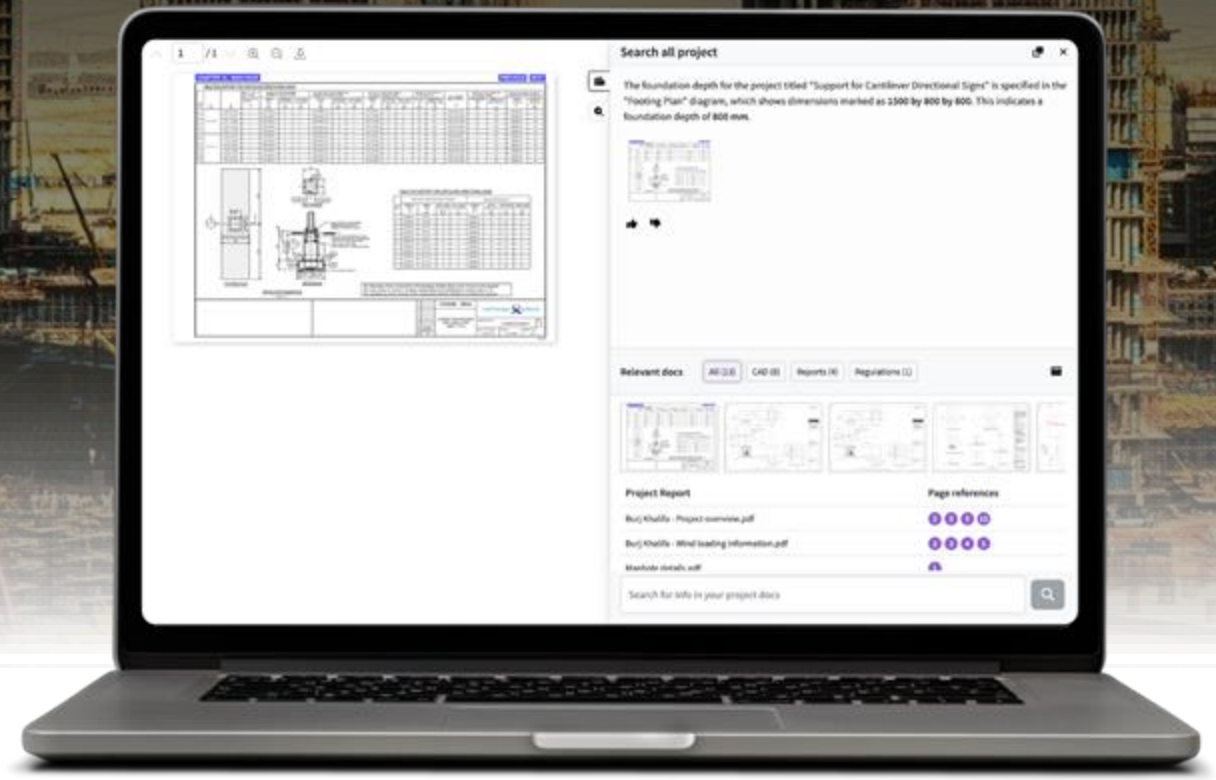
Civils.ai

Eliminating rework and design errors on construction projects



About me

Education:

- *MEng Civil Engineering*
- *MSc in Tunnelling & Underground Space*
- *5 yrs web developer*

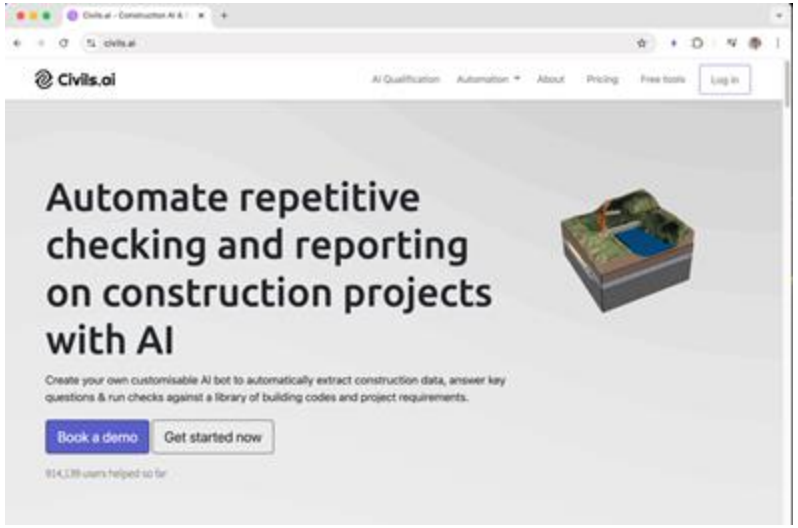
Work:

- *5 years with Morgan Sindall*
- *2 years with Arup*
- *2.5 years as Founder & CEO of Civils.ai*

About civils.ai

What's Civils.ai?

- AI for automating construction workflows - searching & checking data



Track record?

- Founded in Jan 2022 (from startup accelerator)
- Based in Singapore SG
- Used in 7+ countries SG HK US EU GB AU NZ
- 30k+ users
- Working with 25+ companies

Working with:

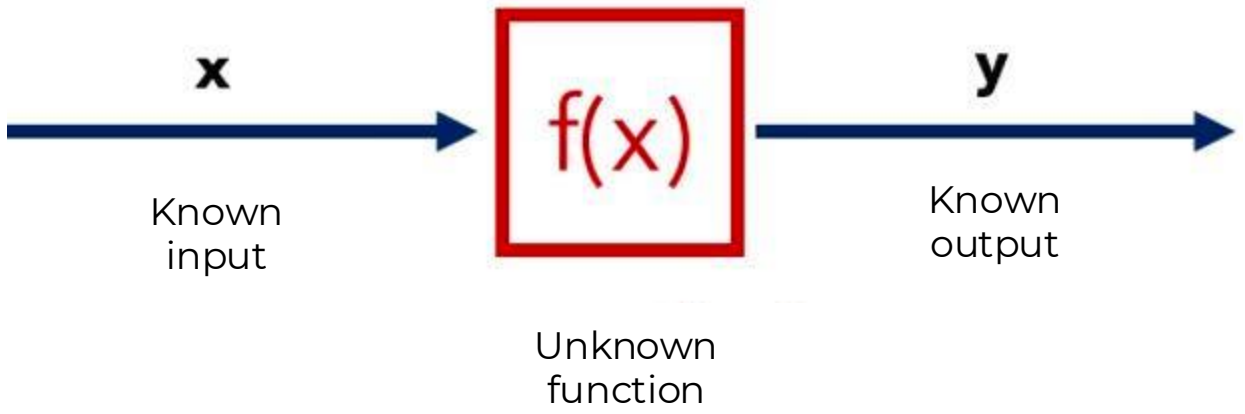
KAJIMA CORPORATION · AECOM · Jacobs · ARCADIS · ARUP · MOTT MACDONALD

jtc · 五洋建設 PENTA-OCEAN CONSTRUCTION · asia infrastructure solutions · WSP · MEINHARDT · Beca

