048
D05559	1# 16LW 42AW RSE U	0.1037	0.2006	0.0067
D06547	1# 14LW 44 W RSE U	0.1033	0.2006	0.006
D07086	1# 15LE 06 W RSE U	0.102	0.2006	0.0034

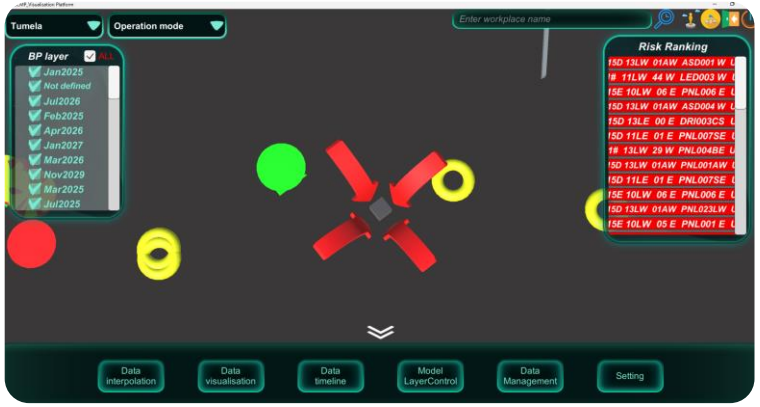
Accuracy: 0.74 / Precision: 0.72 / Recall: 0.77

Visualisation Tool

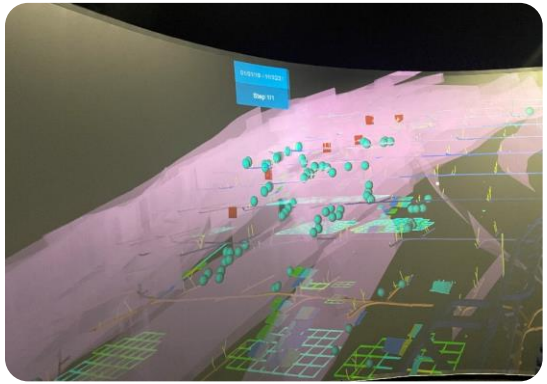


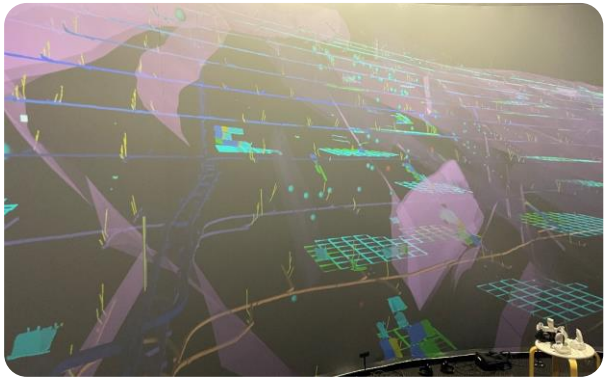


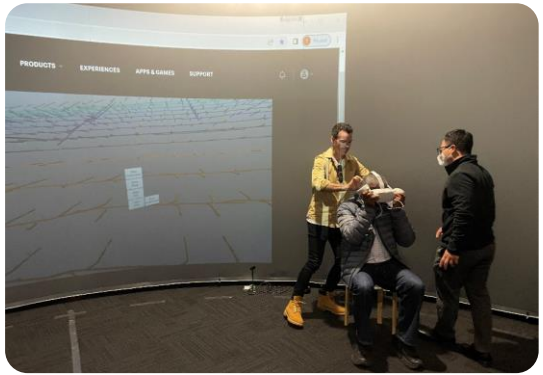


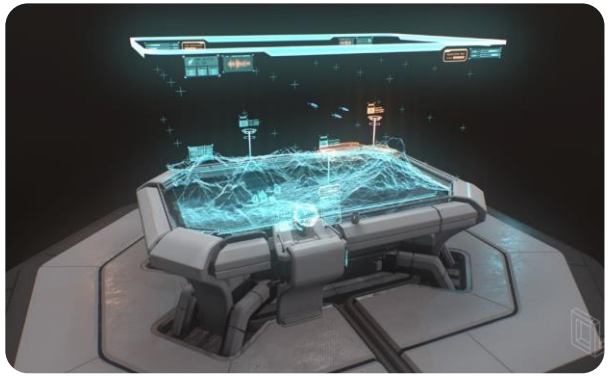


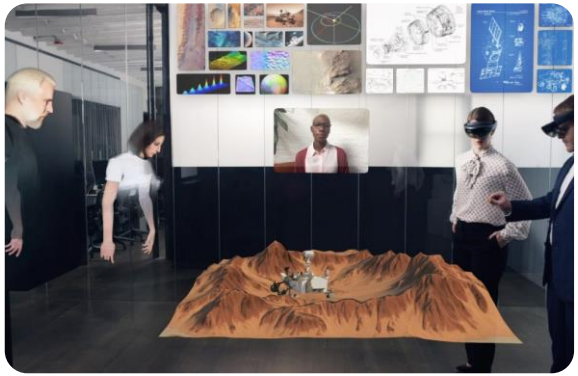
Visualisation Capabilities











Learnings

- **Quality Database:**
  - Essential for ML and digitalization.
- **Comprehensive Database:**
  - Important for future analysis.
- **Coordinate Assignment:**
  - Crucial for accurate data fusion.
- **Cloud-Based Solutions:**
  - Ensure scalability and data integrity.
- **Relevant ML Questions:**
  - Formulate correct questions for effective ML.
- **AI Education:**
  - Basic knowledge needed for collaboration.
- **Software Complexity:**
  - Understand the complexity of development.
- **Self-Learning Model:**
  - Increase data frequency for self-learning
- **Computational Power:**
  - Higher performance required to give detail results on reasons for a workplace to flag as high risk

Collaboration and acknowledgement

Anglo American, in partnership and collaboration with University of South Whales in Australia

- Mr. L Munsamy (Anglo American)
- Mr. R Carstens (Anglo American)
- Mr. C Zhang (UNSW)
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- Mr. C Huang (UNSW)
- Mr. R Liang (UNSW)

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Thank you