Digital Subsurface Intelligence

From data to wisdom and back

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GEOSPATIAL WORLD
ADVANCING KNOWLEDGE FOR SUSTAINABILITY

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Mapping Program Lead **Workflow Innovator** **Industry Advocate**

NOTABLE PROJECTS AND ROLES

Project Lead
Digital Underground Singapore, Singapore-ETH Centre (2018 – 2023)

Co-founder and Event Host
Digital Underground Connect, Singapore

Advisor & Innovation Manager
TerraCarta BV, The Netherlands

Project Lead, Trial Trench Database NL
Centre for Underground Construction, The Netherlands

HIGHLIGHTED CLIENTS AND PARTNERS

SLA Singapore Land Authority
City of Amsterdam
Stadt Zürich
Brunei
HEINEKEN
ProRail
STEDIN
COB

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What do we mean by (Digital Subsurface) Intelligence?

information

the ability to learn or understand things or to deal with new or difficult situations

The Wicked Underground

Or why it's really hard to deal with

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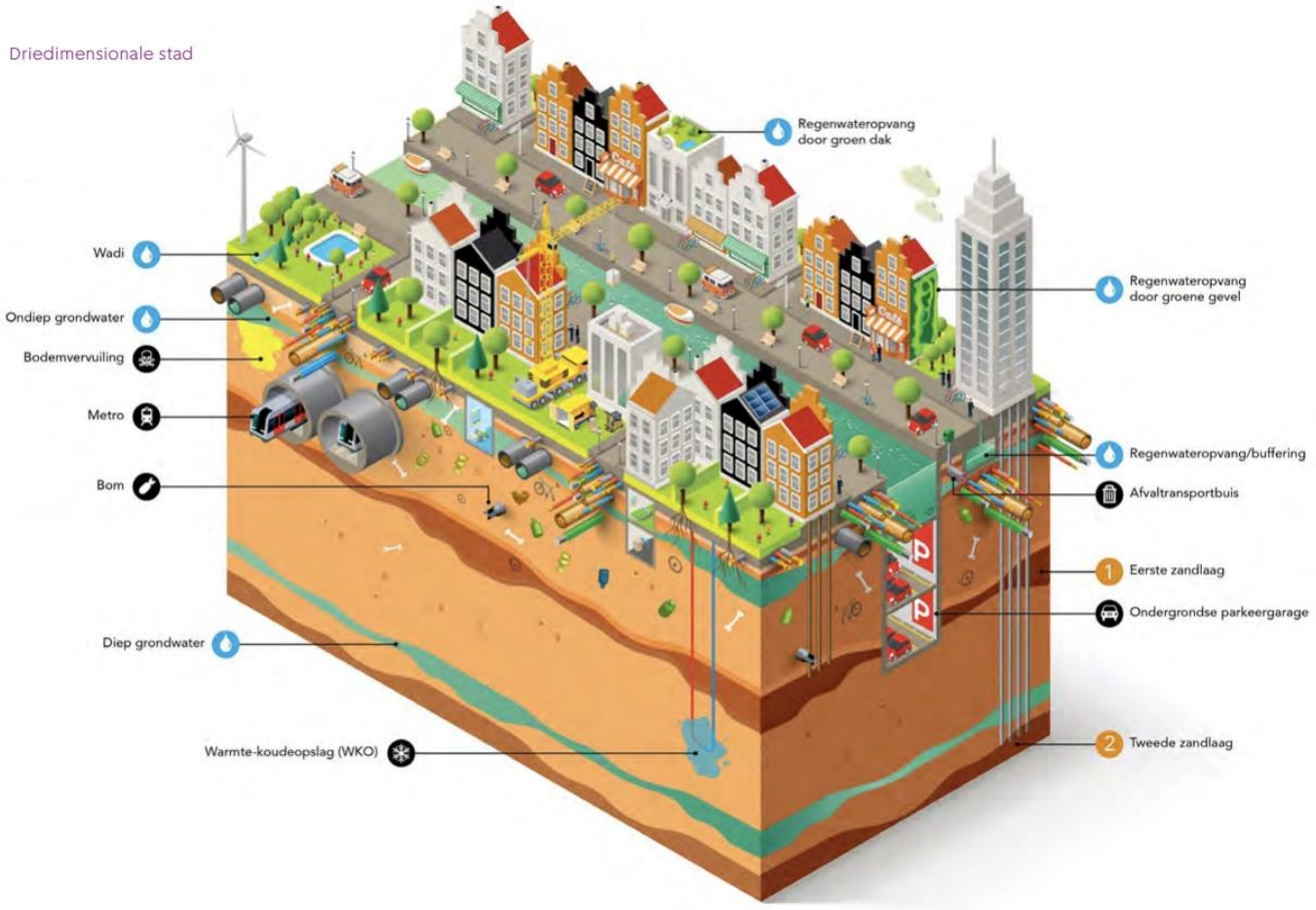