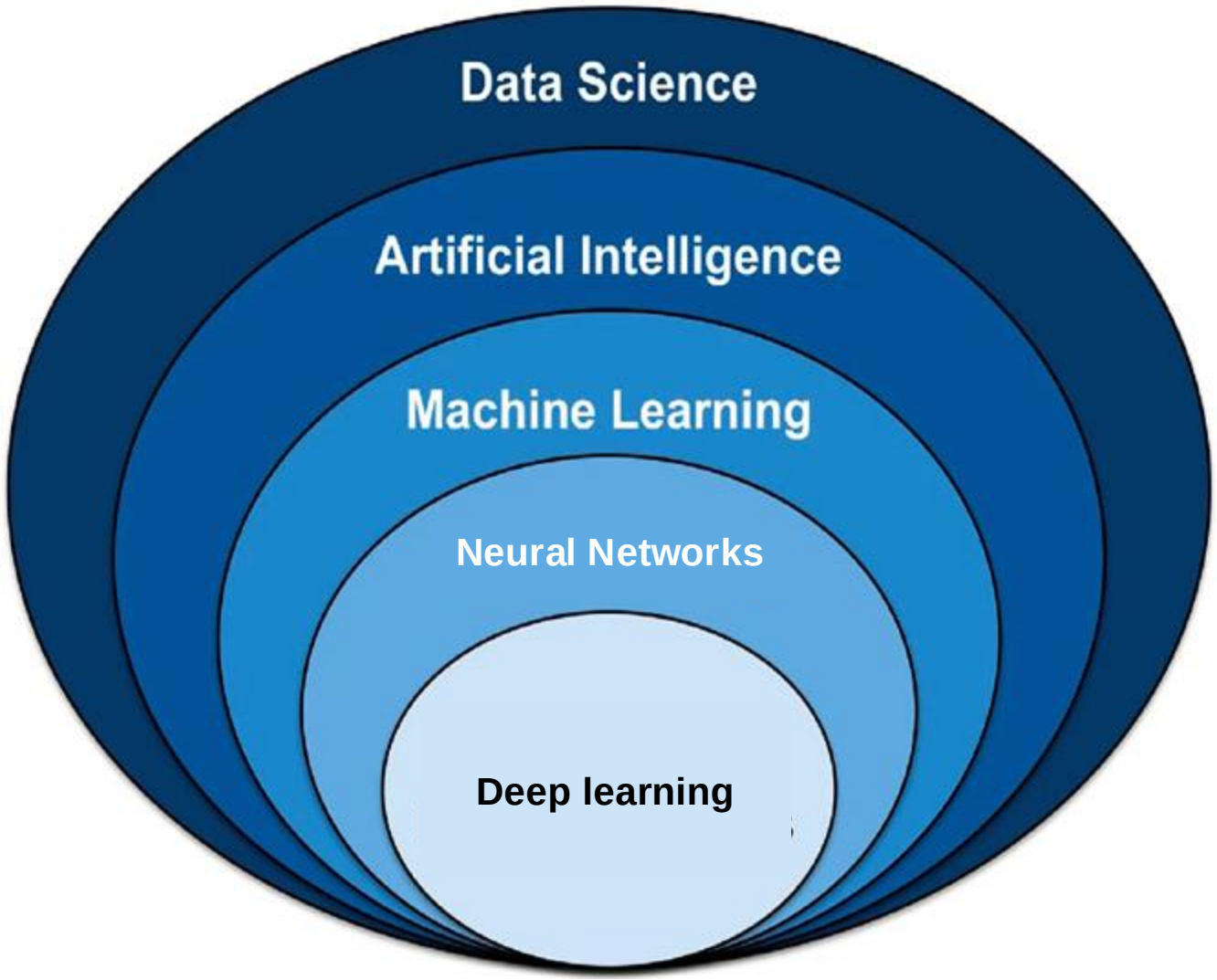
Topics of this presentation

1. High level intro to definitions and different AI technologies
2. How are we using it for geotechnical data collection?
3. What is the underlying technology we use?

The simplest explanation of AI/ML

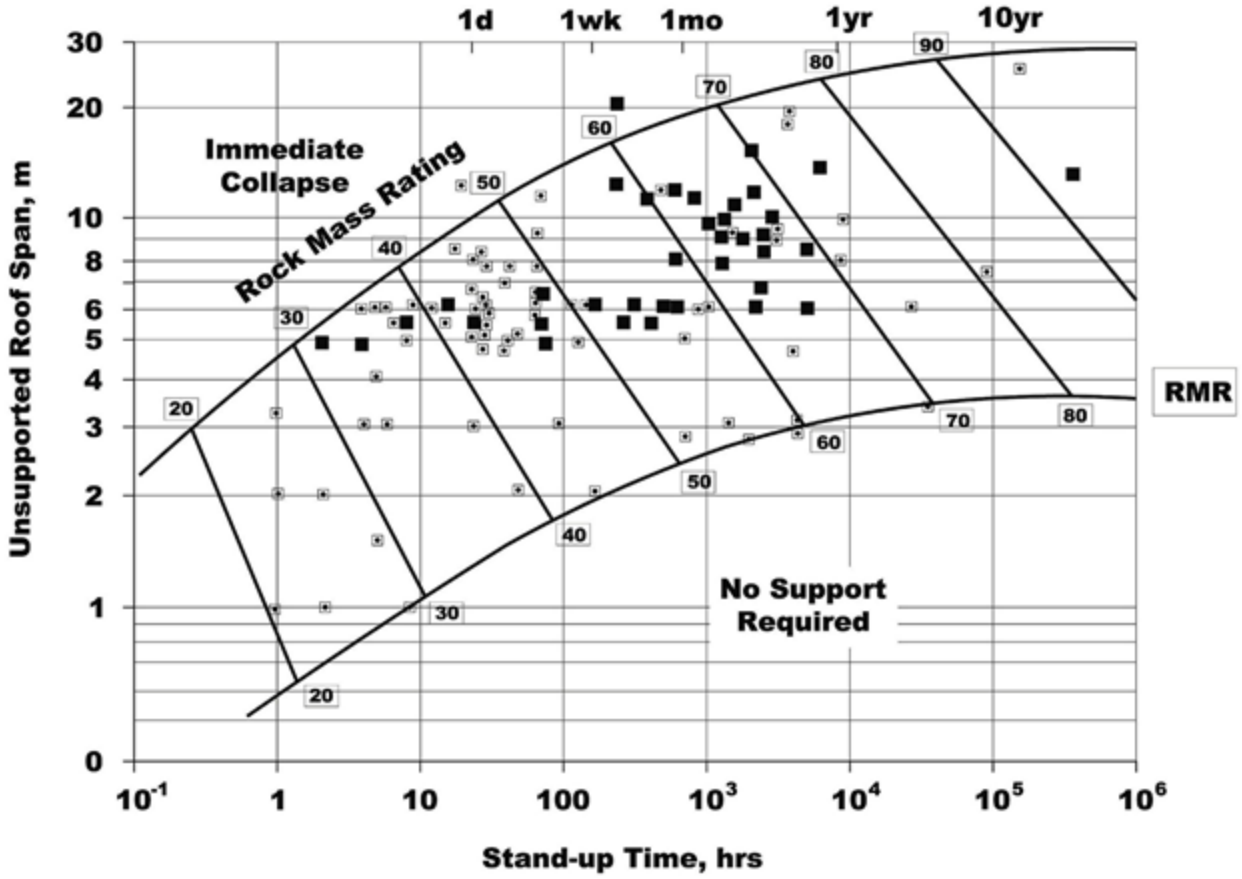


What do we mean by data science, AI & machine learning?



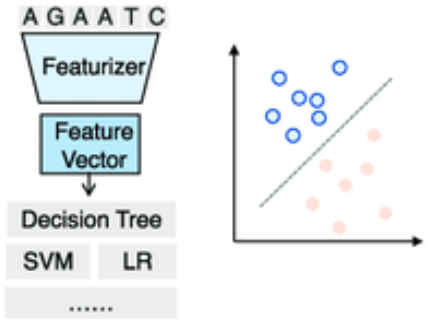
- Data science is overall subject (typically the subject you'd study)
- Artificial Intelligence is any non-natural construct which can take a decision without human intervention
- Machine learning is **ONE** approach to create AI algorithms
  - Others? Rule based system (if, else), bayesian systems etc.
- ANNs are generic function approximators
- Deep learning refers to any Artificial neural network (ANN) network which is more than 2 layers!

Most us are already using foundations of ML in Geotech

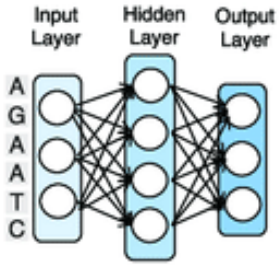


- Regression is a commonly used method in machine learning
- Many empirical formulas we use in our calculations are based upon some form of regression
- But how is it best to calculate these formula?

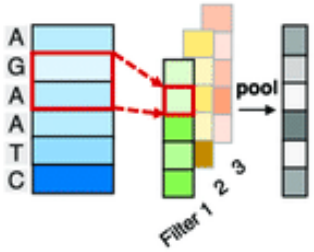
A summary of different available AI technologies



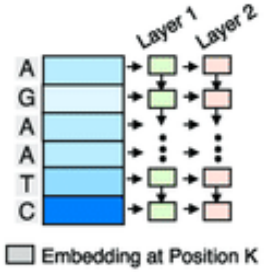
Classical Machine Learning
(Most AI apps use)



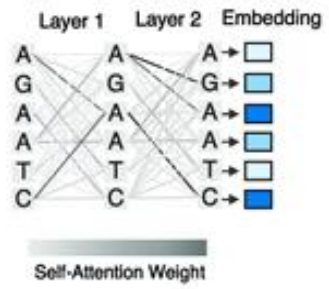
Deep Neural Network
(Text to speech)



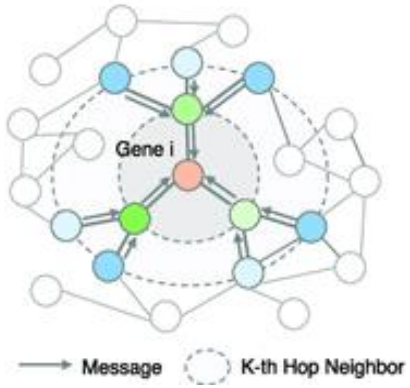
Convolutional Neural Network
(Vision intelligence)



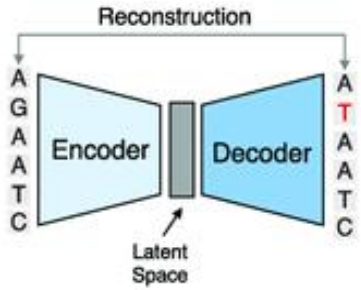
Recurrent Neural Network
(Text to speech)



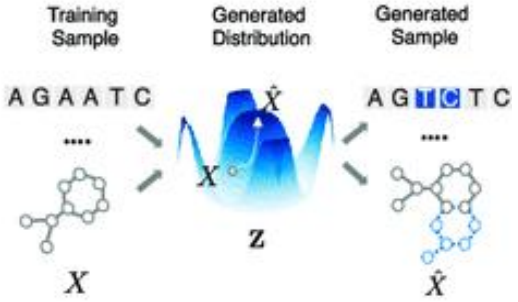
Transformer Model
(Large Language Models)



Graph Neural Network
(Recommendations)



Autoencoder
(Recommendations)



Generative Model
(Image generation)

How do we apply this in geotechnical engineering?

