Why is there a need to understand the interfaces of railway-based infrastructure?

The University of Aberdeen AIR research project

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The aim of the AIR research project

To assist comprehension of the interconnected and interdependent nature of transport infrastructure and its environment, the University of Aberdeen AIR research project is developing standardised qualitative processes of analysis, data gathering, sharing, and management of multi-disciplinary evidence-based data relative to the presence, property, and protection interfaces of transport infrastructure and its environment.

These processes form part of a process of ***infrastructure interface management***, within the discipline of asset management. These processes are intended to be employed by and benefit transport organisations and their interfacing stakeholders, internationally.

This presentation provides…

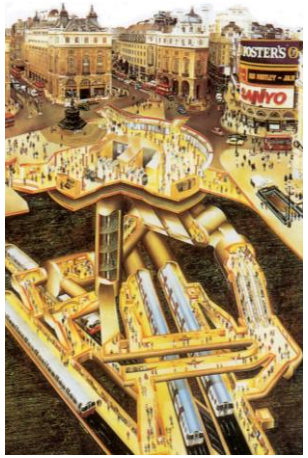
- context to the AIR research project;
- some examples of the presence, property, and protection interfaces between transport and urban infrastructure;
- people involved with *infrastructure interface management*, who need to understand the interfaces;
- how lack of comprehension of the interfaces has safety critical affects on railway-based systems and their environment;
- how the presence, property, and protection interfaces can be represented in a simple to access and use web-based GIS;
- how the AIR processes enable the generation and subsequent sharing of that data; and
- how this assists the safe efficient presence and operation of transport infrastructure and its environment.

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.




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, therefore requires effective processes to develop and share comprehension of the multi-disciplinary presence, property, and protection interfaces between transport infrastructure and its environment.

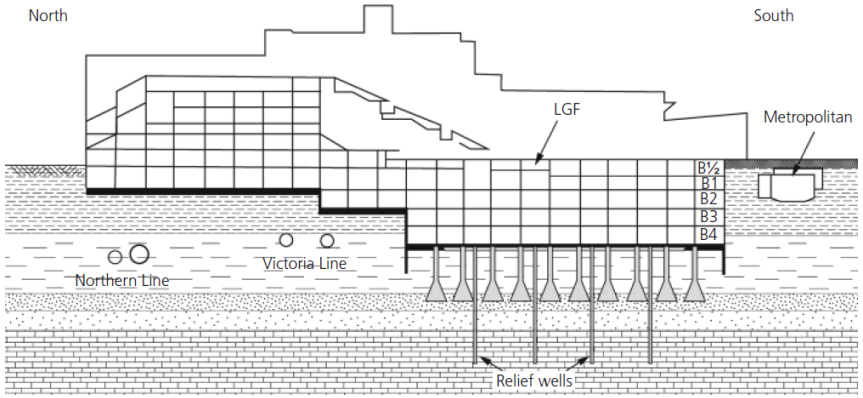
London, UK

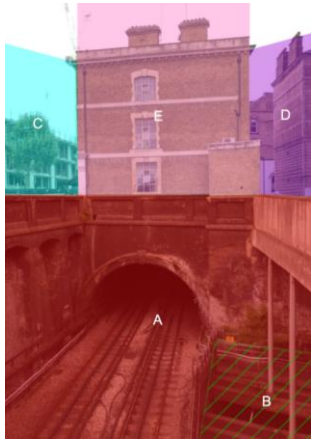
Sao Paulo, Brazil

Woolwich, London, UK

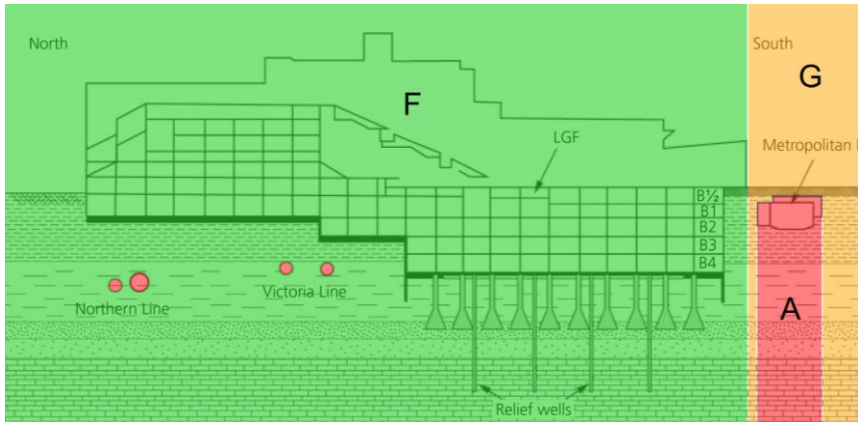
65m below Sao Paulo, Brazil

Example presence, property, and protection interfaces within the urban environment.