image: Municipality of Amsterdam

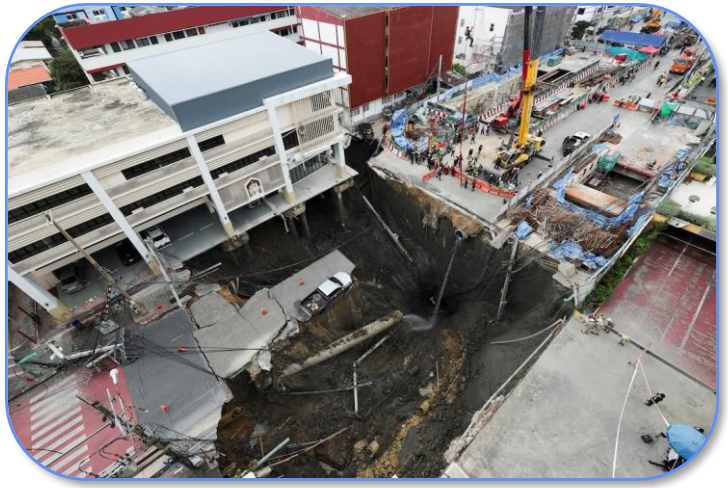
It's complex.
Dense assets. Layers upon layers. Multiple functions and services. Fragmented ownership.

It's opaque.
Invisible and unseen. Observations are spatially and temporally limited.

It's unforgiving.
No quick cheat sheets. No silver bullets. Never-ending uncertainty.

Not dealing with the underground is not an option

What's at stake



Lives

Utility strikes, sinkholes, disruptions

Billions

Cost and schedule overruns, reconciliatory efforts, loss of business

Progress

Inability to effectuate necessary societal advancements and transitions

From left to right: Vajira Hospital sinkhole in Bangkok; Sydney Light Rail; district heating construction in Amsterdam

Rhetorical questions based on real experiences

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Is it intelligent to start your site investigation the day before the shovel goes into the ground?

Is it intelligent to capture, produce, and deliver subsurface data, without ever asking what your client actually needs to do with it?

Is it intelligent to store and share that data in formats and coordinate systems that make integration and reuse nearly impossible?

Is it intelligent to redo the same investigation work - boreholes, trial trenches - in the same area, sometimes within the same project?

Is it intelligent to have data that could have predicted a major incident - and not use it?

Is it intelligent to commission a ground investigation, receive results that call for mitigating action, and proceed with the original plan anyway?

Is it intelligent to build sophisticated 3D and 4D models on underground data that is limited, outdated, or simply theoretical?

Is it intelligent to know that subsurface uncertainty drives significant construction cost overruns, and still allocate a small budget share to resolving it?

Unintelligence ≠ stupidity. Lack of awareness, organisational inertia, limited budget, and many other underlying systemic failures

