PROJECT ICEBERG

Integrated city data

National Underground Assets and Subsurface Data: Review of use case applications

Iceberg Industry Group Workshop

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Ordnance Survey

Executive Summary

The Iceberg Industry Group represents over 130 organisations who are committed to the improvement of the capture and sharing of information that relates to the subsurface. The open community was formed following the publication of research (2018) into a framework to address shortfalls in subsurface data. The research also informed subsequent programmes, most notably the National Underground Asset Register (NUAR) pilot projects delivered by the Greater London Authority and the Ordnance Survey, funded by the Geospatial Commission (2019). NUAR currently focuses on the development of an underground utility asset register for strike avoidance, with the benefits aligned to Health and Safety related outcomes and planning efficiencies.

Working in partnership with the Geospatial Commission (GC), the Iceberg Industry Group delivered a workshop (Nov 2019) looking at additional applications and benefits, (over-and-above strike avoidance), that may be realised by the creation of an underground asset register and better subsurface data use. Delegates were drawn from the Iceberg committee. The workshop was facilitated by British Geological Survey and Ordnance Survey.

Twelve use cases were reviewed and prioritised relative to delegates' organisation perspective ("what is a priority for your organisation?") and from delegates perceived wider industry perspective ("what do you think is a priority for the wider industry?"), to define the top five use case applications which were subject to a detailed review: Asset maintenance planning; Coordination of street works; Development; Resilience planning (including flood), and Underground space usage. The review addressed the key opportunities and challenge to success (SWOT analysis); gaps in current processes (mapping user journeys), and the primary stakeholders involved.

Common issues arising across the themes include: difficulties in identifying the existence of data ("who do I need to contact?", "what data am I asking for?"); accessing the data (e.g. "is the data business model compatible to my/other 3rd party data?", "are file formats compatible?"); understanding levels of dependency of the data (e.g. what is the currency, accuracy of the data?", "what is the associated risk of me using this data?") and constraints on the use of the data ("can I share this with my contractors?"). A perceived reluctance to share data was consistently referenced, possibly arising from uncertainties of the data quality and its appropriate use. A structured framework (potentially a data catalogue) for reporting data was seen as a means to address this.

Costs of implementation were recognised but were felt to be offset by benefits related to minimising management overhead of addressing uncertainty and the improvement of outcomes from better data. In addition, secondary benefits were identified in the creation of a holistic view for urban development, for example, environmental management. However, alignment of benefits to those carrying the cost needs to be more explicit.

Stakeholder mapping identified common players although with varying levels of significance depending on the use case. User journeys flagged the lack of feed-back loops (ability for 3rd parties to update information based on real world observations) as a significant lost opportunity.

A number of recommended actions have been identified to take the analysis further. These will be examined as part of a detailed analysis of the five use cases and will lead to a prioritisation of issues to be addressed to broaden the application and derived benefits of NUAR.

Background

Project Iceberg

Underground Space or the 'subsurface' is an incredibly complex environment upon which society places an increasing set of needs, such as holding significant utility assets, infrastructure assets and buildings. We are also increasingly reliant on the ground for its environmental functions, for example, flood control, waste storage and extraction of natural resources such as water, aggregate and geothermal heat.

Mounting pressures of affordable housing, infrastructure management, climate change and environmental protection place significant pressure on the finite land resource. Late stage awareness of ground properties and physical constraints to planned development is costly – ground risks are one of main causes of project delay and of insurance claims on completed projects (Chapman, 2008[1]). Meanwhile, according to Transport for London, road works account for 38% of the most severe traffic disruptions across London at a total cost of £752 million. The surface world is mapped down to a matter of centimetres but interest in and understanding of the subsurface is more limited. Underground data is scattered amongst many different public and private organisations, held in different formats. Some data is security sensitive, but much is withheld for reasons of perceived commercial advantage or lack of incentive to invest in data sharing. Critically the holders of this data have different technical expertise, different incentives and different approaches to data utilisation and innovation.

Recognising that this is a national-scale challenge, and the need to collaborate across sectors, the British Geological Survey, Ordnance Survey and Future Cities Catapult initiated Project Iceberg. The aim of Project Iceberg is **to help increase the viability of land for development and de-risk future investment through better management of subsurface data**. To enable a means to discover and access relevant data about the ground's physical condition and assets housed within it, in a way that is suitable for modern, data driven decision-making processes.

Iceberg Phase 1 was completed in early 2018 and comprised three work packages:

i. Mapping underground assets in the UK: Market research into current state of play and global case studies
ii. A unified data framework for mapping underground: defining the problem space for an integrated data operating system above and below ground
iii. Use case applications: How integrated data can benefit real people.

Outputs from Iceberg Phase 1 are openly available online[2]

The main recommendation from Iceberg phase 1 was for:

"A data-exchange framework for the subsurface that can be integrated with existing city data systems. A consistent framework into which data is supplied, assured, stored, accessed and analysed by a multitude of users in the short term."

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[1] Chapman, T. (2008) The relevance of developer costs in geotechnical risk management. In: Foundations: Proceedings of the Second BGA International Conference on Foundations, ICOF2008. Brown M. J., Bransby M. F.,Brennan A. J. and Knappett J. A. (Editors). IHS BRE Press, 2008. EP93, ISBN 978-1-84806-044-9.

[2] https://www.ordnancesurvey.co.uk/business-government/innovation/underground-infrastructure

Capitalising on the cross-industry interest in Iceberg Phase 1 and its findings an Iceberg Industry Group was established. The Iceberg Group currently has more than 230 registered members from 136 organisations and a committee of around 20 cross-industry representatives. The Group is led by the British Geological Survey and the Ordnance Survey and is recognised by the Geospatial Commission as an independent think-tank.

The Geospatial Commission

The Geospatial Commission is an expert committee within the Cabinet Office established to maximise the value of geospatial data and help to grow the UK's digital economy.

The Commission provides innovative solutions for identified strategic challenges, and accelerates delivery of economic, social and environmental benefits derived from geospatial data, working with private and public sectors. To enable this the Commission brings together data producers, particularly those in the public sector, to make the production and access to data more coordinated, useful and seamless. The overarching objectives of the commission are to increase economic growth and improve social and environmental outcomes by:

- setting cross-cutting geospatial strategy, policy and data standards
- promoting competition within markets for geospatial data, products and services
- improving accessibility, interoperability and quality of data
- improving capability, skills and resources to support the growth of new and existing geospatial businesses and improve public services

As part of providing strategic oversight of the geospatial ecosystem in the UK, the commission has a close relationship with six, core 'partner bodies' with diverse functions, organisational status and business models.

The partner bodies are: The British Geological Survey; The Coal Authority; HM Land Registry; Ordnance Survey; UK Hydrographic Office; The Valuation Office Agency.

The Geospatial Commission's Strategic Priorities for 2019-2020[3] identify the challenges of data management, particularly underground asset data, across the Infrastructure and Construction Sectors. In consultation with key stakeholders, including the Project Iceberg team, the Commission undertook a research exercise to understand the market, business needs and existing exemplars of good underground data management in the UK and internationally.

