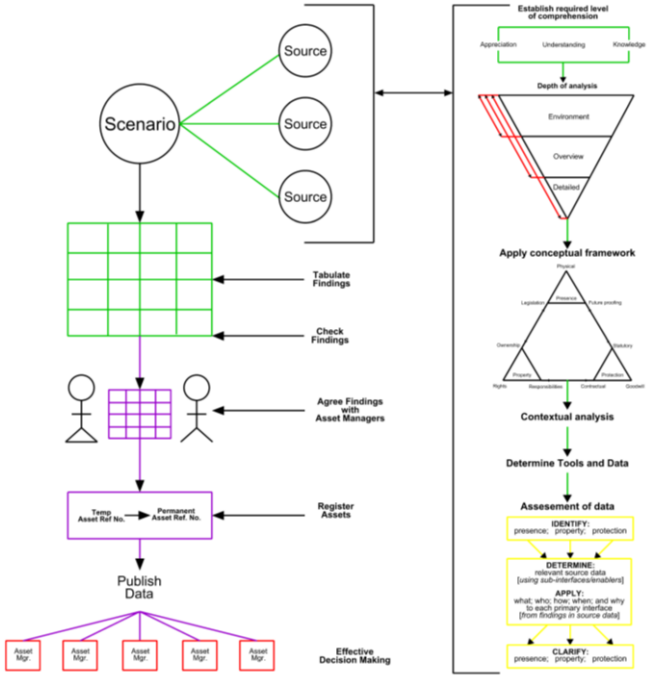
The AIR research project

Developing multi-disciplinary evidence-based comprehension of the interfaces between transport infrastructure and its environment.



Dr. Nathan Darroch MA PhD MIAM
Centre for Transport Research
School of Engineering

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UNIVERSITY OF ABERDEEN

Transport infrastructure and its environment do not exist in isolation.

Transport infrastructure and its environment are interconnected and interdependent. They affect and are affected by one another. The densification of urban environments, globally (United Nations, undated), requires effective processes to develop comprehension of the presence, property, and protection interfaces between transport infrastructure and its environment (Darroch 2012; 2014; 2020; Darroch et al., 2016; 2018; 2020a; 2020b).

The aim of the AIR research project

To assist comprehension of the interconnected and interdependent nature of transport infrastructure and its environment, the AIR research project is developing standardised qualitative processes of analysis, data gathering, sharing, and management of multi-disciplinary evidence-based data relative to the interfaces of transport infrastructure and its environment. These processes are intended to be employed within transport organisations, internationally.

The following slides present the reasoning for the development of the AIR processes.

Populations are urbanizing and cities are densifying, globally.

Paris, France

New York, US

London, UK

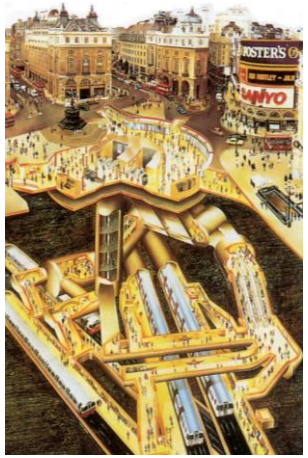
Sao Paulo, Brazil

Cities globally are developing urban underground metro systems (UUMs).

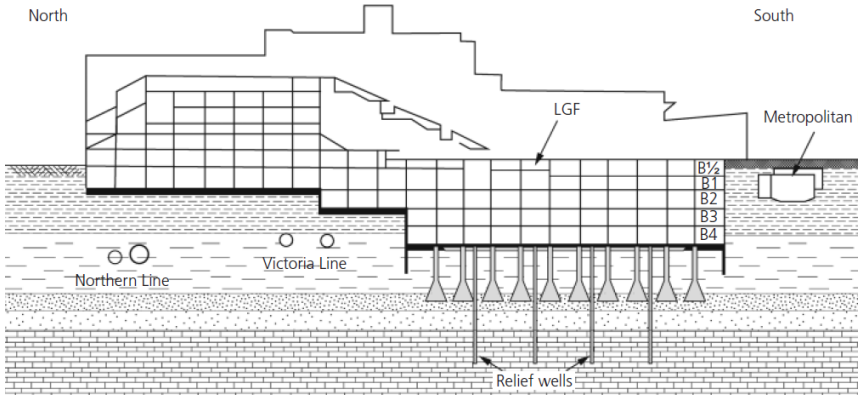
Statistics published by Union Internationale des Transports Publics (UITP, 2018), show that:

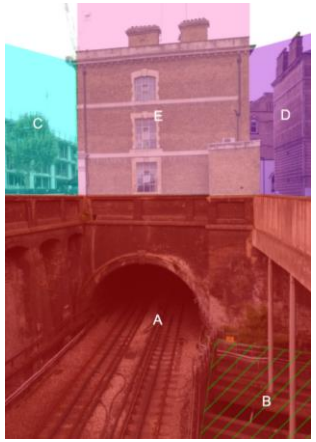
- in the last five years, 103 new metro lines have opened in cities across the world;
- "*world metro ridership has increased by 19.5% over the past six years";*
- "*nineteen new cities are equipped with metros since the end of 2014*";
- an additional 1,400km are intended to be added over the next five years.



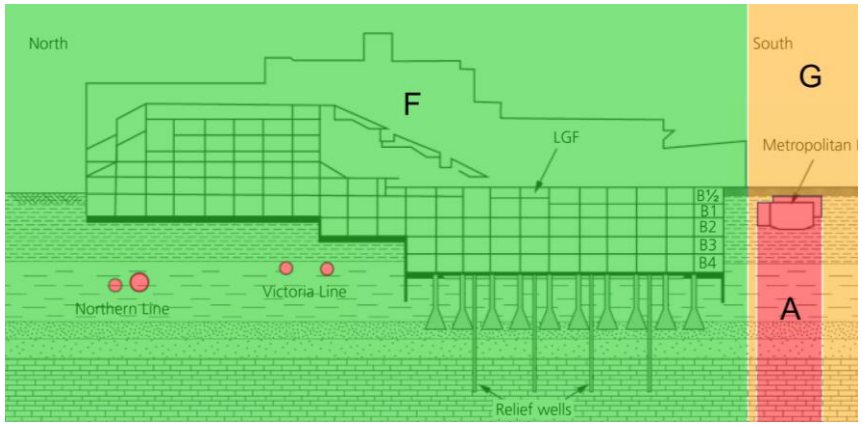




These create presence, property, and protection interfaces, within the urban environment.

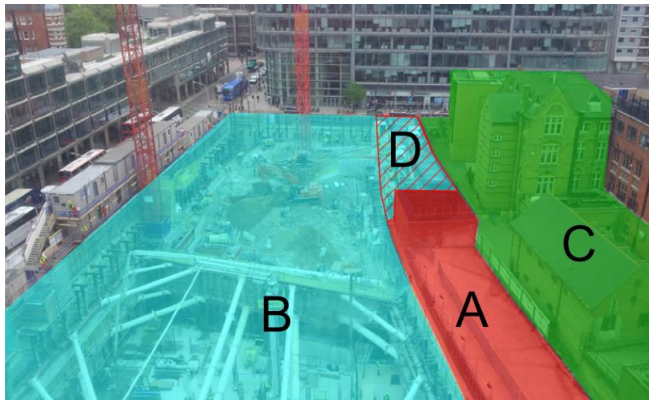




Building located over sub-surface railway tunnel, with shading representing property interests.
Source: *Nathan Darroch.*

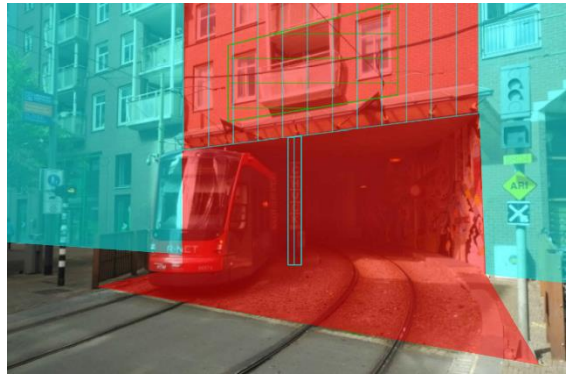


North–south section through the British Library, with shading representing property interests.
Source: Simpson and Vardanega, 2014.

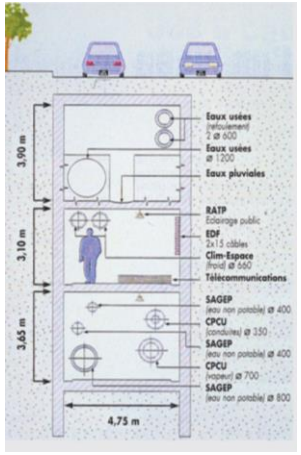


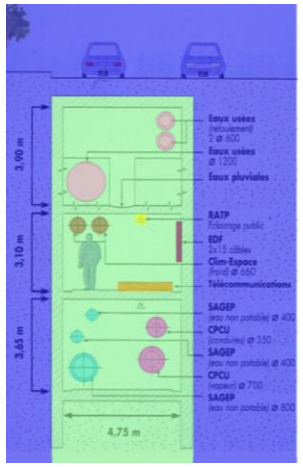
Birds Eye view of construction site on Victoria Street, London, adjacent to metro infrastructure (A) with shading representing property interests.
Source: London Underground, undated.