What these failures have in common

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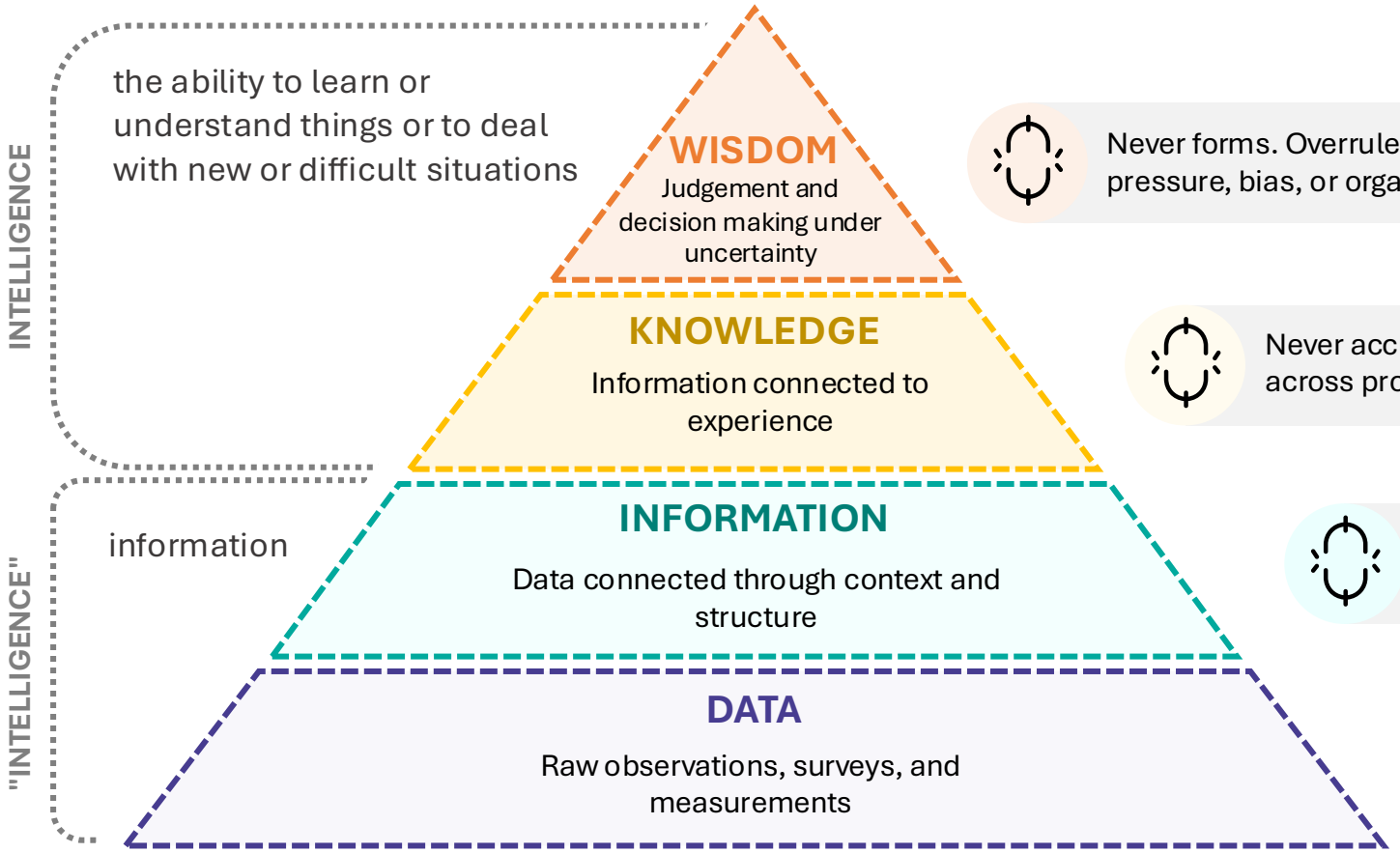

Adaptation from DIKW pyramid, R. Ackoff, 1989

Never forms. Overruled by budget pressure, bias, or organisational inertia

Never accumulated and shared across projects and life cycles

Siloed, PDF-locked, stored in ways that prevent integration and reuse

Collected too late, for the wrong objectives, and without provenance

Where it breaks

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WASTAGE AND REPEATED PAINS

Every project starts from near-zero trust and maximum uncertainty.

“Sisyphus’ eternal task was to roll a boulder up a hill, only to watch it roll back down.”