Gathering and understanding site data is hard
(e.g. from tender docs or national registers)

A lot of this valuable data is trapped in unstructured documents

... today we review & transcribe from 1000's of pages **manually.**

Failing to spot a risk / problem could mean losing the work ... or worse!

America's Biggest Tunnel-Boring Machine Is Stuck Beneath Seattle

What's wrong with big Bertha?

CNN travel Live TV

Italy races to stop leaning tower from collapsing

By Sharon Braithwaite, CNN

2 minute read

Updated 10:00 PM EDT, Thu March 28, 2024

BBC NEWS

'Walkie-Talkie' skyscraper melts Jaguar car parts

BUSINESS NEWS

The Sydney Opera House turns 50: How an iconic structure exceeded its construction budget by 1300%

The building also took 14 years to build instead of the estimated four, and designer Jørn Utzon quit in 1966

By Ananya Bhattacharya

Published October 20, 2023

Automate tender reviews, desk studies & checking workflows

Import your **documents**

Specs

Contracts

Site Investigations

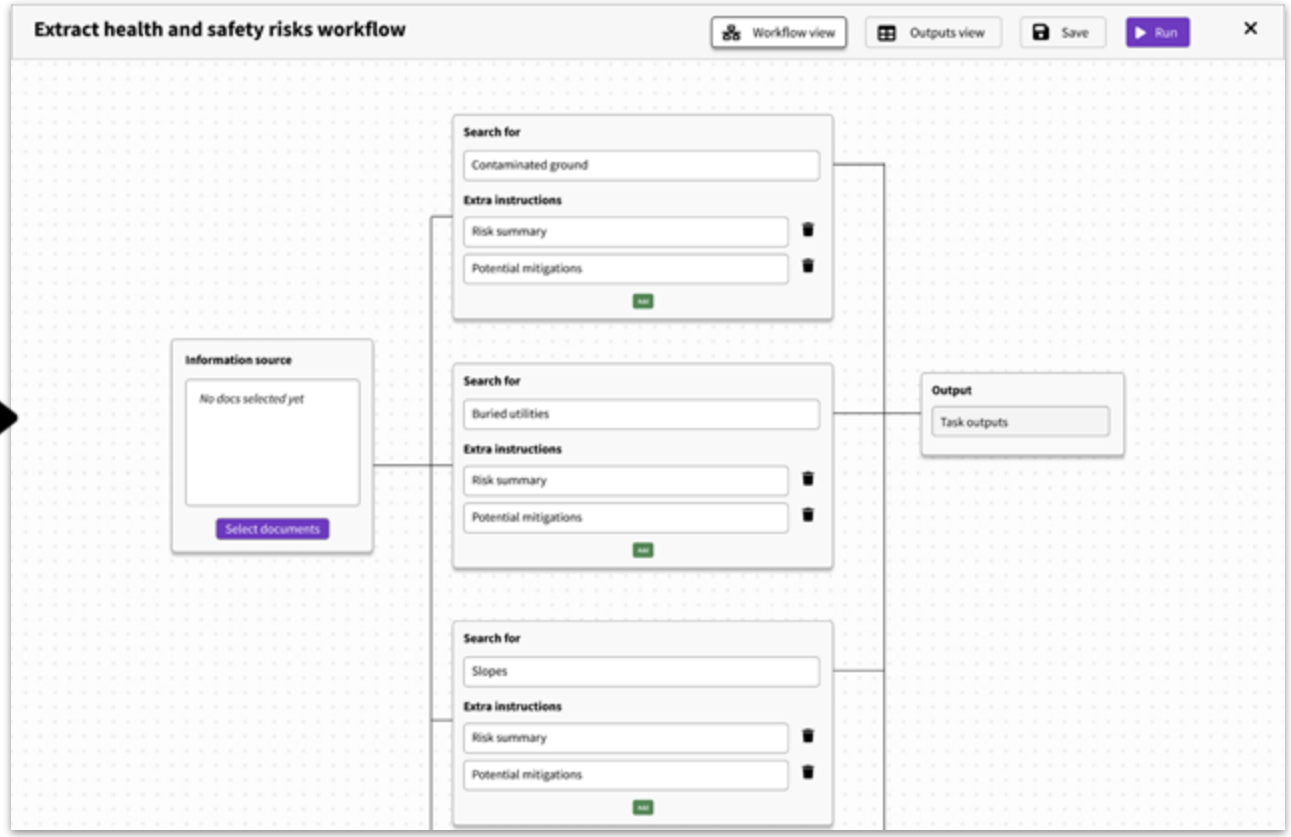
Drawings

Plans & Methods

Building codes

...

Create & publish your own custom AI web applications



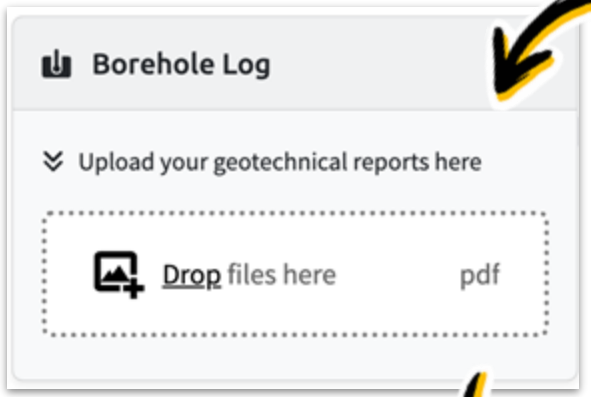
Generate outputs to support decision making

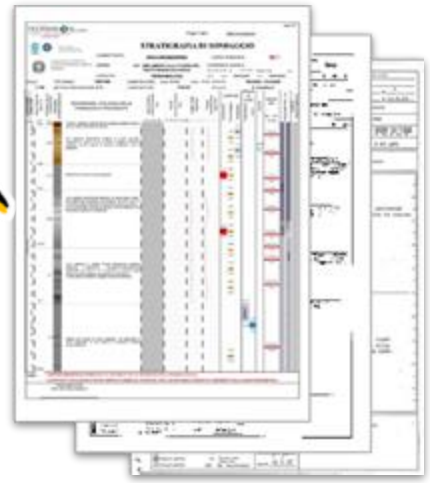
Detect & identify **key risks** & **requirements** on project

Automate **checking** workflows

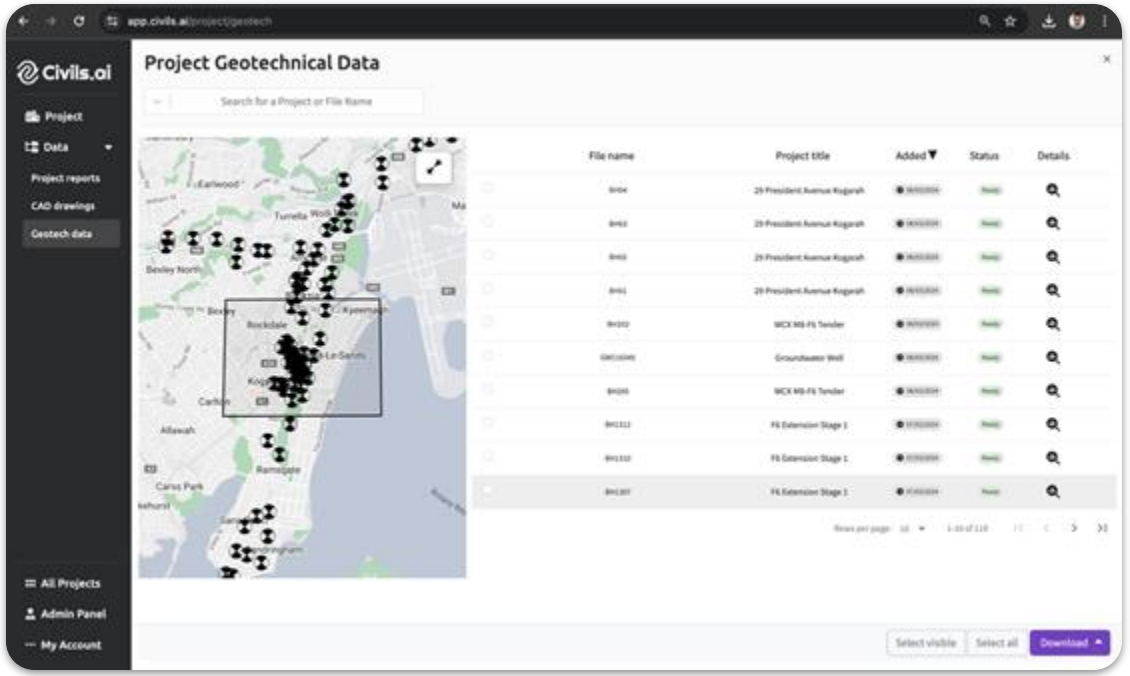
Extract geotech data from tender docs & archives