In April 2019, as a result of this research exercise, the Geospatial Commission announced a £3.9m investment for two pilot projects in the North East of England and London to evaluate the benefits of a National Underground Asset Register (NUAR). These two pilot projects focus on specific use cases related to strike avoidance and improved efficiency of planning excavations, and will provide learnings, evidence and recommendations to inform a planned national implementation. Working in partnership with the Geospatial Commission, the Iceberg Industry Group will be reviewing additional applications and benefits over and above the pilot use cases that may be enabled by the creation of an underground asset register and better subsurface data use.

[3] Geospatial Commission Annual Plan 2019/20, HM Government. April 2019. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/799197/6.5522-CO-GeospatialCommissionAnnualPlan.pdf

	Use case	User needs	Reason
Street Works	Coordination of street works	Asset owners / local authorities need to understand all available underground asset data, maintenance plans and to integrate with street works registers	To better coordinate street works for utility maintenance, leading to less overall disruption
	Aligning with street works notifications	Asset owners / local authorities need to make sure that the execution of works is a single process for the asset owners	To remove duplication and rework in the process of notifying and agreeing execution for works particularly in complex environments
Resilience	Resilience planning	Government planners need to identify critical and vulnerable infrastructure assets	To better understand criticality and risk to better inform emergency, security, and disaster response planning
	Emergency response	Emergency responders need to access up to date underground asset data live	To better understand an emergency involving utility assets and can take immediate informed action
Asset Management	Telecoms network deployment coordination	Asset owners need to identity the state and attributes of underground infrastructure assets	To coordinate between utility companies leading to more efficient infrastructure deployment (e.g. broadband roll-out in the EU Cost Reduction Directive)
	Utility maintenance planning	Asset owners need to integrate and compare underground infrastructure location with environmental data (e.g. soils, geology, groundwater)	To identify environmental risks to their assets and mitigate the effects
Development	Underground space usage	Urban planners need to integrate and compare underground infrastructure location with environmental data (e.g. soils, geology, groundwater)	To make the business case to move above-ground facilities underground (thus freeing up land for development)
	Development	Developers need to integrate buried utility/infrastructure data, including location, condition and capacity, with surface infrastructure maps	To have a complete view of surface and subsurface infrastructure to result in more efficient development searches and plans
	Smart cities	Urban planners need to identify locations and attributes (e.g. capacity, type) of underground infrastructure	To support the deployment of Smart City infrastructure (e.g. sensors) through existing services use or new services rollouts
Environment	Managing heritage assets	Academic researchers / excavators need to identify sites of buried archaeological interest	To better manage or protect sites of archaeological interest
	Flood risk planning	Government planners need to integrate location and condition of subsurface waterways (sewers, culverts) with environmental data and current flood protection	To understand and have a holistic view of the entire urban environment to better plan for flooding
	Natural resource management	Regulators and Planners need to integrate underground asset and environmental data	To safeguard natural resources (such as groundwater) by optimising the location of underground assets

Table 1 High-level Use Cases identified during the Geospatial Commission's National Underground Asset Register (NUAR) research phase

Introduction

An Iceberg Industry workshop was held at the OS Geovation Hub in London on 13th November 2019 to provide an initial evaluation of the additional applications and benefits of an underground asset register and better subsurface data use. The workshop was attended by members of the Iceberg Committee (Table 2) and facilitated by Stephanie Bricker (British Geological Survey), Katy Freeborough (British Geological Survey) and Rollo Home (Ordnance Survey).

The workshop was designed around an initial brainstorm and prioritisation activity focused on the NUAR use cases and the themes they cover. Twelve additional use case applications were reviewed during the workshop (Table 1), these use cases were provided to the Iceberg committee by the Geospatial Commission and originate from the NUAR Stakeholder consultation exercise and business case review. The prioritisation exercise was followed by a more detailed review of five uses cases identified by the group to be of greatest priority and interest for the industries represented.

Workshop Attendees

Christiana Amacker	Greater London Authority	James Kilroy	LandScope Engineering
Simon Bailey	GeoPlace	David Latham	Kent County Council
Neil Brammall	Geospatial Commission	Katie Lysons	Arup
Stephanie Bricker	British Geological Survey	Nelio Matos	Connected Places Catapult
Katy Freeborough	British Geological Survey	Ben Nduva	SCISYS
Chris Gaunt	Landmark	Paul Nicholls	Skanska
Ben Gilson	Arup	John Robinson	Malcolm Hughes Surveys
Rollo Home	Ordnance Survey	Alex Sage	Atkins
Matt Hayes	VU City	Fionn Wardrop	LinesearchbeforeUdig

Table 2 Workshop attendees

Geospatial Commission Baseline Data

Neil Brammall (Technical Advisor to the Geospatial Commission) provided the group with an update on current activities within the Geospatial Commission relating to the National Underground Asset Register, reaffirmed the GC's wish to engage with the Iceberg Industry Group and promoted a 'call to action' to assist in the collection of baseline data on utility strikes.

The Geospatial Commission is focusing on a safety use case for the NUAR pilots – Strike avoidance (with associated efficiency benefits). The estimated economic cost of accidental strikes on underground pipes and cables is £1.2 billion a year. However, it is difficult to accurately quantify the costs as comprehensive data on utility strikes in the UK is lacking and the root cause of incidents is often unknown. The Geospatial Commission are hoping to improve this situation in the coming months by engaging industry in a two-part survey to gather further data and evidence:

1) Broad industry survey on strike numbers
2) Research into detailed cause of strikes events

The Iceberg Committee will be contacted by the GC in due course to assist in the baseline data survey.

Whilst the current focus of the Geospatial Commission NUAR pilots is strike avoidance and safe digging, the GC are keen to gather further evidence in support of the additional use cases to enable further discussion on potential future activities and welcomed the review piece by the Iceberg Committee.

Discussion points:

Q: Utility Strike Data – are the Geospatial Commission interested in regional or wide-spread (national) strikes as information, quality and response might be very different between industries and regions?

A: The work is driven by realities for data and data collection, which is yet unknown. Ideal is national view but if only localised/ regional data is available this can be extrapolated. The quality of data is currently unknown – e.g. Utilities companies may have data relating to damage to their assets but lack information on the root cause.

Q: Will event information be stored in accessible GIS?

A: Potential issues may arise with GDPR and data privacy. The Geospatial Commission will be assessing these issues, as a potential interim solution postcode summary data may be presented.

Q: Lessons learnt would be good output?

A: Yes, agreed. The main output will also be continued future data collection to keep up base line of trends information.

Q: Costs to industry (e.g. retail, schools, etc.) and knowledge of infrastructure may be a key dimension for further analysis of information?

A: Yes, agreed. University of Birmingham studies[4] and cost of damages also forms part of the research.

Users of the NUAR would be interested in all asset owners not just utilities e.g. inclusion of roads, pathways, transport tunnels etc. Not all users of the NUAR are utilities companies.

There may be blockers and data protection in terms of sharing data, even from interested parties (e.g. MOD underground assets). How should these be considered in discussions?

Key Actions:

- GC to circulate requirements for the Baselines Data survey to the Iceberg Committee when the details are confirmed.
- Iceberg Committee to contact Neil Brammall at the GC with any follow-up queries on the Baseline Data research.