Questions worth asking

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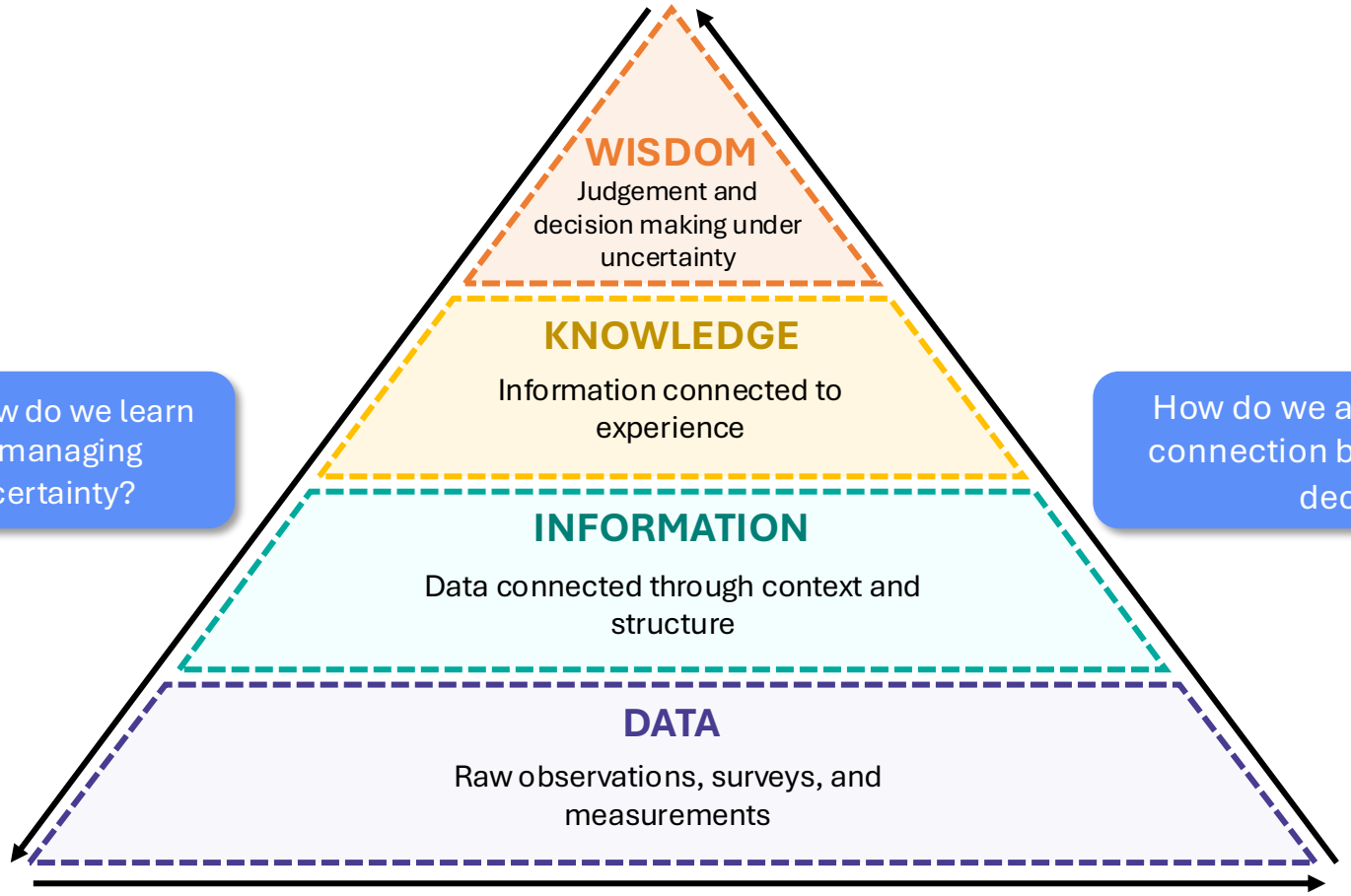

As organisations, how do we learn and get better at managing underground uncertainty?

How do we actually make the connection between data and decisions?

How do we make sure that data and insights live on beyond the lifetime of individual projects?

Examples in practice

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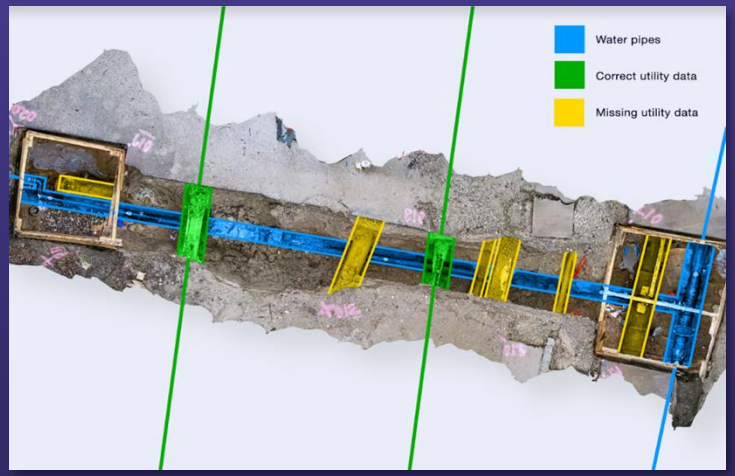
Examples in practice