These interfaces also occur for other forms of transport and urban infrastructure.



Building located over a tramway, DenHaag, Netherlands, with shading representing property interests.
Source: Nathan Darroch.

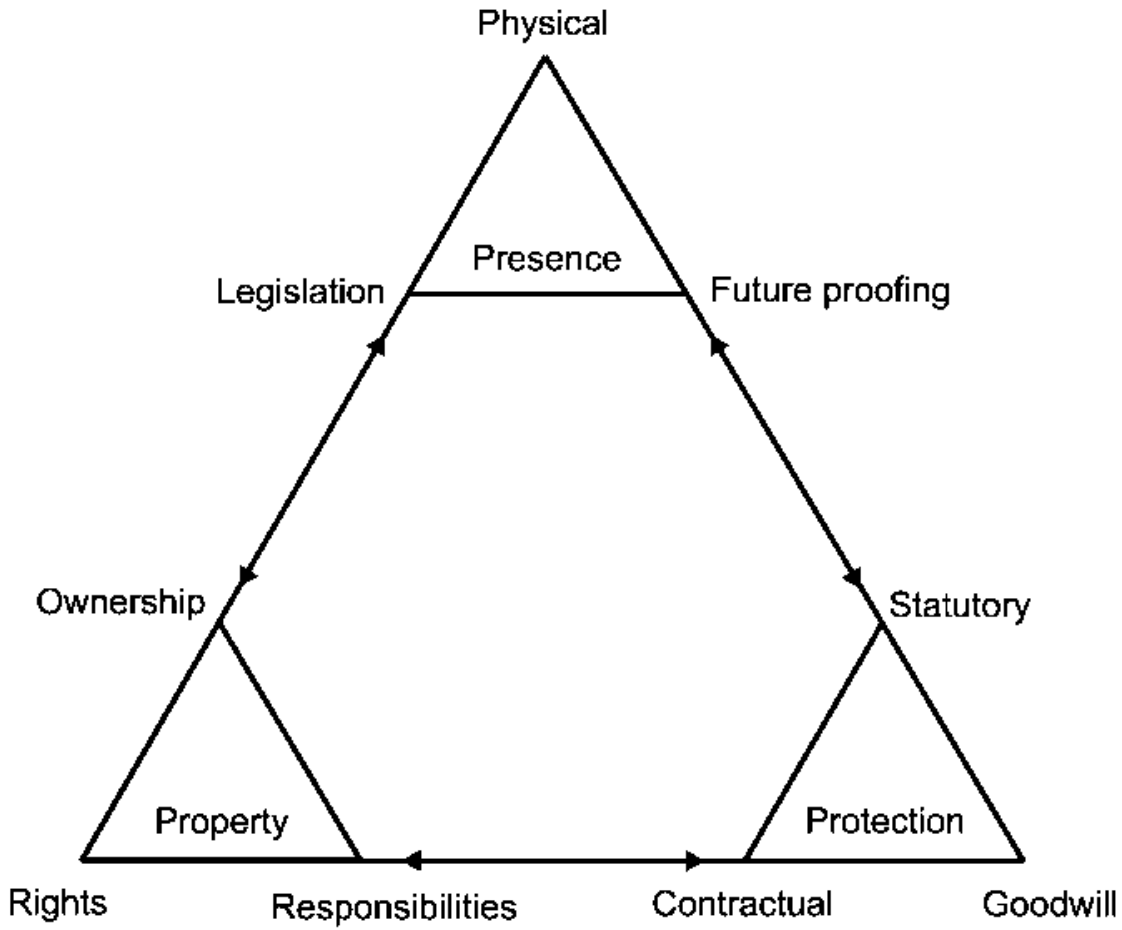




Utilidor, Paris France, showing the presence interface and shading representing property interests.
Source: National Research Council, 2013.

Buildings located over public highway, London, UK, showing the presence and protection interfaces.
Source: Nathan Darroch.

The interfaces are multi-disciplinary.



A conceptual framework showing the interfaces of UUMI and its environment.
Source: Darroch, Beecroft, & Nelson, 2016.