(**1**) Upload or Sync your GR/SI or Boring logs



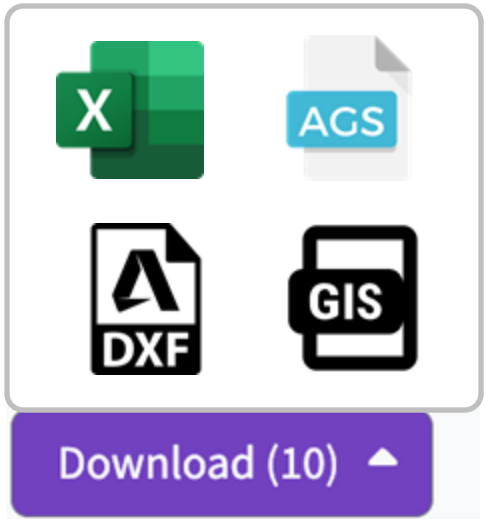


(**2**) Our AI pipeline will extract the key data for you



(**3**) Manage and visualise your boring logs

(**4**) Download the extracted data in different file formats



Data extraction accuracy and reliability

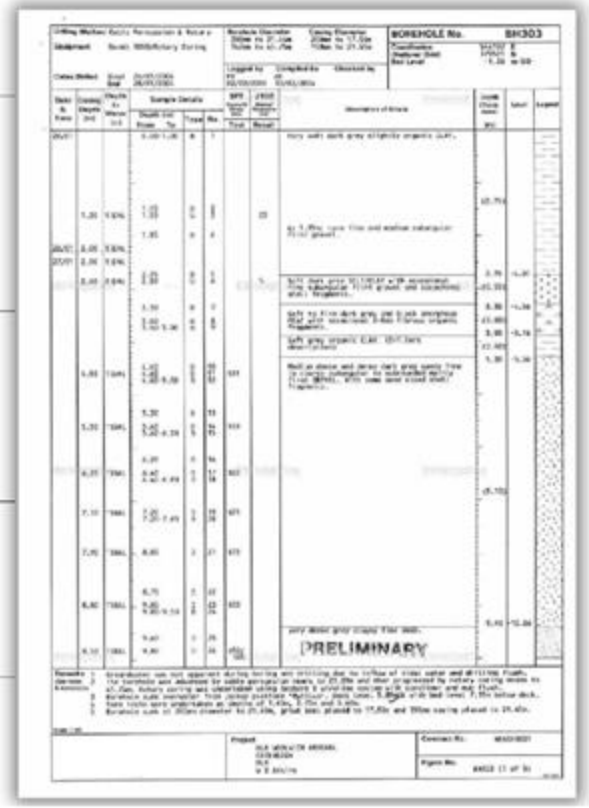
We **extract a wide range of key data** from your borehole logs saving you from hours of repetitive data entry

Meta data:
- Borehole name
- Project name
- Coordinates
- Coordinate system
- Drilling date

Levels:
- Ground level
- Water strike

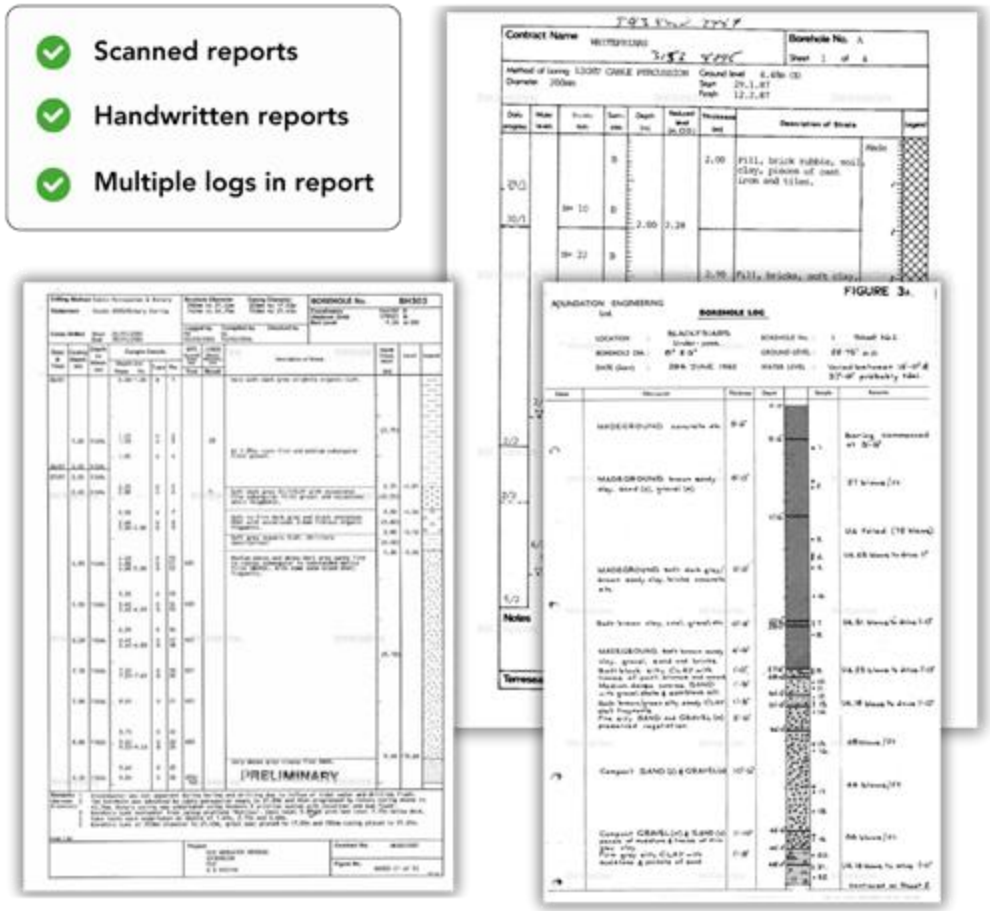
Geology:
- Classification
- Descriptions
- Thicknesses
- Weathering

In-situ tests:
- SPT
- RQD
- TCR
- SCR
- Shear vane



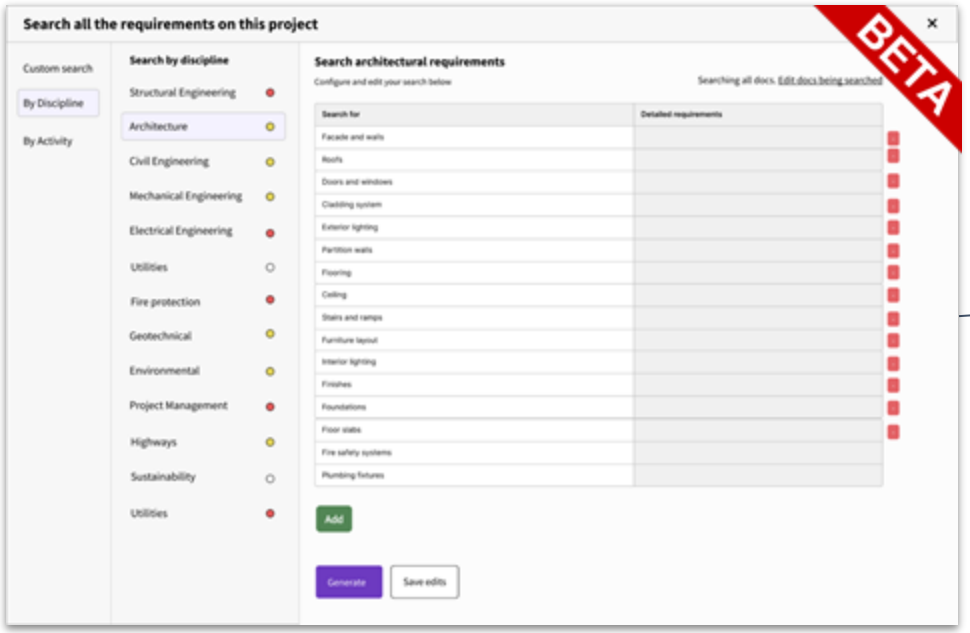
We even **read accurately** from **scanned and handwritten reports**

- Scanned reports
- Handwritten reports
- Multiple logs in report



Extract out other types of data in unstructured documents

1) Upload tender docs



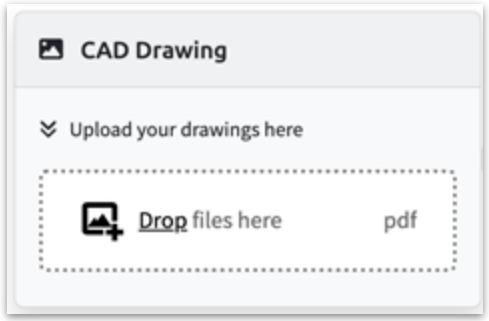
2) Select pre-scripted search templates or run custom searches:

- Unique risks with site location
  - Environmental data
  - Topographic
  - Site constraints
  - As-built information

3) Extract into Excel

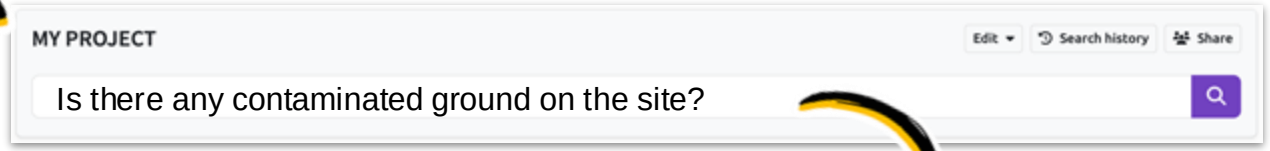
For ongoing compliance: **run quick searches** back against your library of tender docs