[4] https://www.birmingham.ac.uk/research/activity/civil-engineering/environmental/future-cities-and-infrastructure-engineering-research.aspx

Pre-Workshop Survey

Prior to the workshop, a questionnaire was sent out to all invited participants. The survey was designed to gain initial feedback on the twelve proposed use cases. Participants were asked to prioritise each of the use cases from 1 (low) to 5 (high) from both their organisation's perspective (what is a priority for your organisation?) and from their perceived wider industry perspective (what do you think is a priority for the wider industry?). Participants were also asked to group similar or linked use cases into themes.

The results from the Survey are presented in the table below (Table 3). Two scores are provided for each use case, the first is the average score, and the second is the percentage of the scores that were a four or a five. It can be seen that Coordination of street works was considered a top priority for both organisational and wider industry perspectives. Aligning street works notifications and Development also ranked as high priority, although changing slightly in final rankings between organisation and wider industry. These were put forward as the key discussion topics for the workshop.

The other use cases changed in priority with organisational experience favouring underground space usage, flood risk planning and smart cities as priority use cases, and views on the wider industry favouring resilience planning, emergency response and utility maintenance planning.

Individual organisation perspective

	Priority Score	% of 4 and 5 scores
Coordination of street works	3.87	73
Development	3.86	64
Underground space usage	3.64	50
Aligning with street works notifications	3.47	67
Flood risk planning	3.43	43
Smart cities	3.40	53
Utility maintenance planning	3.36	50
Resilience planning	3.14	50
Managing heritage assets	3.07	50
Telecoms network deployment coordination	2.87	40
Emergency response	2.79	36
Natural resource management	2.69	23

Perceived wider industry perspective

	Priority Score	% of 4 and 5 scores
Coordination of street works	4.73	100
Aligning with street works notifications	4.27	80
Development	4.13	67
Resilience planning	4.07	80
Emergency response	4.07	73
Utility maintenance planning	3.80	60
Smart cities	3.73	67
Telecoms network deployment coordination	3.67	67
Underground space usage	3.67	53
Flood risk planning	3.53	47
Managing heritage assets	2.87	40
Natural resource management	2.73	7

Table 3 Use Case Prioritisation based on the results of the pre-workshop survey completed by the Iceberg Committee

Value of the Underground

As an introductory exercise, workshop attendees were asked to introduce themselves and offer a view on the value of the Underground/Underground Asset Register. The aim was to understand individual interests in the NUAR use cases and motivations for improved subsurface management.

The responses can broadly be categorised as follows:

Cost-Value: reducing inefficiencies and costs in obtaining data and increasing the value of data through data-sharing and increased usage.

Risk: access to more accurate spatial data to reduce project risks. Collaborative action to reduce shared and/or cascading risks.

Underground Usage: improved management of underground space and greater promotion of the potential uses of underground space. Understanding the interactions between surface and subsurface.

Data Standards: Improved data model compliant with ISO/PAS standards, to improve data collection, reduce data loss and support data-driven decision-making.

Safety: reduce uncertainty and increase safety associated with digging and underground development.

Brainstorm activity – Subsurface considerations for the identified use cases

Use Case Groupings

For the brainstorm activity, the 12 use cases were grouped into five broader themes, Street Works; Utilities Management; Resilience; Development; and Environment (Table 1) based on the results of the pre-workshop survey. The grouping of the use cases and the terminology used to describe the uses cases was discussed during the workshop, with the key points summarised as follows:

Q: Street works and Utilities management could be considered together?
A: These items were separated out to distinguish based on spatial considerations – local digging for street works vs regional-strategic utility management and planning.

Telecoms is key priority at present – the bigger picture is often a key driver to localised activity and how to choreograph street works.

Highway maintenance shouldn't be ignored as provides a key link to underground assets

We should be considering all assets, not just utilities.

'Works' promoters are a key target – they collate asset owners within a spatial location.

Key Actions:

- Change theme from utilities management to 'Asset Management'
- Change use case from utility maintenance planning to 'Asset Maintenance planning'
- New possible case studies identified:
    - Clash Detection
    - Geo-technics
    - Wayleaves (management of rights of access)

The group were asked to align themselves with one of the themes for the brain storming activity. It was apparent initially that many of the attendees were aligned to the 'Development' theme. Brief discussion highlighted that the Environment theme and the aligned use case topics were not well represented by attendees in the room, and expert input would need to be sought from beyond the workshop participants. The resilience and environment themes were combined for the purpose of the brainstorm activity, and attendees rearranged themselves into more evenly sized groups.

Theme	Use case within theme (result of survey)	Initial group numbers (showing interest in topic)	Final group numbers
Street works	Coordination of street works Aligning with street work notifications	3	3
Development	Underground space usage Smart Cities Development	7	4
Asset Management	Telecoms network deployment coordination Asset maintenance planning	4	5
Resilience	Resilience Planning Emergency Response	1	3
Environment	Natural resource management Managing heritage assets Flood risk planning	0	

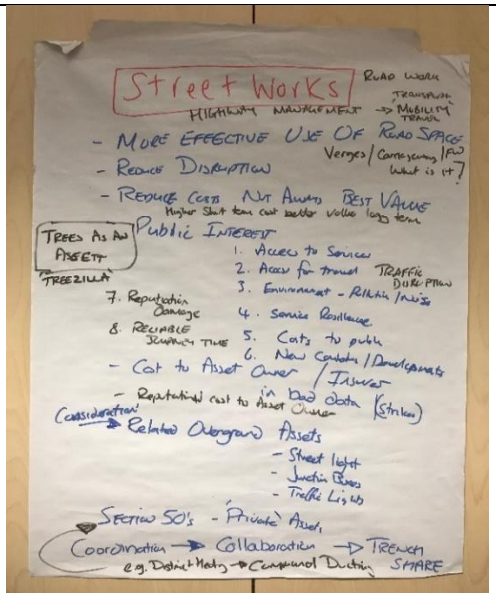
Table 4 Brain storm activity use case themes

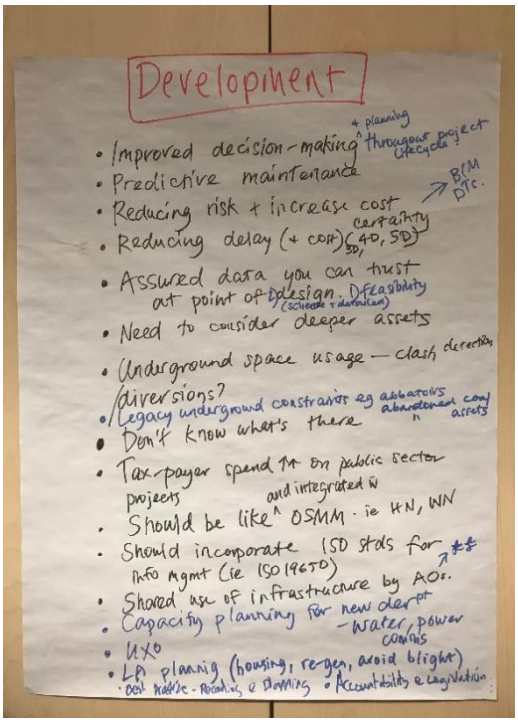
Summary of discussions:

Results of the brainstorm activity, with specific remarks for each of the fives themes are provided in the tables in below. However, in addition to specific information for each topic, a number of common observations are discerned:

- There is a requirement for improvements to data capture, data sharing and data integration with associated information on data quality, accuracy, and confidence. Best practice guidance was suggested.
- All themes identify opportunities for increased efficiencies (e.g. through cross-organisation coordination) for internal business processes and also for public services. A focus on long-term value and public benefits was highlighted.
- The need to engender change through some form of incentivisation was noted. A preference was felt for economic motivation (the 'carrot' of improved efficiencies or mitigated risks) rather than regulatory ones (the 'stick' of oversight).
- Opportunities for improved decision-making exist, particularly associated with a shift towards more proactive or predictive management (rather than reactive management), e.g. for maintenance planning or resilience assessment.
- Increased awareness of constraints associated with underground development is an over-arching need, particularly in relation to risk reduction and cascading/linked hazards and events.