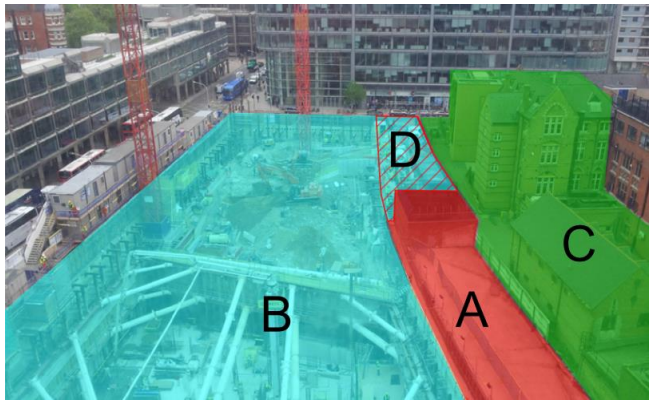




Building located over sub-surface railway tunnel, with shading representing property interests.
Source: *Nathan Darroch.*

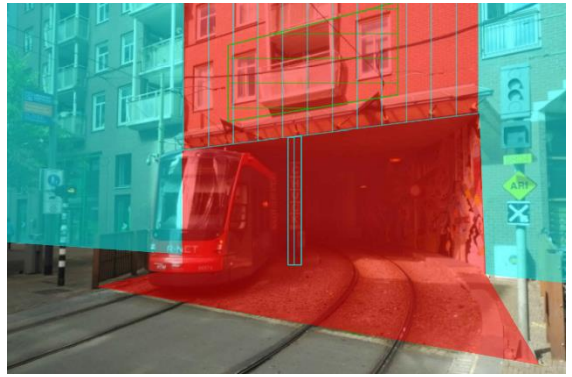


North–south section through the British Library, with shading representing property interests.
Drawing source: Simpson and Vardanega, 2014.

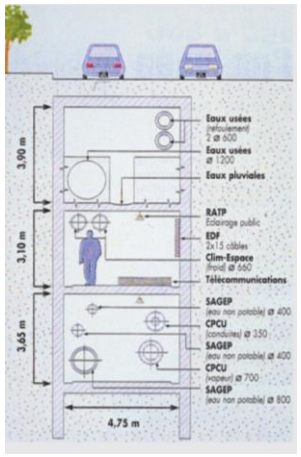


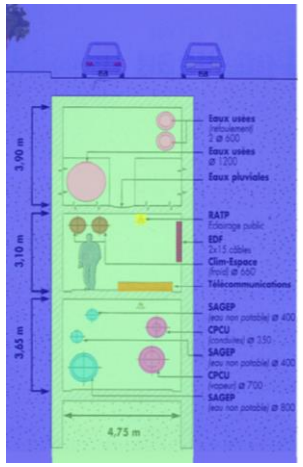
Birds Eye view of construction site on Victoria Street, London, adjacent to metro infrastructure (A) with shading representing property interests.
Source: London Underground, undated.

Example presence, property, and protection interfaces within the urban environment.