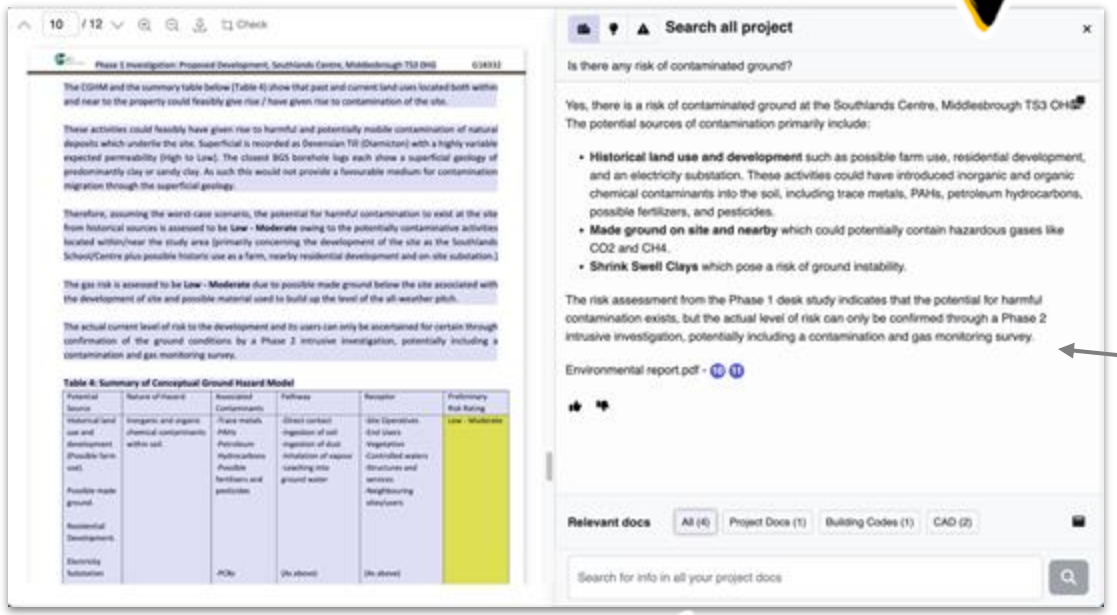
(**1**) Upload or Sync your doc archive(PDF)



✓ Tender docs *(including CAD)*
✓ Building codes

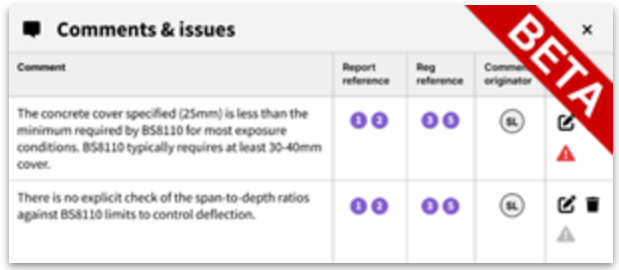
(**2**) Type your prompt or question





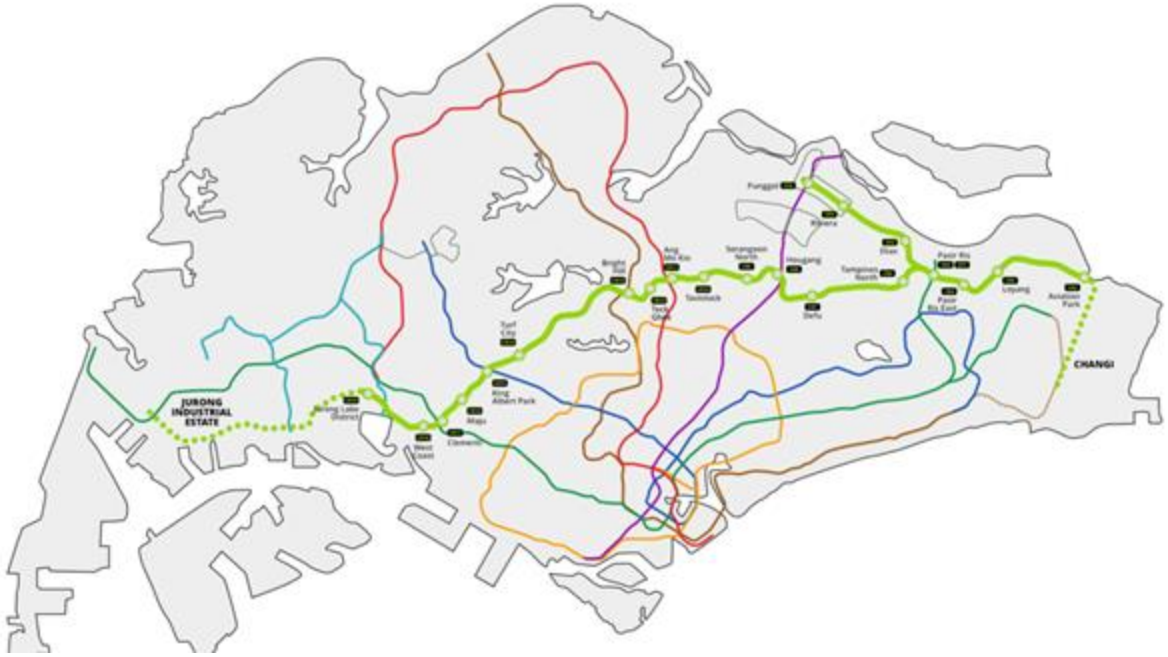
(**3**) Get answers & references

(**4**) Opens the docs



5) Generate lists of risks and non-compliances

Case study on a **tunnel project tender** (2023)



Client: *Confidential*

Project: Cross Island Line - *Package details confidential*

Service provided:

- Civils.ai worked with geotechnical team to **extract data using AI** from hundreds of geotechnical reports
- We **saved 250 man-hours** of repetitive error-prone manual transcription of information from past reports.
- Helped team review tender specifications and optimise their proposals... **they won the work!**

Design cost saving:

$35,000

Time period:

6 months

Case study from compliance checking of **design** of a **$520 million** infra project

473

Queries answered over 3 month period

89%

Output accuracy (user feedback)

20 mins

Time saved per doc + travel time if on site

10×

ROI for design team

Used by 25+ organisations

鹿島 KAJIMA CORPORATION

AECOM

ARCADIS

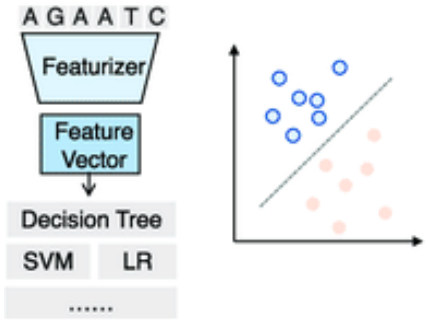
jtc

Jacobs

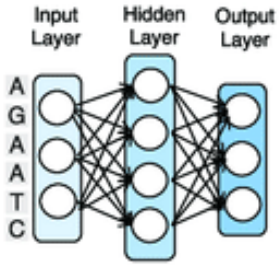
五洋建設 PENTA-OCEAN CONSTRUCTION

What is the underlying technology?

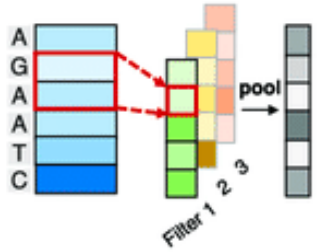
A summary of different available AI technologies



Classical Machine Learning
(Most AI apps use)



Deep Neural Network
(Text to speech)



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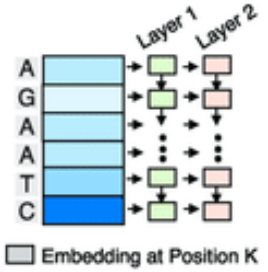

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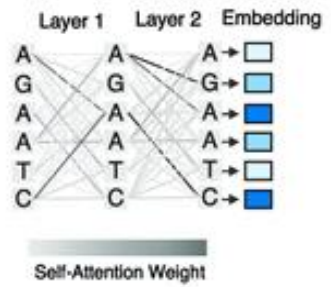
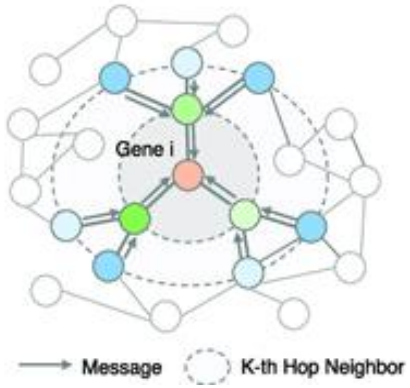
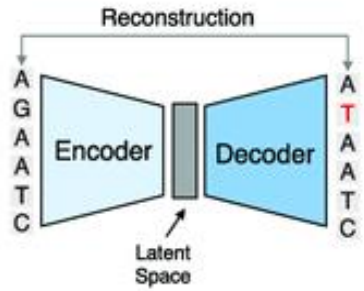
(Text to speech)



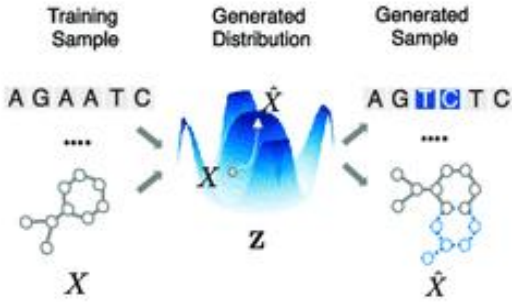
Transformer Model
(Large Language Models)



Graph Neural Network
(Recommendations)