3D reality capture for subsurface asset management, Novafos DK

- 3D reality capture as standard practice for all open utility trenches
- Reliable documentation of construction work in the field, basis for as-builts
- Reuse of information for asset management, future design and planning

source: Novafos, IT34

Examples in practice

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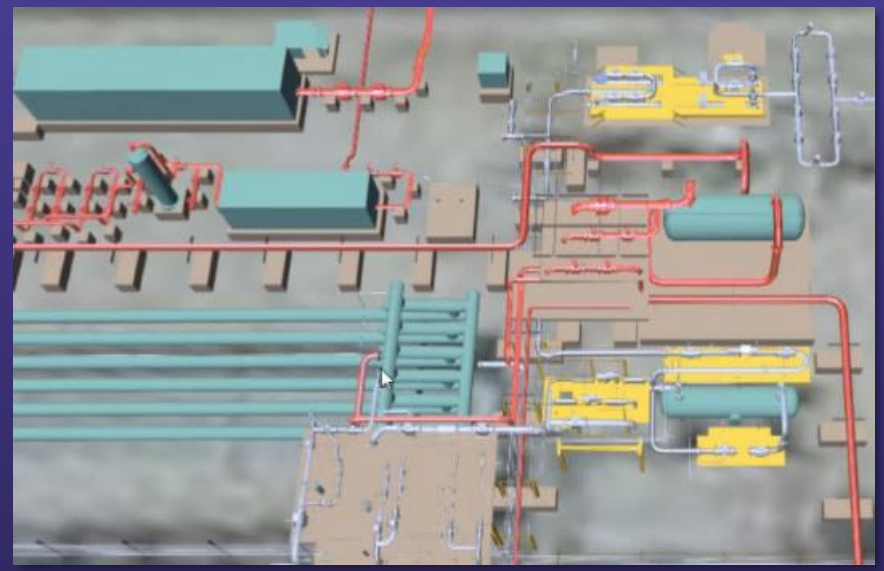

Underground Imaging, Shell Global

- Utility-Mapping-as-a-Service for global projects and assets
- Standard utility mapping workflow with built-in data provenance, traceability and QA/QC
- Results integration into digital twin for construction design and asset management
- Massive excavation cost savings and design clash avoidance benefits

source: TerraCarta BV, Shell

Examples in practice

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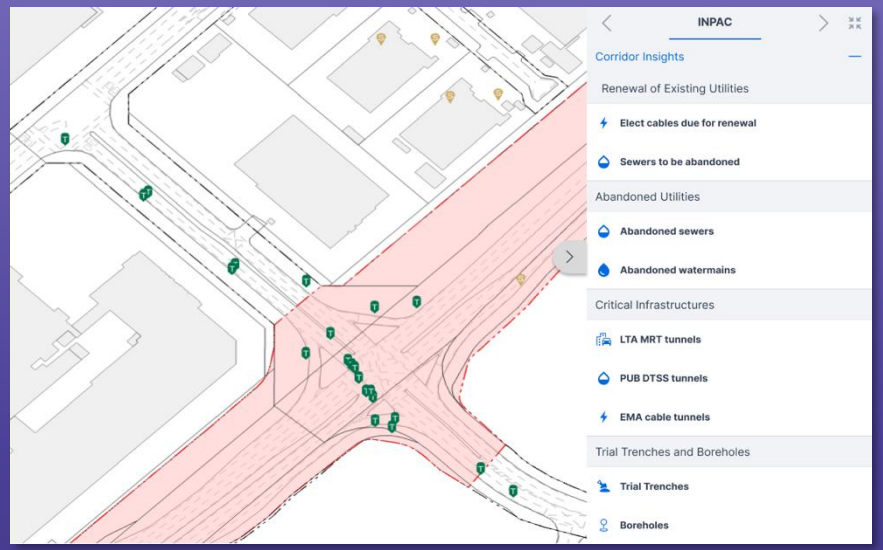