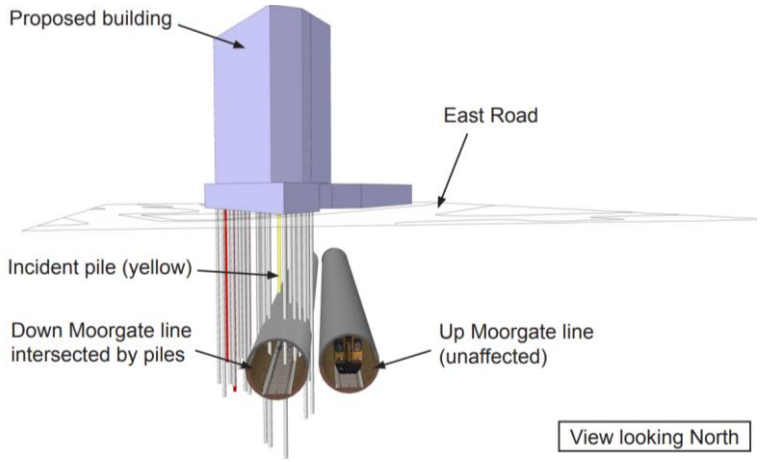
The lack of comprehension of the interfaces can have adverse effects.

Derailment of passenger train, Wimbledon, 2018.
Source: RAIB, 2018.

Sewer collapse, under railway, Forest Hill, UK, 2016.
Source: BBC, 2016.

Collapse of multiple buildings resulting from excavation collapse, due to metro construction, Cologne, Germany. ***Source:*** *National Research Council, 2013.*

Augers within a tube railway tunnel after penetration, London, 2013.
Source: RAIB, 2014.



Pile design for new building above a tube railway tunnel, London, 2013.
Source: RAIB, 2014.

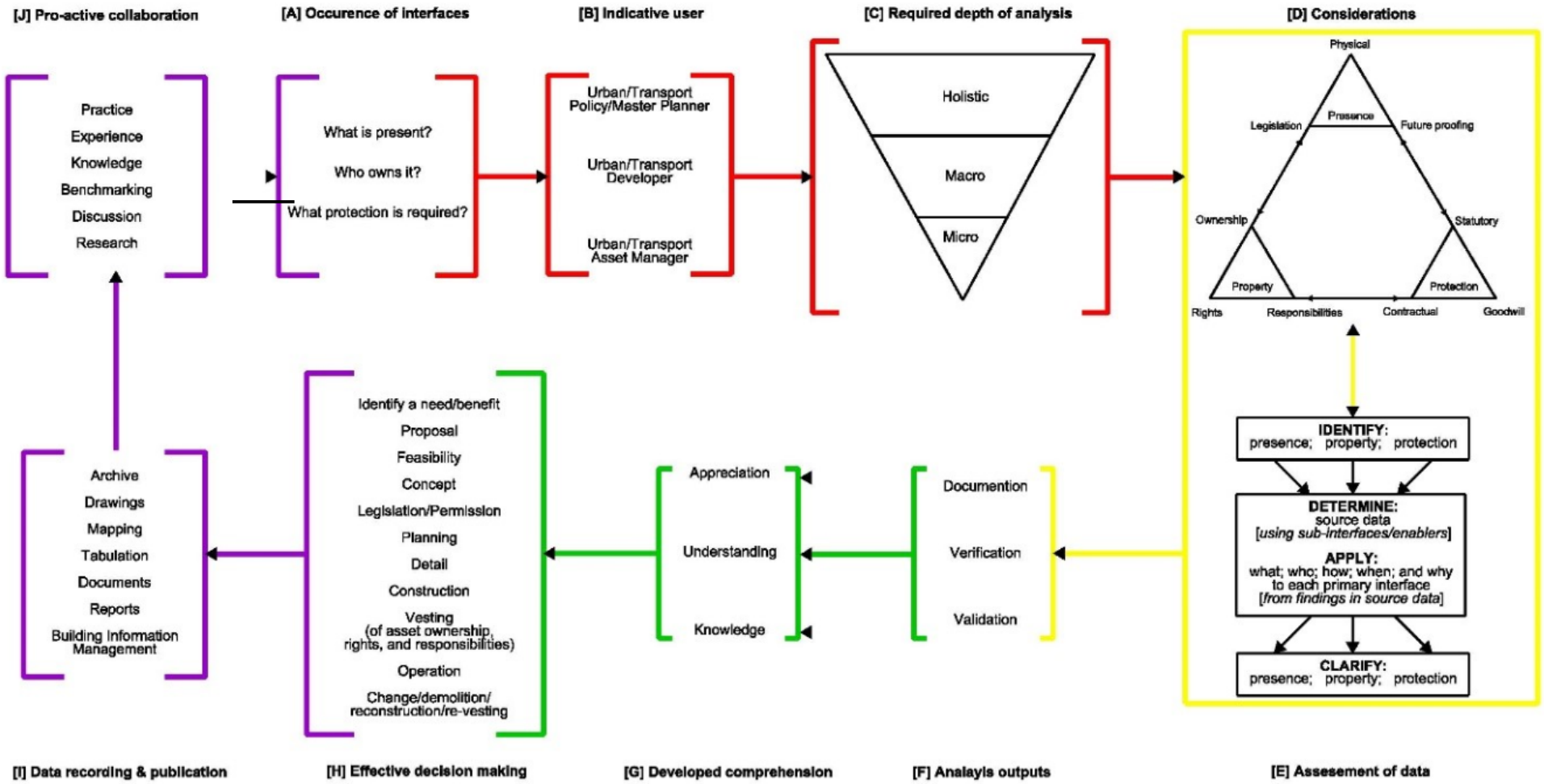
Application of the AIR processes enables common comprehension of the interfaces