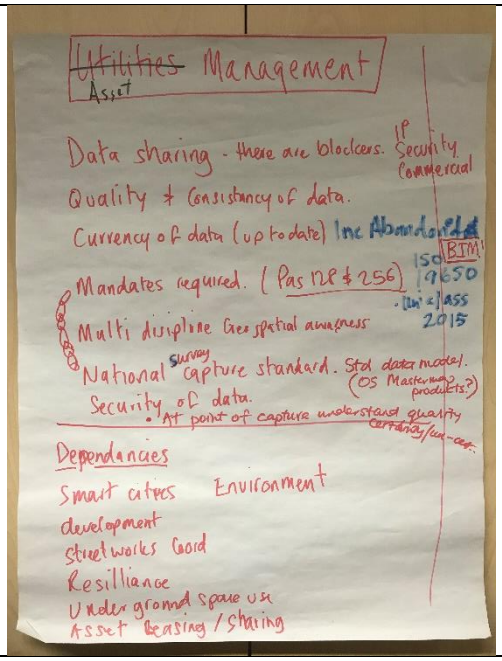
Street works	

• More effective use of Road space
• Reduce disruption
• Public interest
  1. Access to services
  2. Access for travel
  3. Environment pollution and noise
  4. Service resilience
  5. Costs to public
  6. New contractors / developments
  7. Reputational damage
  8. Reliable journey time
• Cost to asset owner insurer in bad data (strikes)
• Related over ground assets (streetlights, junction boxes, traffic lights
• Section 50's – private assets
• Coordination > Collaboration > Trench Share
• Trees as an Asset
• Higher short term cost – better long term value
• Highway management – Mobility of travel
	

Development	
• Improved decision making and planning throughout project life cycle • Predictive maintenance • Reducing risk and increase cost certainty (BIM, DTs) • Reducing delay (and cost) 3D, 4D, 5D • Assured data you can trust at point of feasibility and design (scheme and detailed) • Need to consider deeper assets • Underground space usage- clash detection/ diversions • Legacy underground constraints (e.g. abattoirs, abandoned coal, abandoned assets) • Avoid 'Don't know what's there!' • Tax payer increase on public sector projects • Should be integrated with OS Master Map (i.e. Highways Network, Water Network) • Should incorporate ISO Standards for information management • Shared use of infrastructure by AOs • Capacity Planning for new developments • UXO • Local Authority planning (housing, regeneration, avoid blight) • Best practice (recoding and planning and accountability and legislation	

Asset Management

- Data Sharing – there are currently blockers (e.g. IP, Security, Commercial)
- Quality and consistency of data
- Currency of data - is it up to date? Is it abandoned?
- Mandates required – (e.g. ISO 19650, Uniclass 2015, PAS 128 and 256)
- Multiple discipline spatial awareness
- National survey capture standard. Standard data models (OS MasterMap products)
- Security of data
- At point of capture need understanding of quality of data certainty
- Dependencies
    1. Smart cities
    2. Environment
    3. Development
    4. Street works coordination
    5. Resilience
    6. Underground space usage
    7. Asset leasing and sharing



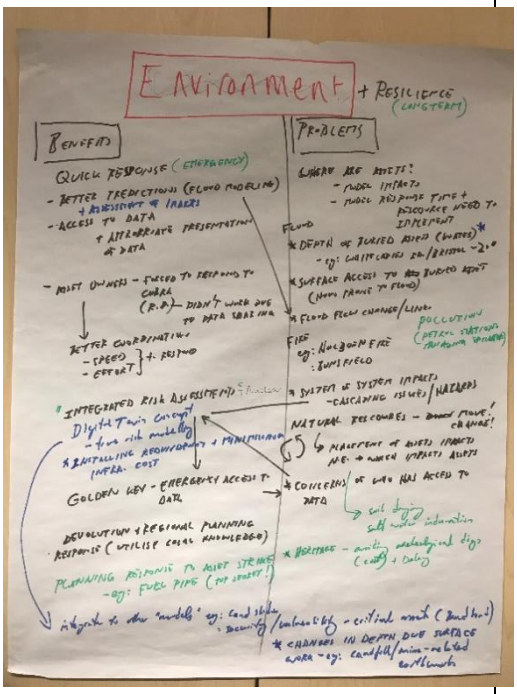
Environment and Resilience

Benefits:

- Quick emergency response
- Better prediction (flood modelling and assessment of impacts)
- Access to data and appropriate representation for data
- Asset owner forced to respond (COBRA) (Resilience Direct didn't work due to data sharing)
- Better coordination & response, improving speed and effort
- Integrated risk assessment and live risk modelling
- Golden Key/Emergency access data
- Devolution and regional planning response (utilising local knowledge)
- Planning response to asset strike (e.g. fuel pipe - top secret!)
- Integration with other models critical and vulnerable infrastructure
- Linking assets affecting unnatural flow channels

Problems:

- Where are the assets > model impacts and response time need to know!
- Depth of buried asset
- Surface access to buried assets
- Cascading issues and hazards
- Natural resources move and change but the asset doesn't
- Concerns over who has access to data
- Avoiding Heritage digs causing delays – localised records storage



Several general points were also highlighted during the brainstorm activity:

Data and Info Considerations	Use Case Considerations
Depth of assets – key issue for success, however not always documented. Consider which use cases need 2D data and which need 3D.	*Natural Environment changes but the assets don't (e.g. climate shrink –swell) situation around an asset key to understand (consider salt water ingress and corrosion, shrink swell potential and response of asset etc.). Surface level changes (landscaping, embankments) impacting relative depth of assets.*
Data sharing – Trusting other organisations' data. Quality of data is key. Issue of conflicting data in same location?	*Potential for asset leasing – redundant assets / extra assets being laid in anticipation and used by other utility organisations*
NUAR key for documentation of knowledge, asset legacy is important. Real problem with asset infrastructure management is reliance on individuals to provide expert/local knowledge.	*NUAR key asset for resilience planning (e.g. Fire/explosion on site - Holborn fire), chemical leak and unknown underground assets. Uncertainty, access to data in response all need to be considered, but portal would really help in an emergency.*
Date of the data needs recording in the system	
Coordination of knowledge response and information sharing in an event.	

Scoring and Prioritisation

The workshop group moved on to discussing the prioritisation of the use cases and which themes/ projects should be considered during the workshop. It was noted that the workshop participants were skewed towards development and utilities (Table 2) with less representation of heritage and natural resource managements sectors.