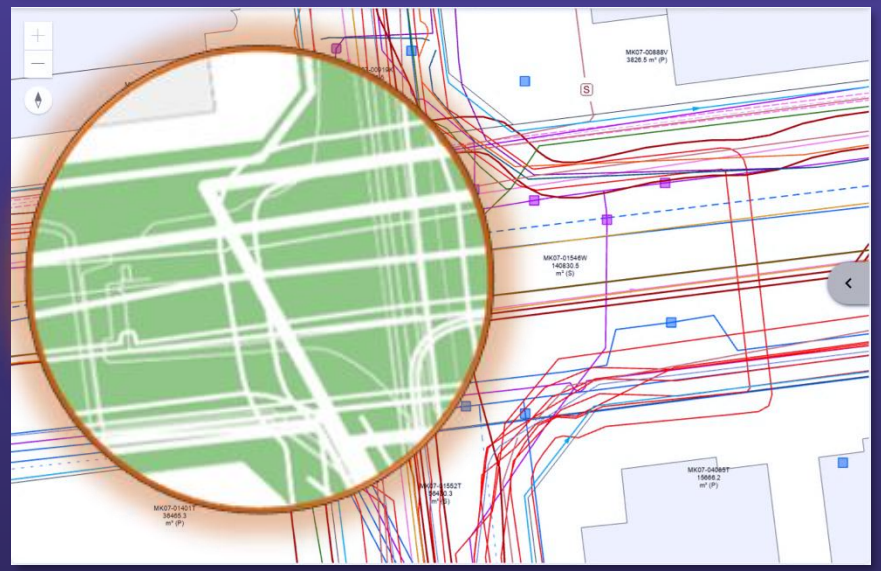

Major Infrastructure Projects Workflow, URA Singapore

- Planning and coordination of major infrastructure projects
- Advanced utility mapping and analysis for optimization of underground space use for existing and future infrastructure
- Data integration to support planning awareness and reuse across organisations, safeguarding of space

source: Urban Redevelopment Authority of Singapore

Examples in practice

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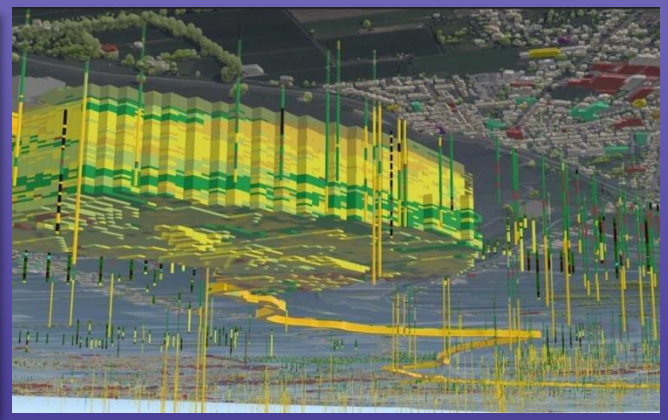
KLIC

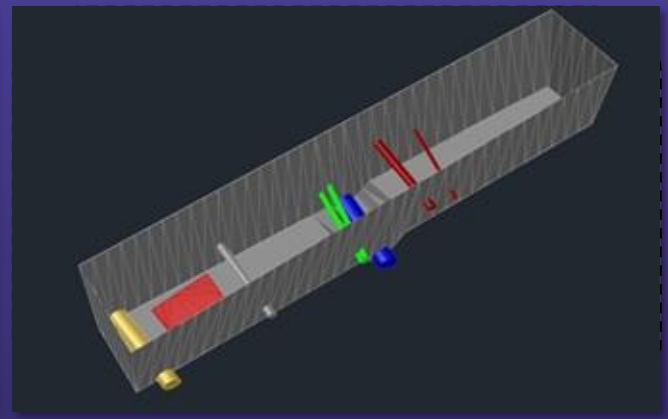


BRO

Advancements in underground data sharing, The Netherlands

- Established utility (KLIC) and ground information data sharing (BRO) platforms
- Proactive sharing of long-term infrastructure plans - infraplannen.nl
- Development of a trial trench database - platform for sharing as-found utility data
- Data-driven programming and design