The densification of urban environments, globally, requires effective processes for the analysis of the multi-disciplinary (legal, historical, transport and urban planning, civil engineering, and asset management) presence, property, and protection interfaces between transport infrastructure and its environment. Subsequent sharing of data generated through the analysis within transport infrastructure owning/managing organisations and with their interfacing urban stakeholders contributes to:

- organisational cost and time savings;
- the effective creation of and amendment to the interfaces between new transport infrastructure and its environment;
- the increased safe presence and operation of transport infrastructure and its environment;
- effective implementation of asset and urban management processes; and
- the development of effective sustainable transport and urban management policies and planning.

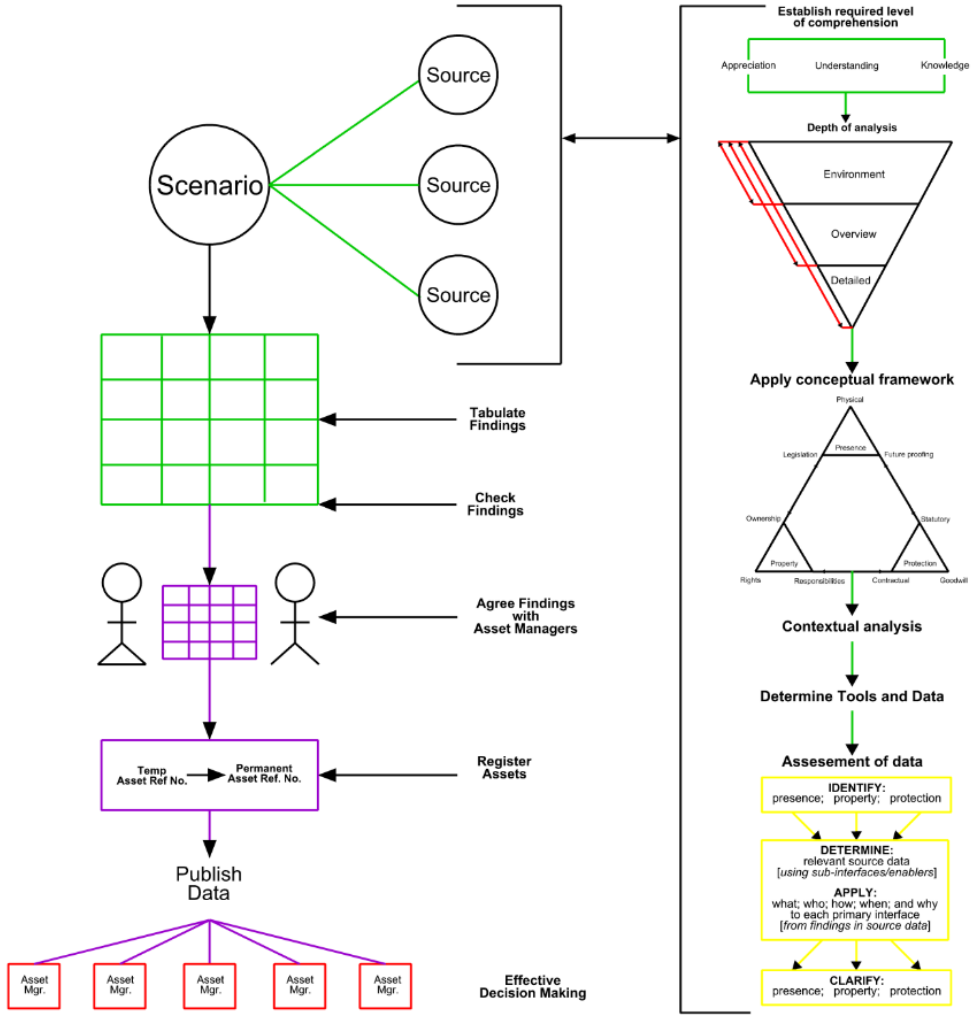
The following slides present the AIR processes.