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





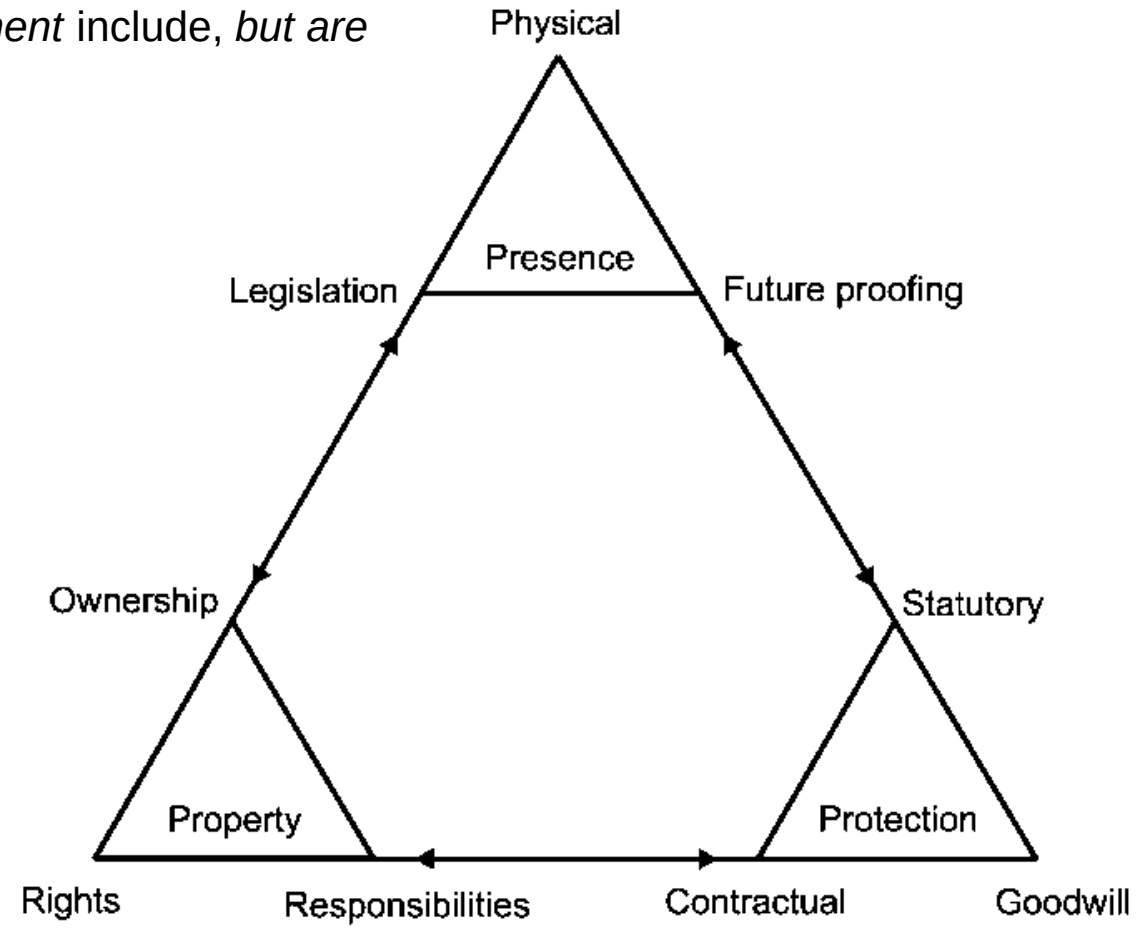
Utilidor, Paris France, showing the presence interface and shading representing property interests.
Source: National Research Council, 2013.

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

The interfaces are multi-disciplinary, interconnected, and interdependent.

People involved with *infrastructure interface management* include, *but are not limited to:*

- asset managers;
- civil engineers;
- geo-technical engineers;
- structural engineers;
- systems engineers;
- urban planners;
- transport planners;
- data managers;
- project managers;
- property surveyors;
- legal practitioners;
- geographers;
- historians;
- legislators;
- politicians.



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

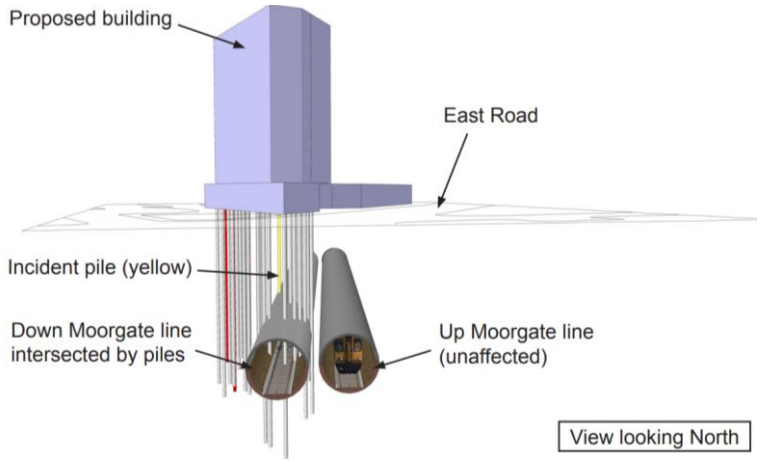
The lack of comprehension of the interfaces can have adverse effects.