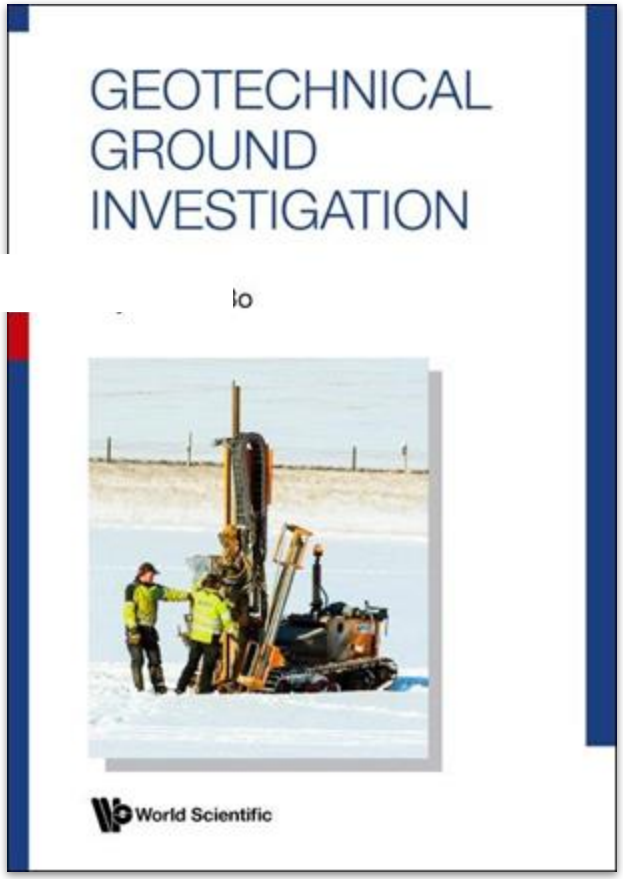
Autoencoder
(Recommendations)

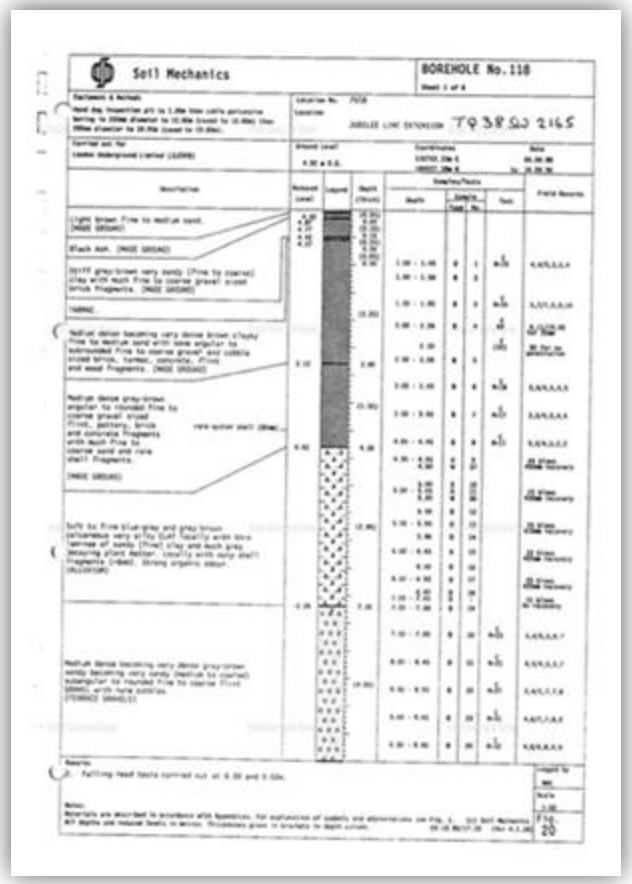


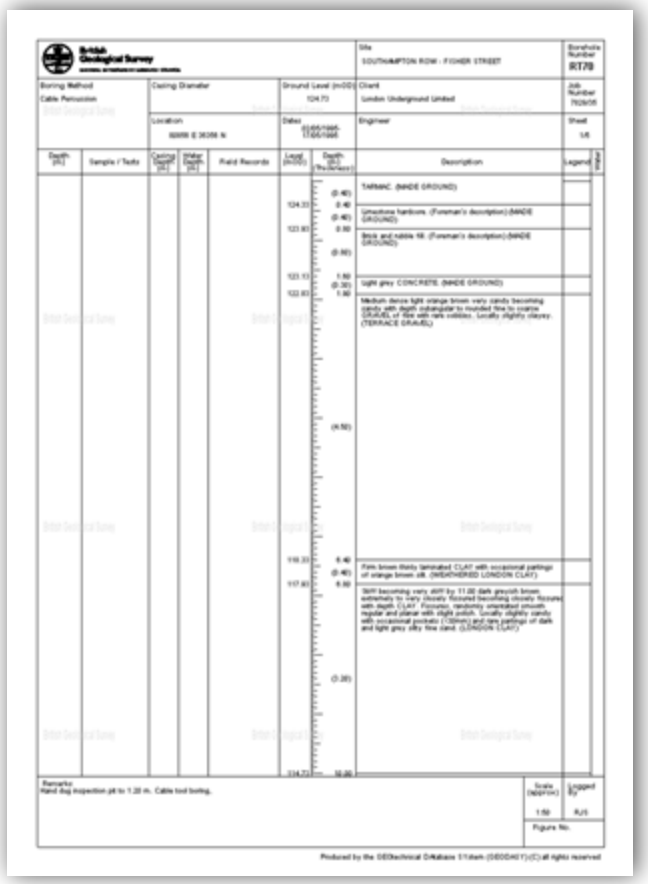
Generative Model
(Image generation)

We use CNN (Vision intelligence) techniques

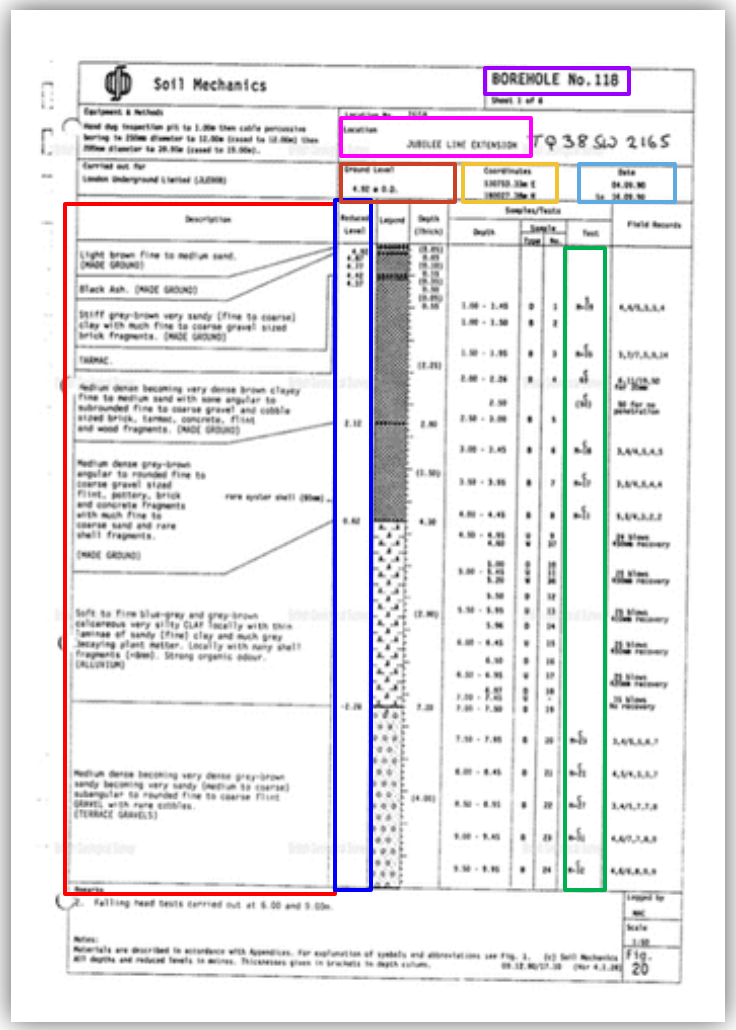
- A lot of geotechnical data in our industry is still sent via PDF’s
- Lots of historical project data in PDF’s