Analysis of the interfaces enables effective organisational decision making.



Workflow showing how the AIR processes contribute to asset and interface management.
Source: Darroch, 2020.

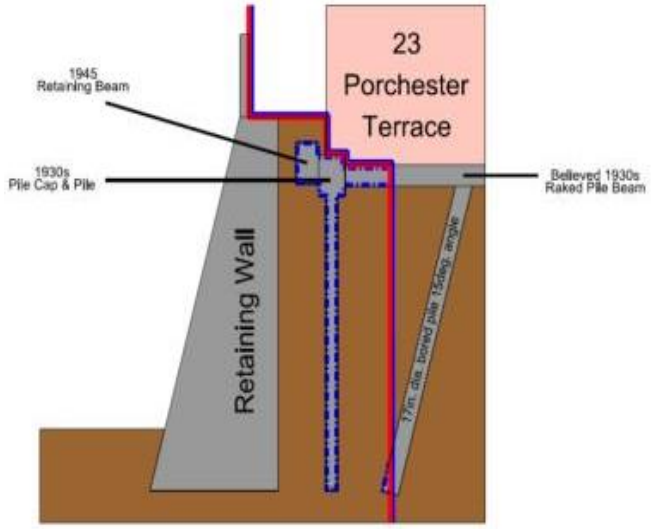
Standardised processes of analysis and data recording enable structured comprehension.

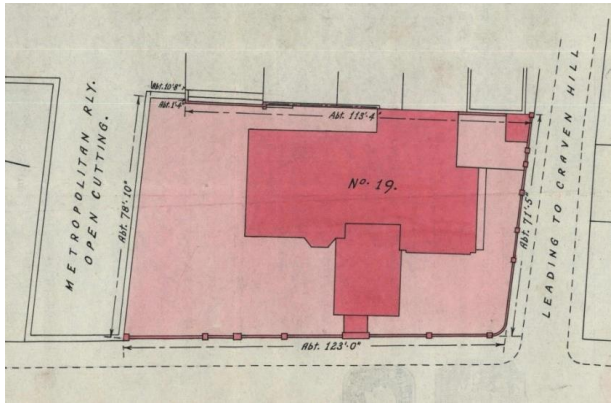


Workflow showing the AIR processes of analysis and evidence-based data generation.
Source: Darroch, 2020.

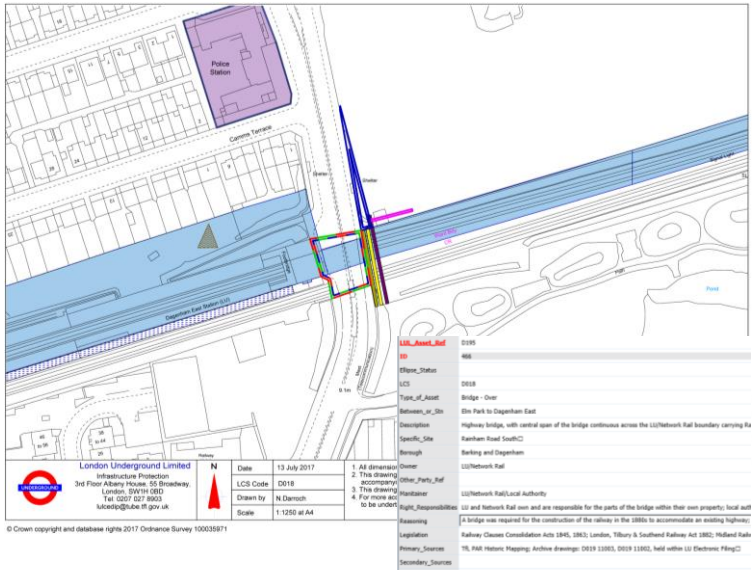
The AIR Research Project - *Developing multi-disciplinary evidence-based comprehension of the interfaces between transport infrastructure and its environment.*