Action: Iceberg Committee to ask wider community to complete the Use Case survey

It was discussed that Coordination of Street work and Aligning street works essentially covers two main issues: Keep network moving & minimising disruption (e.g. carrying out maintenance on multiple utilities at the same time).

- Enabling all work to be done and minimising impacts
- Better data means improved planning of street works at the regional scale

The workshop participants agreed that 'Smart cities' was a concept rather than a use case – it should be considered a topic/theme rather than a use case, 'smart' approaches could be applied to all other use cases. Some conceded that the same might be said for development, although this was still considered to be a priority topic for evaluation by the group.

The participants also discussed the resilience and flood risk planning use cases coming to the conclusion that resilience planning should include flooding as a hazard and the two use cases should be combined.

For the purposes of the workshop activity, participants broadly agreed with the findings of the pre–workshop survey and the following use cases were chosen as a priority for review:

- Asset maintenance planning
- Coordination of street works
- Development
- Resilience planning (including flood)
- Underground space usage

Activities

The Groups were asked to carry out three activities for their assigned use case:

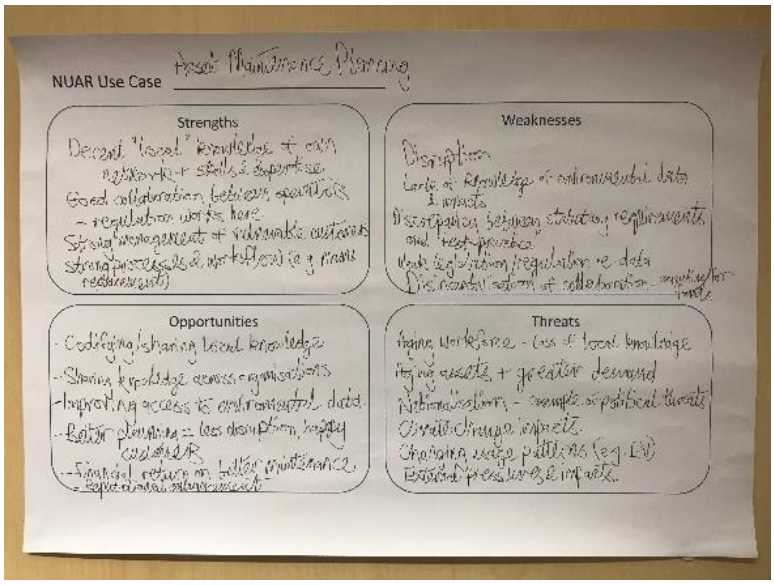
1. **SWOT Analysis:** carry out a Strength, Weakness, Opportunity, and Threats (SWOT) analysis for the prioritised use cases.
2. **Stakeholder Identification:** complete a stakeholder mapping exercise, plotting key potential stakeholders of the identified use case by potential involvement and sector.
3. **Journey Mapping:** review the user journey or process for the use case, considering the current state, access and use of subsurface data within the decision making process. Groups were asked to consider how this could be changed in the future with NUAR industry collaboration and better subsurface data management.

The summary results of the analysis are presented for each of the uses cases in the following pages.

Asset Maintenance Planning

User need: **Asset owners** need to integrate and compare underground infrastructure location with environmental data (e.g. soils, geology, groundwater)
Reason: To identify environmental risks to their assets and mitigate the effects

SWOT	
Strengths: • Local knowledge of own network, skills and expertise • Good collaboration between operators (encouraged through regulation) • Strong management of vulnerable customers • Strong processes and workflows (e.g. mains replacement) Weaknesses: • Disruption • Lack of knowledge of environmental data and impacts • Discrepancy between statutory requirements and best practice • Weak legislation/regulation re. data • Dis-incentivisation of collaboration – competing for funds	Opportunities: • Codifying/sharing local knowledge • Sharing knowledge across organisations • Improving access to environmental data • Better planning = less disruption, happy customers • Financial return on better maintenance • Reputational enhancement Threats: • Aging workforce – loss of local knowledge • Aging assets and greater demand • Political threats – e.g. nationalisation • Climate change impacts • Changing use patterns (E.g. EV) • External pressures and impacts

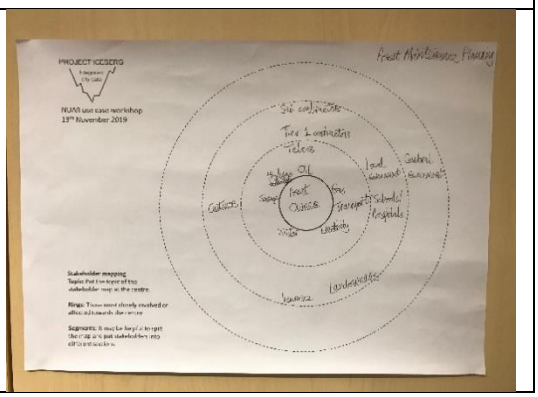


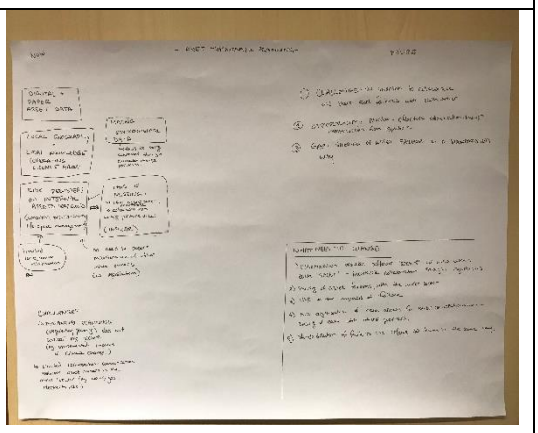
The strengths are very positive for this use case, where it is considered that local knowledge and skills base is good, there is already some collaboration between operators and regulations.

The key opportunity is the documentation of the knowledge and financial gains to better maintenance and collaboration. Also noted is the potential for better access to environmental data, the opportunity for better planning leading to less disruption.

Key weaknesses identified are a lack of local knowledge of environmental data and impacts, and a discrepancy between statutory requirements and best practice, alongside weak legislation/regulation around data. There is also a concern of dis-incentivisation of collaboration resulting from competition for funds.

Threats are considered to be the local knowledge lost through an aging workforce, aging assets and political threats (e.g. nationalisation). Changing usage patterns and climate change impacts are also mentioned.

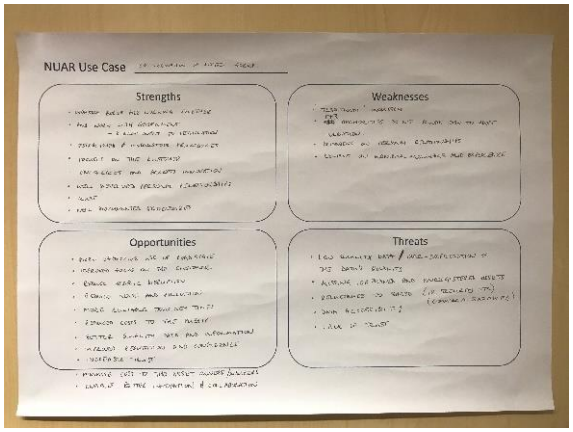
Stakeholder mapping	
• Circle 1 stakeholders identified as Asset Owners (e.g. Telecoms, water, electricity, gas, transport, highways, sewage) • Circle 2 stakeholders identified as users (customers, services, landowners), contractors, local government • Circle 3 Central Government	

User Journey	
Problems include: • Missing data, repetitive information and insular data holding • Financial planning (regulatory planning) does not consider the big picture e.g. environmental impacts *What needs to change*: • Collaboration between sectors and within sectors, • Sharing of asset failure data, • HSE on impacts of failure, • Digitisation of data for better collaboration and sharing of data, • Standardisation of failure and terminology used to describe/ refer to them.	