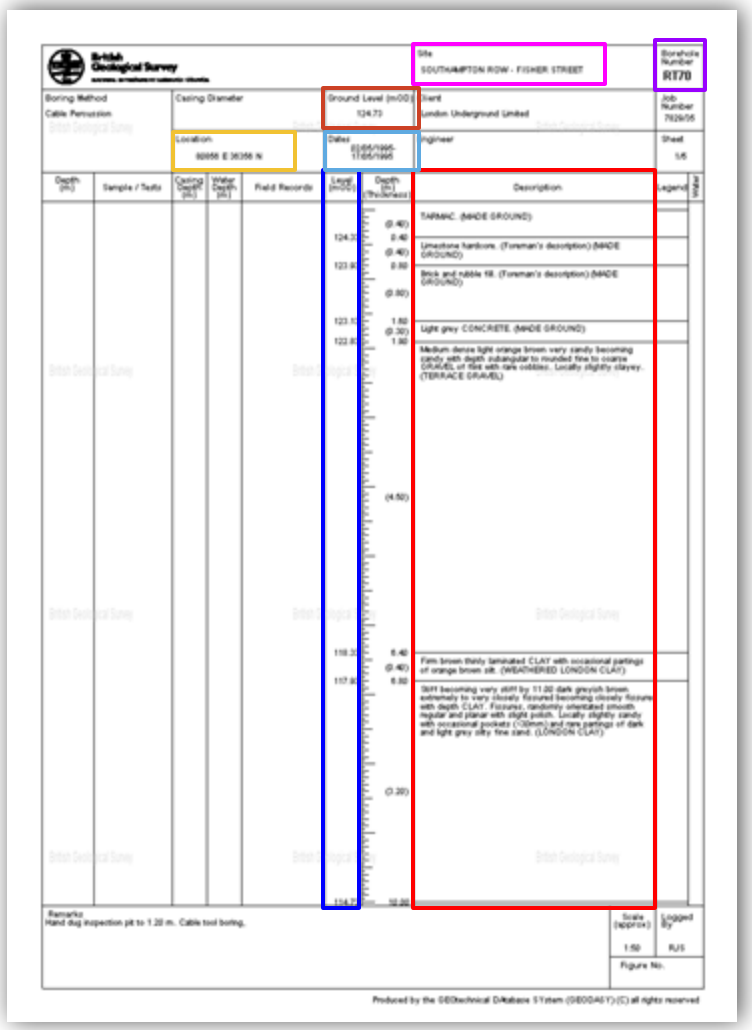






Identifying and labelling is a key part of using vision intelligence

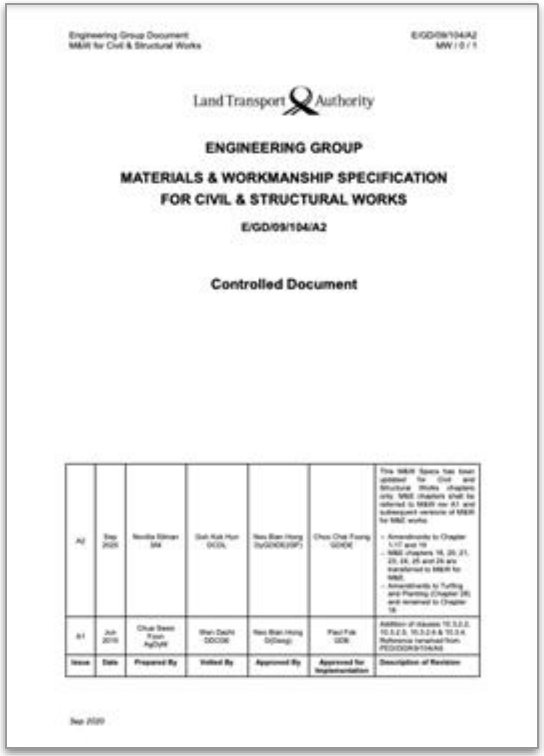




- Geological description
- Levels
- Borehole no.
- Project
- Date
- Coordinates
- Ground level
- SPT count

We use transformer techniques

We use AI embeddings to structure all written text information in tender docs



Engineering Group Document
M&W for Civil & Structural Works

E/GD/09/104/A2
MW / 0 / 1

Land Transport Authority

ENGINEERING GROUP

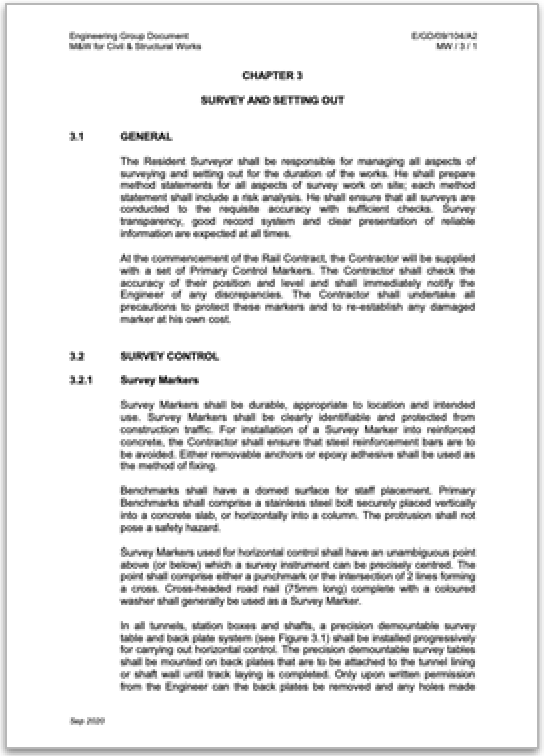
MATERIALS & WORKMANSHIP SPECIFICATION FOR CIVIL & STRUCTURAL WORKS

E/GD/09/104/A2

Controlled Document

A2	Sep 2020	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
A1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Issue	**Date**	**Prepared By**	**Vetted By**	**Approved By**	**Approved for Implementation**	**Description of Revision**

Sep 2020



Engineering Group Document
M&W for Civil & Structural Works

E/GD/09/104/A2
MW / 3 / 1

CHAPTER 3

SURVEY AND SETTING OUT

3.1 GENERAL

The Resident Surveyor shall be responsible for managing all aspects of surveying and setting out for the duration of the works. He shall prepare method statements for all aspects of survey work on site; each method statement shall include a risk analysis. He shall ensure that all surveys are conducted to the requisite accuracy with sufficient checks. Survey transparency, good record system and clear presentation of reliable information are expected at all times.

At the commencement of the Rail Contract, the Contractor will be supplied with a set of Primary Control Markers. The Contractor shall check the accuracy of their position and level and shall immediately notify the Engineer of any discrepancies. The Contractor shall undertake all precautions to protect these markers and to re-establish any damaged marker at his own cost.

3.2 SURVEY CONTROL

3.2.1 Survey Markers

Survey Markers shall be durable, appropriate to location and intended use. Survey Markers shall be clearly identifiable and protected from construction traffic. For installation of a Survey Marker into reinforced concrete, the Contractor shall ensure that steel reinforcement bars are to be avoided. Either removable anchors or epoxy adhesive shall be used as the method of fixing.

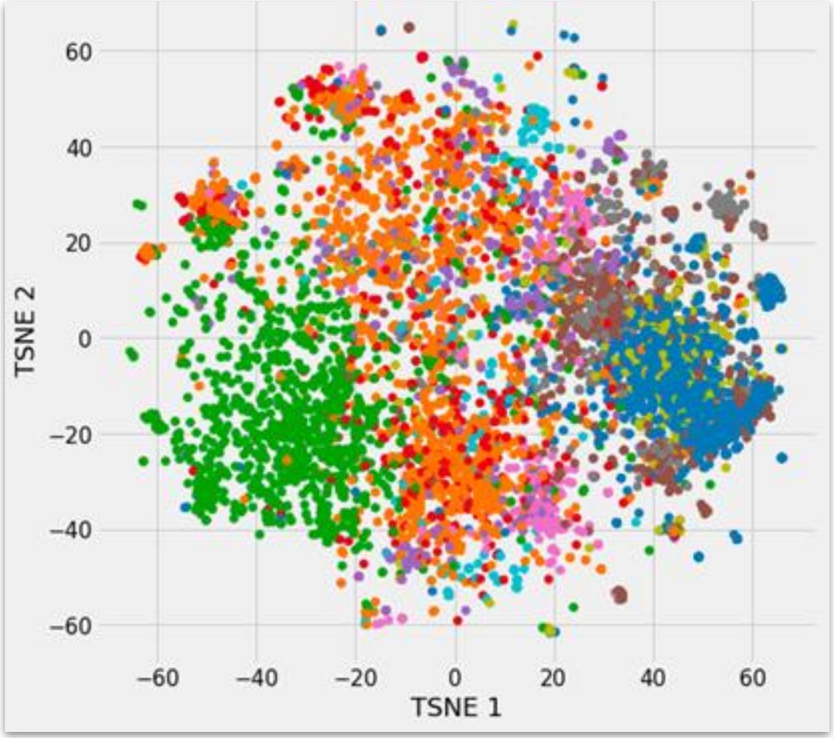
Benchmarks shall have a domed surface for staff placement. Primary Benchmarks shall comprise a stainless steel bolt securely placed vertically into a concrete slab, or horizontally into a column. The protrusion shall not pose a safety hazard.

Survey Markers used for horizontal control shall have an unambiguous point above (or below) which a survey instrument can be precisely centred. The point shall comprise either a punchmark or the intersection of 2 lines forming a cross. Cross-headed road nail (75mm long) complete with a coloured washer shall generally be used as a Survey Marker.