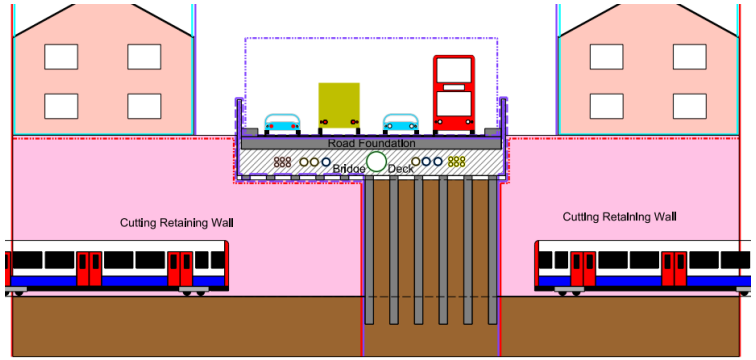
Standardised processes of data sharing enable co-ordinated access to data through GIS.





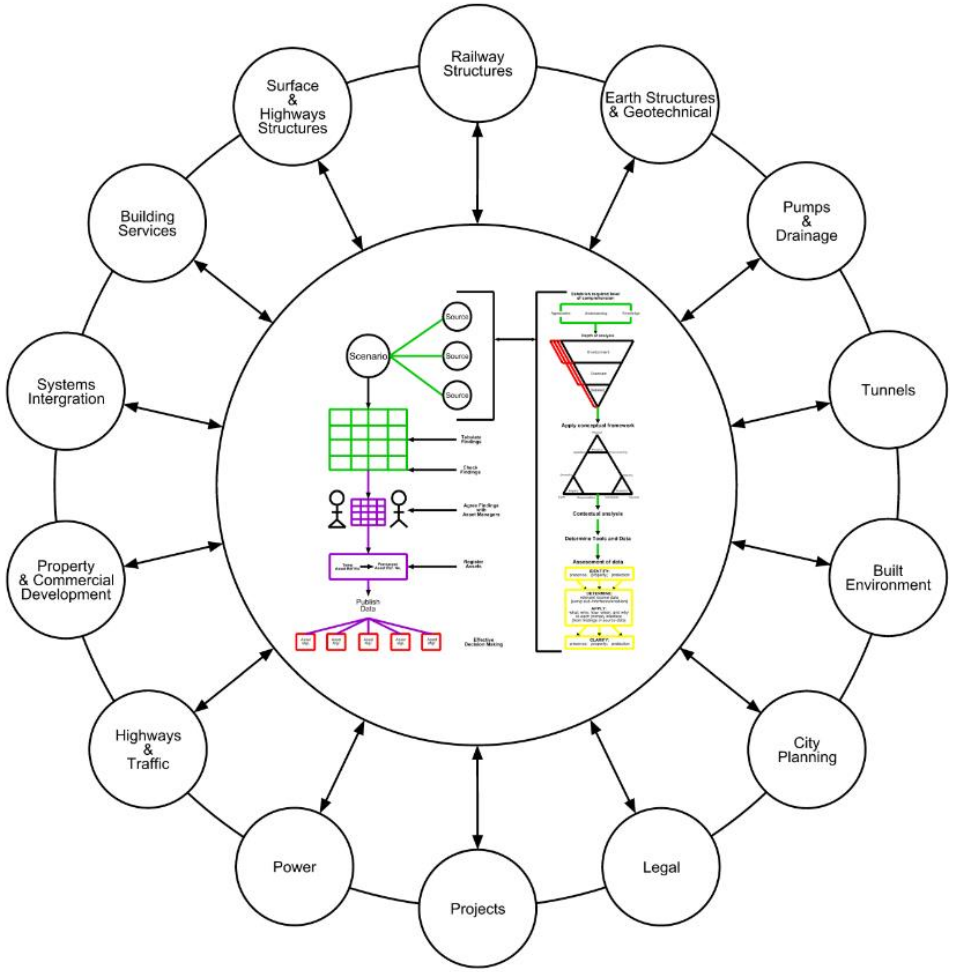
Asset ref. no.	The identifying code for transport organisation assets/infrastructure
AIR ref. no.	A temporary code where there is no identifying code for transport organisation assets/infrastructure
Location code	A code identifying a section of road/railway between or at key locations
Type of asset	Standardised description of the asset/infrastructure
Between or at key locations	A standardised description of where the occurrence of the interface is between key locations
Asset description	More detailed description of the asset/interfacing infrastructure/assets
Specific site	A standardised description of where the specific occurrence is
Local authority	The governmental body responsible for the urban environment, within which the interfaces occur
Owner	Standardised identifier for the owning organisation/party for the infrastructure/asset
Other party ref. no.	The identifying code for interfacing organisation assets/infrastructure
Maintainer	Standardised identifier for the maintaining organisation/party for the infrastructure/asset
Rights and responsibilities	Standardised brief description of rights and responsibilities for infrastructure/assets within the occurrence
Reasoning	Standardized explanation of the reasoning for the occurrence of the interface
Legislation	Relevant legislation, powers, or authority for the occurences of the interfaces
Primary sources	Standardised references to source primary data, linked to key archive locations
Secondary sources	Standardised references to source secondary data, linked to key archive locations
Notes	Any additional notes or comments from analysis