Coordination of Street works

User need: Asset owners / local authorities need to understand all available underground asset data, maintenance plans and to integrate with street works registers
Reason: to better coordinate street works for utility maintenance, leading to less overall disruption.

SWOT	
Strengths: • Trusted relationships: Industry bodies working together and with government to inform legislation • Well-documented, established and understood procedures • Focus on the customer • Encourages and embraces innovation Weaknesses: • 'Traditional' industry • 173 authorities so not always easy to adopt innovation • Dependant on personal relationships and reliant on individual knowledge and experience	Opportunities: • More effective use of road space • Improved focus on the customer and reduced public costs • Reduce traffic disruption, noise and pollution and more reliable journey times • Better quality data and information • Improved trust, reputation and confidence • Minimise cost to the asset owners/insurers • Enable better innovation and collaboration Threats: • Low quality data/over-expectation of data quality • Missing, orphaned, unregistered assets • Reluctance to share (IP, security, commercial sensitivity) • Data accessibility • Lack of trust

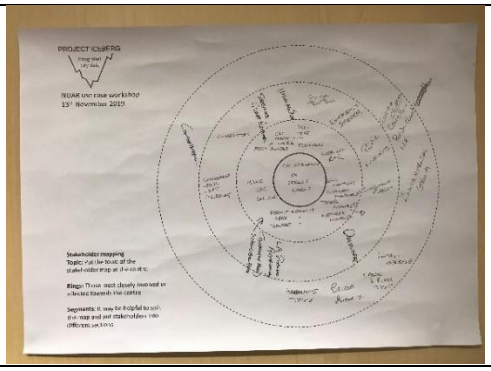


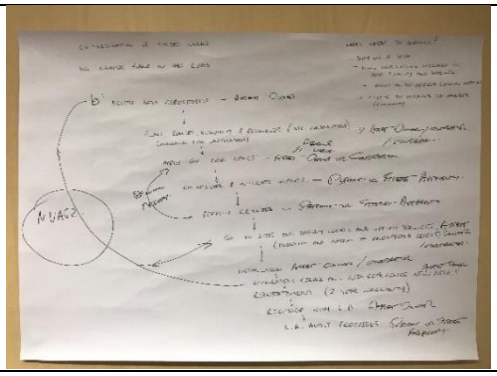
The key strengths identified are focussed on collaboration and relationships (industry bodies, government, customers).

Key opportunities focus on better data and collaboration leading to the reduction of disruption, costs, and pollution. The opportunity to create a more reliable, and trustworthy, working regime.

The weakness is perceived to be the dependence on personal relationships, convincing the 'traditional' way of working and gathering individual knowledge and experience in a standard way.

Threats include quality of data or an over expectation of the data quality. Accessibility of data and reluctance to share are also identified, as is the managing of missing, orphaned and unregistered asset data.

Stakeholder mapping	
• Circle 1 stakeholders identified as Asset Owners, maintenance departments and permit authority holders • Circle 2 stakeholders identified as users (customers, services, landowners), contractors, local government/ local authority, developers and emergency services • Circle 3 stakeholders identified as Parish Councils, councillors, Environmental groups, charities and heritage organisations	

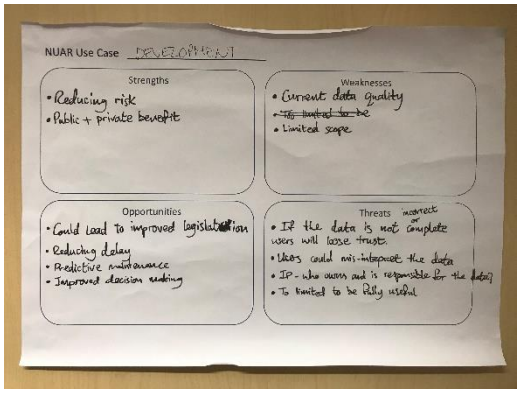
User Journey - laying fibres in the road	
Clear processes and procedures exist for the installation of fibres. The largely linear process is undertaken by Asset Owners and contractors and is subject to permitting and auditing. A feedback loop (after asset installation) to update asset owner data repositories exists. What needs to change? • More constructive approach to data quality and sharing, • Create an engaged stakeholder community	

Development

User need: **Developers** need to integrate buried utility/infrastructure data, including location, condition and capacity, with surface infrastructure maps.

Reason: to have a complete view of surface and subsurface infrastructure to result in more efficient development searches and plans.

SWOT	
Strengths: • Reducing risk • Public and private benefits Weaknesses: • Current data quality • Limited scope	Opportunities: • Improved legislation • Reducing delays • Predictive maintenance • Improved decision-making Threats: • Loss of trust from incorrect or incomplete data • Users could misinterpret data • IP – who owns the data and is responsible for it? • Too limited to be fully useful

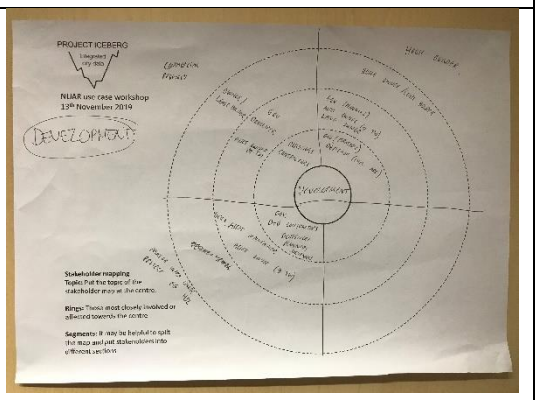


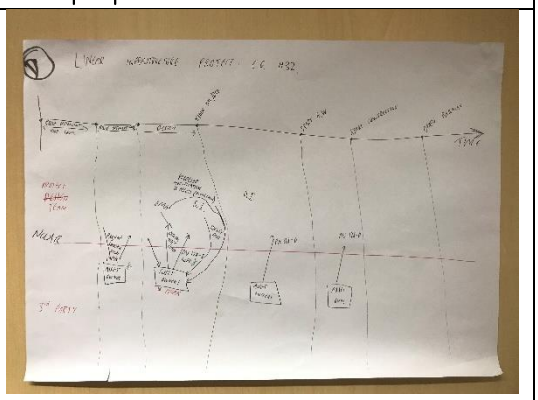
The key strengths identified include reducing risk in initial stages of project planning, and the benefits to stakeholders through increased collaboration, data sharing and relationships.

Key opportunities focus on data sharing to improve decision making, and maintenance. This could lead to a reduction of delays and, in the long term, the potential for improved legislation.