In all tunnels, station boxes and shafts, a precision demountable survey table and back plate system (see Figure 3.1) shall be installed progressively for carrying out horizontal control. The precision demountable survey tables shall be mounted on back plates that are to be attached to the tunnel lining or shaft wall until track laying is completed. Only upon written permission from the Engineer can the back plates be removed and any holes made

Sep 2020

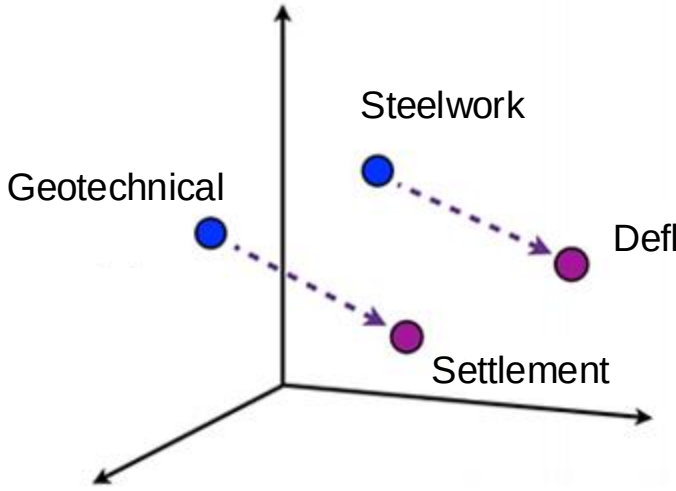
Tender docs



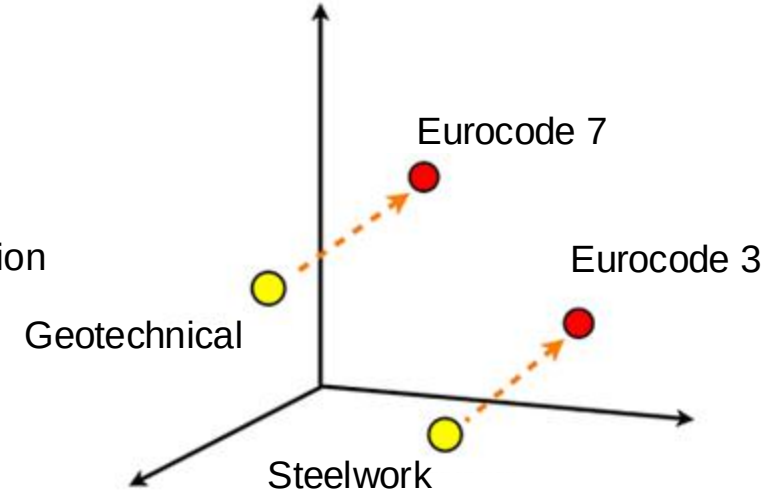
Vector space representing all the words

Transformer techniques

	0	1	2	3	4	5	6	7	8	9
Geotechnical	1	0	1	0	0	1	1	0	0	1
Steelwork	0	0	0	0	0	0	0	0	1	0
Deflection	1	0	0	1	0	0	0	0	0	0
Settlement	0	1	0	0	1	0	1	1	0	0
Eurocode 7	0	0	1	0	1	0	1	0	0	1
Eurocode 3	0	1	0	0	0	0	1	0	1	0



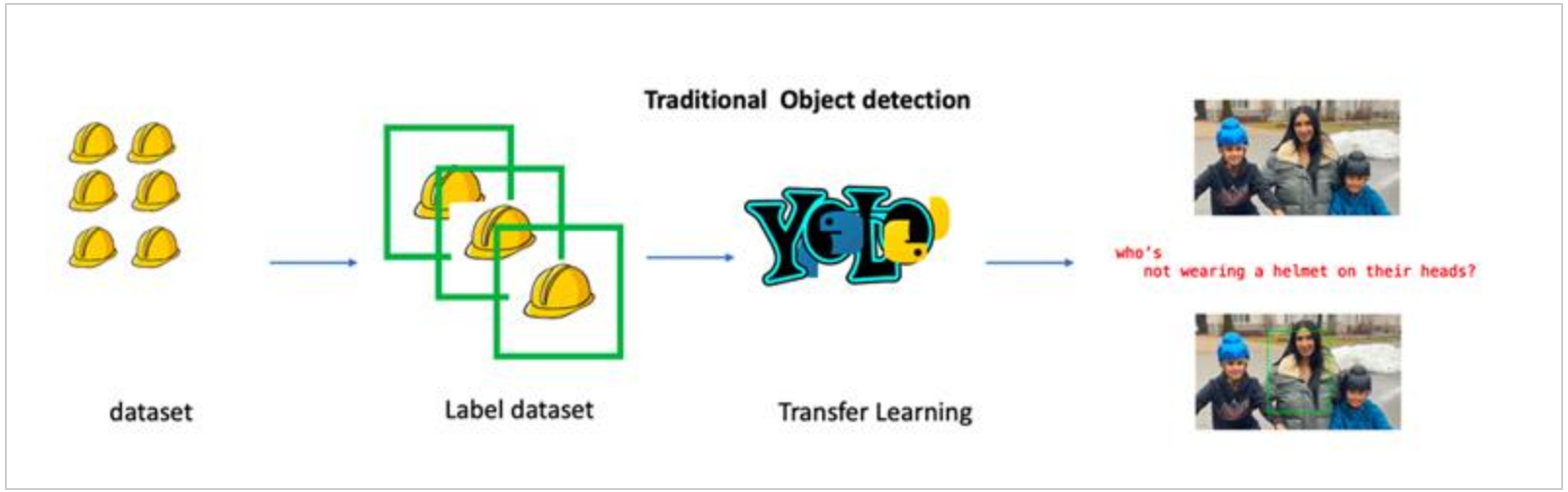
Design type - Design check



Design type - Design code

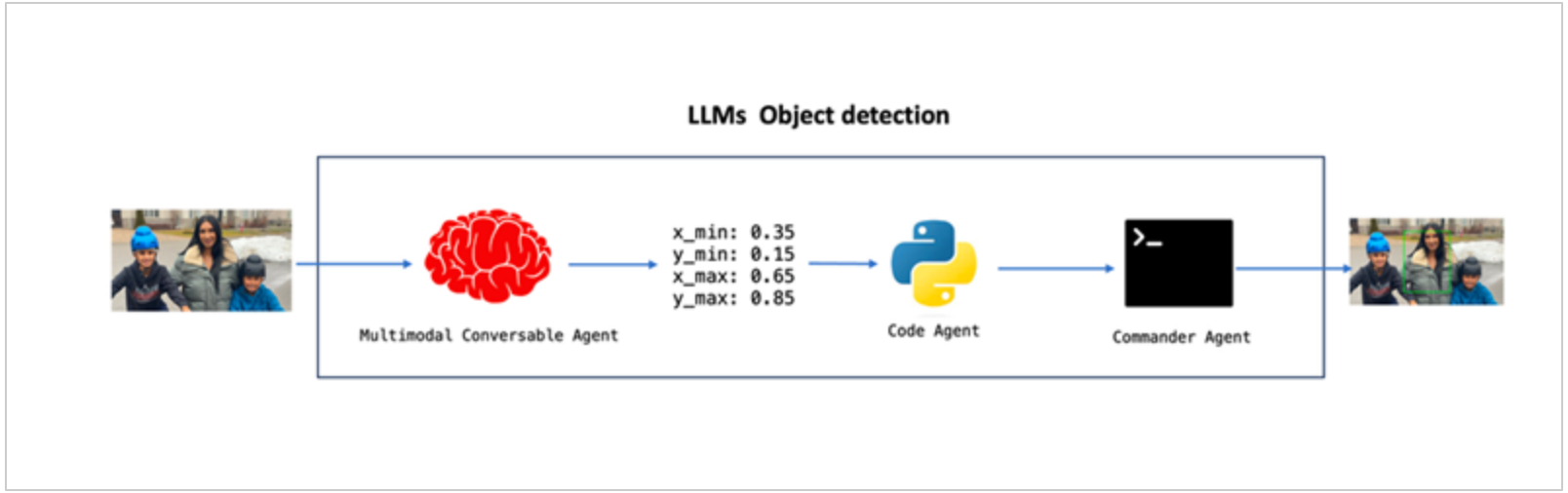
Why do we use these techniques together?

Challenge:
How can i extract structured data from these docs?



Strengths: Accuracy and predictability

Weakness: Where can we get data from?



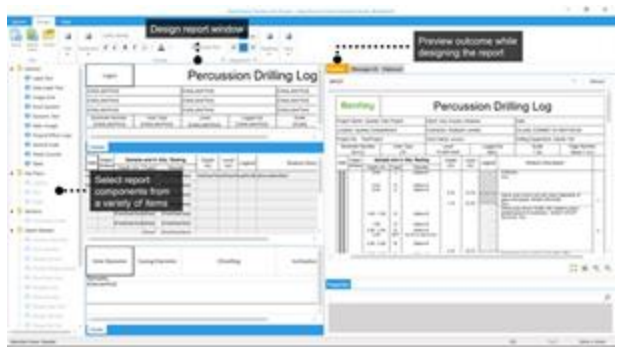
Strengths: Flexibility and efficiency

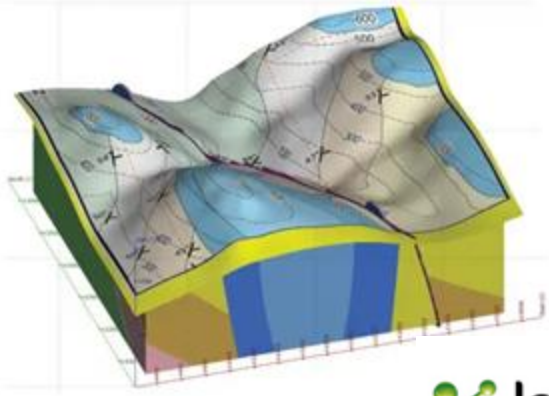
Weakness: Probabilistic results

How can we help with digital twins?

Civils.ai

Automated data extraction and checking workflows





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Thank you for listening

If you are interested in a **trial** please email:

stevan@civils.ai