infraplannen.nl



Trial trench database

Examples in practice

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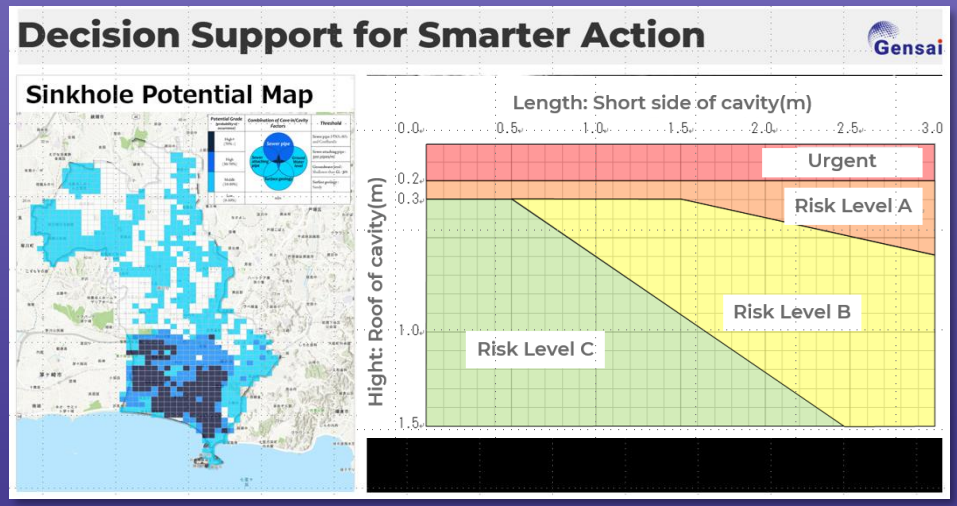


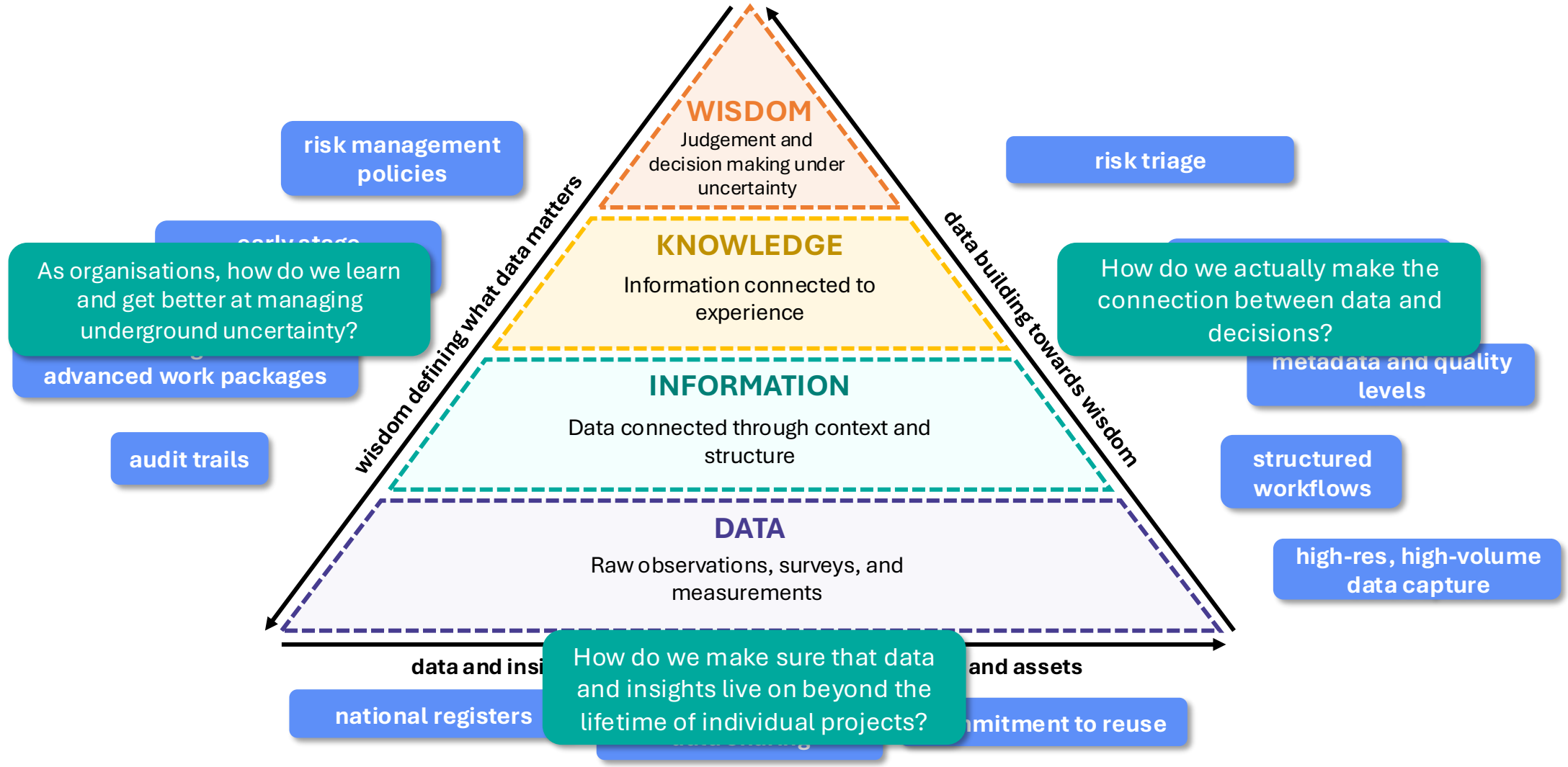
Gensai sinkhole prevention programme, Japan