The big weakness is perceived to be the current levels of data quality and limited scope of data.

Threats include quality of data. Incorrect, incomplete or misinterpreted data could lead to errors and a loss of trust within the community. Accessibility of data, limited data and concern about data ownership/responsibility are also identified.

Stakeholder mapping	
Three categories of stakeholder were identified: commercial property; house builder; major infrastructure project. Circle 1 stakeholders identified: Designers, contractors, government (strategic), architects Circle 2 stakeholders identified: Developers, asset owners, Government (planning), land owners, infrastructure asset maintainer Circle 3 stakeholders: Land owner, lease holder, home owner	

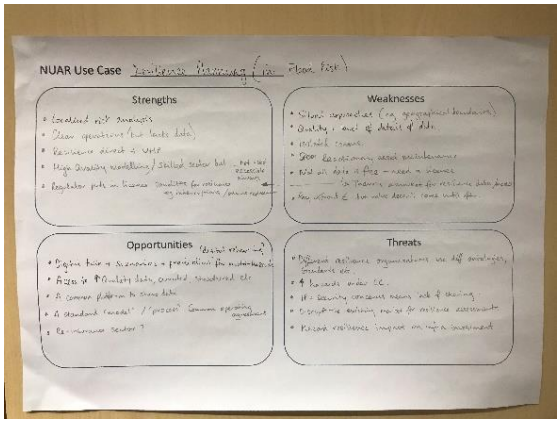
User Journey – using the example of a linear infrastructure project	
The existing process of subsurface data use for infrastructure projects adopts a linear approach with data exchanged between Asset Owners and the project team multiple times at the route optimisation, design, site investigation and groundworks stages. PAS 128 standard is used throughout. The only point of data feedback is at the design stage where plans are modified following site investigation. What needs to change: • Data feedback loop • Mandating/legislation for data feedback • Common data standard	

Resilience Planning (including flood risk planning)

User need: **Government planners** need to identify critical and vulnerable infrastructure assets.
Reason: to better understand criticality and risk to better inform emergency, security, and disaster response planning.

SWOT	
Strengths: • Localised risk analysis • Clear operations (but lack of data) • Cross-industry collaboration via Natural Hazards Partnership and Resilience Direct • Highly skilled flood modelling sector • Strong regulation and licence conditions for resilience measures Weaknesses: • Modelling skills/data not always accessible/used • Siloed approaches (e.g. geographical boundaries) • Quality and level of detail of data • Isolated communications • Reactive asset maintenance • Not all data is free – a licence is needed, have to pay upfront but value is not realised until later.	Opportunities: • A market for resilience data/models exists • 'Digital rehearsing' Digital Twins, scenarios and predictions for multi-hazards • Access to high quality, curated and structured data • A standard 'model'/'process' with a common operating agreement • Re-insurance sector Threats: • Different resilience organisations use different ontologies and standards • Increased hazards under climate change • IP and security concerns means lack of sharing • Potential disruption to existing markets for resilience assessments • Hazard resilience impacts on infrastructure

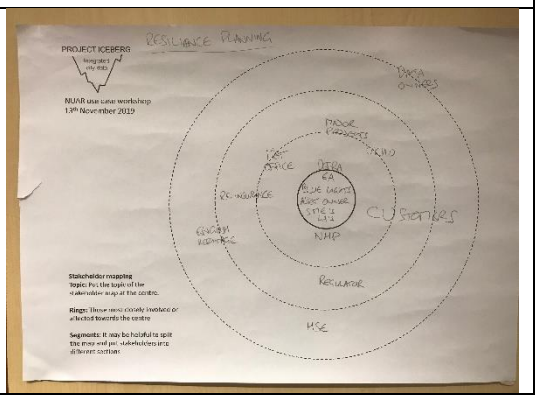
The opportunity for improved detailed risk analysis is key. This had very strong opportunities for links and communications with emergency response agencies and was considered a dependant collaborator with the *emergency response* use case. Current modelling and knowledge is high with improved links between some organisations (e.g. Resilience Direct and the Natural Hazard Partnership) but key base data is missing or difficult to access. The quality, appropriate level of detail and enforced boundaries (e.g. geographical/ departmental) inhibit access to useful data. The NUAR offers the opportunity to formalise access to standardised data, stored in a structured format.



Concern about accessibility of data, confidentiality and payment options have to be considered. Certain sources of data are currently only accessible with a licence and security concerns could still mean a lack of sharing. This results in valuable information for modelling being effectively inaccessible in the risk analysis. The NUAR is not viewed as a fix-all dataset, but an improvement in accessibility options for more standardised data.

Stakeholder mapping

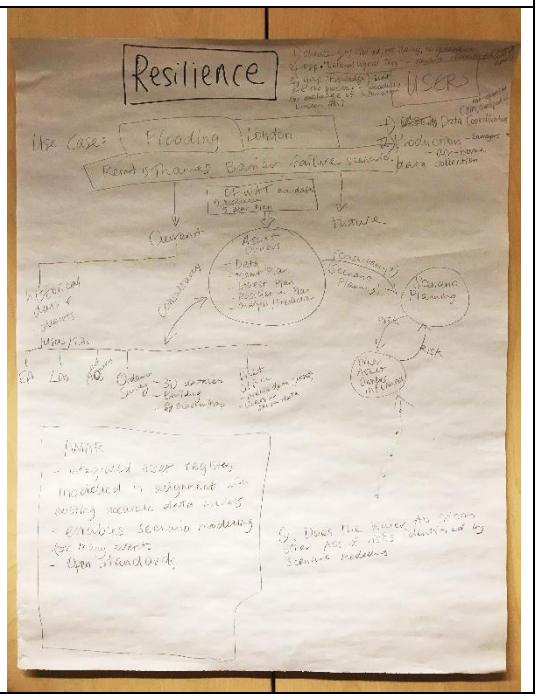
- Circle 1 stakeholders identified as Asset Owners, Environment Agency, Blue Lights, SME's, Local Authorities
- Circle 2 stakeholders identified as customers, DEFRA, MetOffice, Construction projects and regulators, English Heritage
- Circle 3 stakeholders identified as Data owners, HSE



User Journey - focussed on the Flooding of London (Thames Barrier failure)

What needs to change:

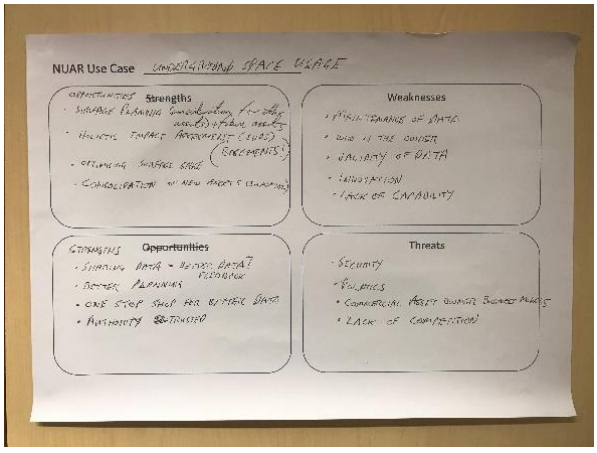
- Key component is collaboration of data sharing by a number of government and non- government organisations.
- NUAR would offer an integrated asset register that could be modelled in alignment with existing accurate data models
- Combination of NUAR and other datasets enable scenario modelling for many events in a unified format
- Standardising of data collection
- Allow for analysis of probability modelling for scenarios
- How would the feedback loop work and the informing of asset owners on the outcome of the modelling?