Adjacent Land Owner - Owner
London Underground - Owner
Sectioned bridge deck
Local Highway Authority - Owner
Local Highway Authority - Responsibility
Local Highway Authority - Rights

Sharing of the evidence-based data enables common comprehension of the interfaces.

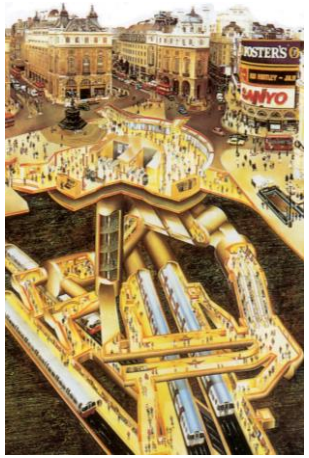


Workflow showing how the AIR processes contribute to asset and interface management.
Source: Darroch, 2020.

Enabling the safe efficient presence and operation of transport and urban infrastructure.

Where UITP, 2018, stated that:

- there are "*640 lines in 182 cities in 56 countries around the world*";
- "*covering 13,811km arriving at 11,043 stations*";
- these serve "*168 million passengers use metros in 182 cities within 56 countries every day*";
- with UITP predicting "*that an average of 1400km of metro line will be added every year from 2018-2022*".



Piccadilly Circus Station, London.
Source: London Transport Museum, undated.

Central China's mega-city Wuhan has started the construction of the country's largest "underground city," as more cities look to underground space as land resources become scarce.
Source: Hubei, 2015

Objectives of the AIR research project

To achieve effective common comprehension of the interfaces of transport infrastructure and its environment, the AIR research project will:

- develop a prototype AIR GIS interface, and supporting processes for the development of the Asset Interface Register;
- apply the AIR processes to selected detailed case studies, incorporating interconnected and interdependent occurrences of railway-based transport infrastructure interfacing with its environment, within participating railway-based transport organisations, across the world;
- evaluate the findings of the detailed case studies to determine the benefits and limitations of the AIR processes to enabling effective interface management of transport infrastructure and its environment;
- identify implications for current and future transport and urban policy and practice resulting from the employment of the AIR processes;
- offer further opportunities for development and implementation of AIR within the participating railway-based transport organisations, across the world.

Call for participation

The AIR Research Project, within the Centre for Transport Research at the University of Aberdeen, UK, is seeking, for stage 1 of the research, the participation of:

- urban underground metro organisations;
- academic institutions across the world with knowledge of national and international needs, practices, and academic considerations, for the effective management of the interfaces;
- practitioners in transport and urban management, with knowledge of the needs, practices, and considerations for the effective management of the interfaces.

Where stage 1 of the research project will see the development and application of organisational and internationally applicable standardised processes of evidence-based data gathering and sharing, relative to the interfaces of urban underground metro infrastructure and its environment. Stage 2, will see the application of those processes to surface railway-based transport infrastructure (tramways, heavy rail, light railways). A call for participation in stage 2, will be undertaken in Summer 2021.

Call for participation

Through the subsequent findings of the research, and the benchmarking of participating organisations, employing the AIR processes, the development of global, practitioner, industry, and academic, comprehension of the effects and affects of the interfaces of transport infrastructure and its environment, will be enabled.

If you or your organisation would be interested in participating in this research, which will run between September 2020 and May 2023, please contact the research project co-ordinator, Dr Nathan Darroch, Honorary Research Fellow, Centre for Transport Research, School of Engineering, University of Aberdeen, UK: nathan.darroch@abdn.ac.uk.

Other example interfaces of transport infrastructure and its environment can be found at www.nathandarroch.co.uk.

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