- National programme for proactive disaster mitigation established in 2025
- Proactive scanning, monitoring, and triage
- Routine operations, emergency response, before and after construction
- Risk-driven decision making

source: Geo Search Co. Ltd.

Back to the pyramid

What we're starting to see



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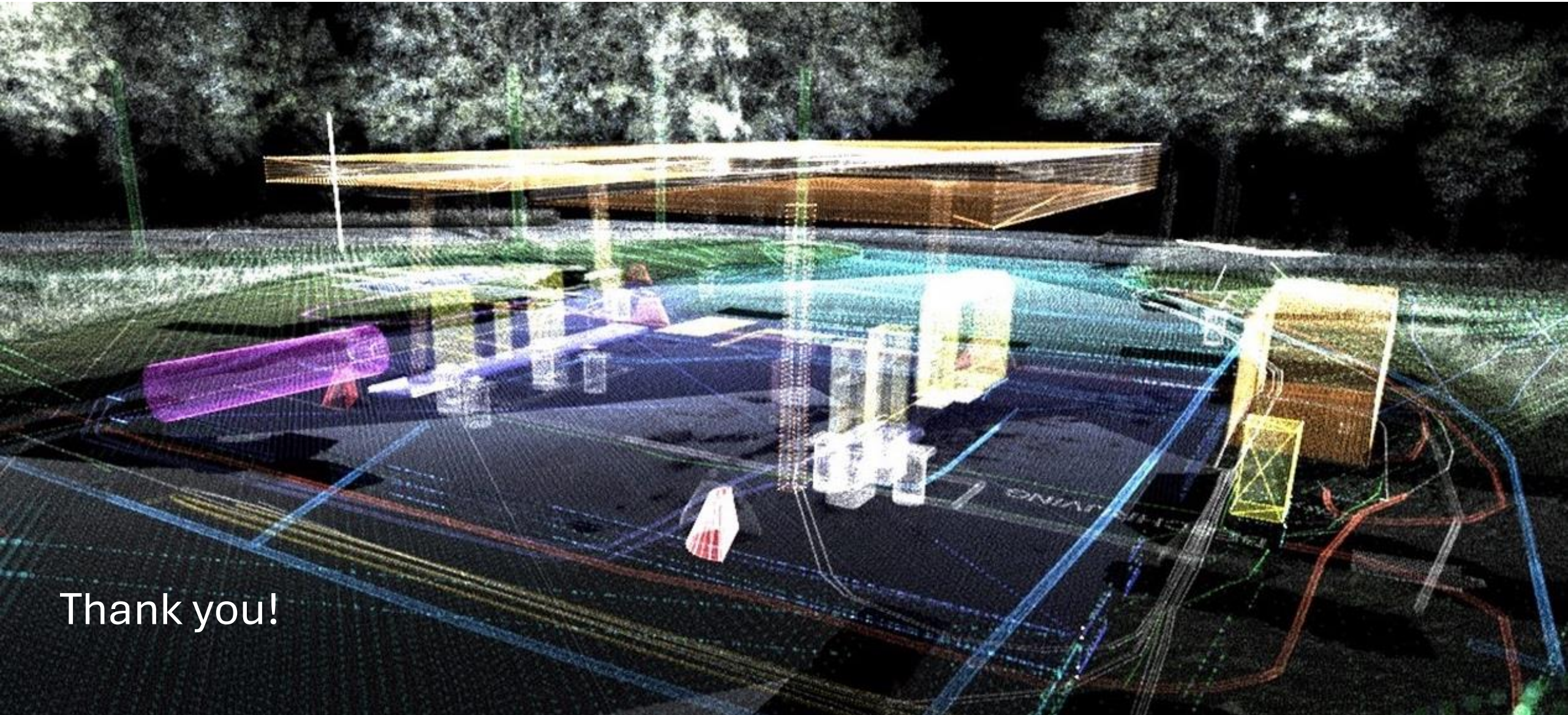

Thank you!