Underground Space Usage

User need: Urban planners need to integrate and compare underground infrastructure location with environmental data (e.g. soils, geology, groundwater)
Reason: to make the business case to move above-ground facilities underground (thus freeing up land for development).

SWOT	
Strengths: • Sharing data – better data feedback • Better planning • Authorities are trusted Weaknesses: • Maintenance of data • Who is the owner? • Validity of the data • Innovation • Lack of capability	Opportunities: • One stop shop for better data • Surface planning to consider future asset needs • Holistic impact assessment e.g. SuDS, basements • Optimising surface space • Consolidation of new assets Threats: • Security • Politics • Commercial asset owner business models • Lack of competition



The SWOT analysis for Underground Space Usage is not too dissimilar to those identified for the development use case. One of the key strengths relates to the role of local authorities as a trusted organisation to manage development underground.

Several opportunities are highlighted and relate to better access to data and holistic assessment of underground usage, particularly focused on assessment of future needs and the assets needed to support these future uses.

The primary weaknesses relate to data e.g. ownership, maintaining datasets, interoperability. Threats include security concerns around access to data, and issues relating to the commercial interests/business models of asset owners/private underground uses.

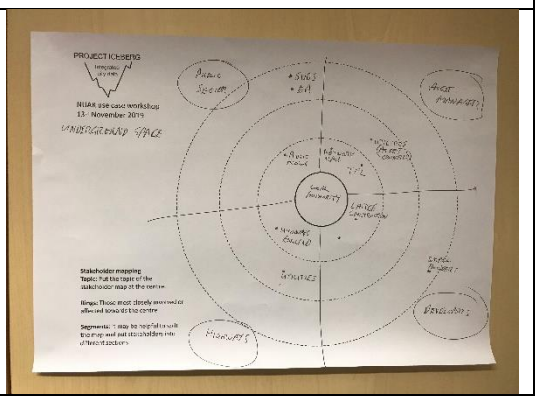
Stakeholder mapping

Four groups of stakeholders were identified: Public sector; Asset Owners; Highways; Developers.

Circle 1 stakeholders identified: Public housing; Network rail; TfL; Large constructions; Highways England

Circle 2 stakeholders identified: Utilities (asset owners)

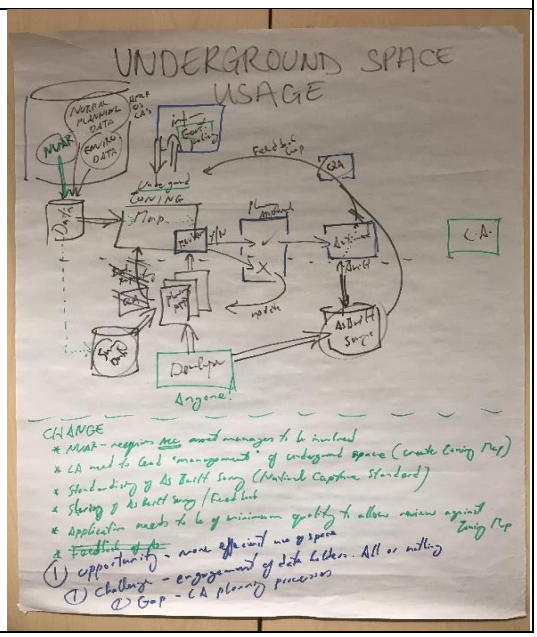
Circle 3 stakeholders identified: Environment Agency; SuDS sector; small builders



User Journey

What needs to change:

- NUAR requires all asset managers to be involved
- Local authorities need to lead 'management' of underground space (create a zoning map)
- Standardising of 'As built' with (National Capture Standard) and sharing/feedback of 'As built' survey.
- Application needs to be of minimum quality to allow review against zoning map



Feedback

As a summary to the discussions the groups were asked to consider three key questions for their use case:

- What is the key opportunity for the identified use case?
- What is the key challenge to the success of the use case?
- What is the key gap in the current processes within the use case?

Use case	Key Opportunity	Key Challenge	Key Gap
Underground space usage	More efficient use of space	All relevant data holders need to engage	Improvement in planning process
Development	Efficiency of data access and acquisition	Quality of data Feedback loop Scope of NUAR (need to include deeper assets)	Heritage and asset owners not in the room at this workshop. Need to get their points too
Asset management planning	Incentivise people to share data and get involved	No incentive to share	Sharing asset failures in a standard way
Resilience	National development – all players on board don't need same twin just right details	Data siloed – no government leadership, no quality legislation	Knowledge about the process and information change between asset owners
Coordination of street works	Increase effectiveness and use of road space	Build a trusting environment where asset owners are happy to share their data. Trust in data	Lack of direct utility input (actual practitioners from a cross section of asset owners)

Table 5 Group use case summaries: identifying opportunities, challenges and Gaps

Final Discussions

It was identified that the Iceberg committee (and therefore representation at the workshop) is self-selected and though a good cross-section of organisations are included not all communities interested in the subsurface are represented e.g. geo-heritage and environment. For a more-rounded assessment of the NUAR use cases further viewpoints are needed.

Further discussion identified that better case study examples (Real world examples) are needed from a wider range of industry case studies to support further analyses of the use cases.

It was also highlighted that there are differences between the use cases, some are considered a specific use case (e.g. Street work coordination) and some are considered more of a theme for a set of use cases (e.g. Development or smart cities) which could have better defined specific use cases.

Action: Update Use Case list

Final table discussions again reported on the scale of availability, quality and accessibility of datasets. Furthermore, the level and quality of 3D information (utility depth data) available is unknown.

It was suggested that a timeline of feasibility could be considered for the Use Cases. It is identified that some could be addressed easier and quicker than others. Linkages and overlap between the different use cases was also suggested, such that dependencies and efficiencies can be established.

Action: Consider a Use Case list timeline and feasibility

Next steps

The next phase of the Iceberg review is to consider in more detail the five prioritised use cases: Street Works; Development; Utilities Management; Resilience; and Underground Space Use. The review will primarily consider the strategic case for change and feasibility of implementation, and will present information current practice, case studies, stakeholder mapping, and where possible, consideration of the economic case. A series of recommendations will be presented to the Geospatial Commission following this review in line with ambitions to see continued progress, beyond the two NUAR pilot projects, towards improved subsurface management.

Several members of the Iceberg Committee have offered to help with this review process and contribute to the final review report to be presented to the Geospatial Commission (table 6). Further work will be carried out to engage the wider Iceberg community to build on the views of the workshop. A gap analysis is also proposed to identify which industry sectors are not currently represented, followed by a targeted on-boarding exercise of representative bodies.

Street works	Simon Bailey - GeoPlace
Development	Katie Lysons - Arup
Utilities Management	To be confirmed
Resilience	Steph Bricker and Katy Freeborough - BGS
Underground Space Usage	Rollo Home - OS

Table 6 Iceberg committee members agreeing to assist review process