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

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

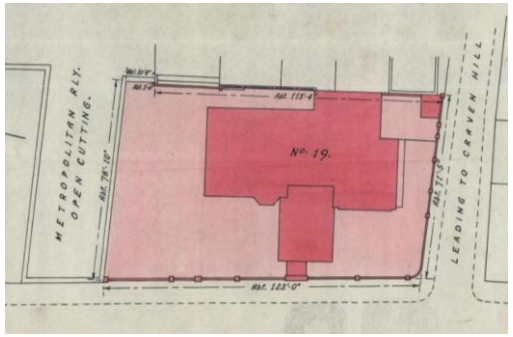
Collapse of multiple buildings resulting from excavation collapse, due to metro construction, Cologne, Germany. ***Source:*** *National Research Council, 2013.*

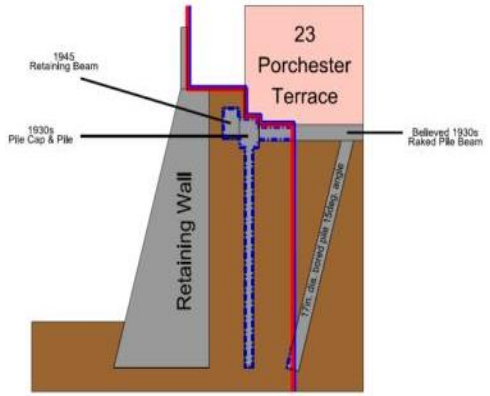
Augers within a tube railway tunnel after penetration, London, 2013.
Source: RAIB, 2014.

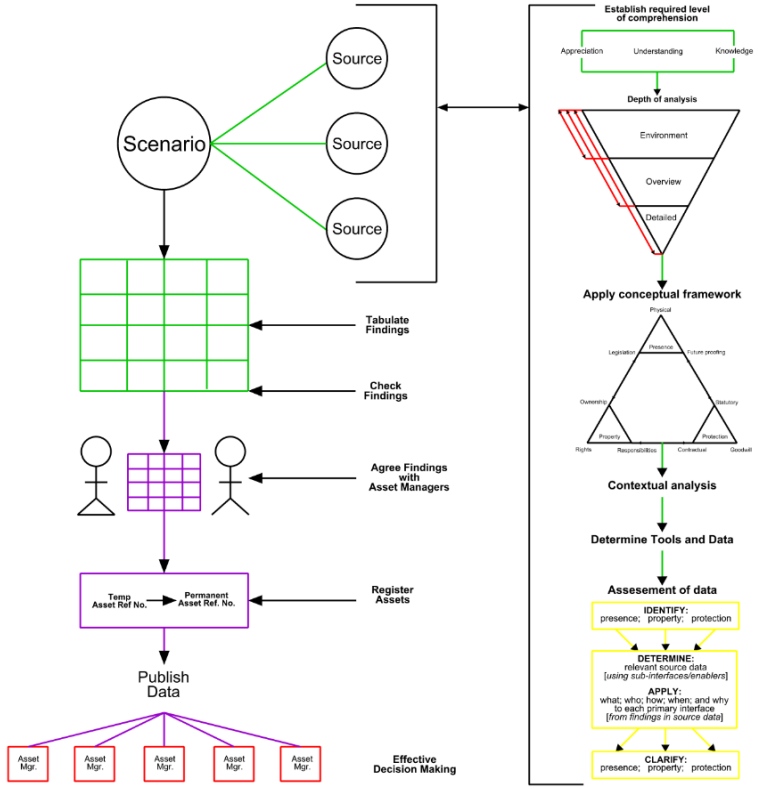


Pile design for new building above a tube railway tunnel, London, 2013.
Source: RAIB, 2014.

Standardised approaches to comprehending these interfaces are essential.

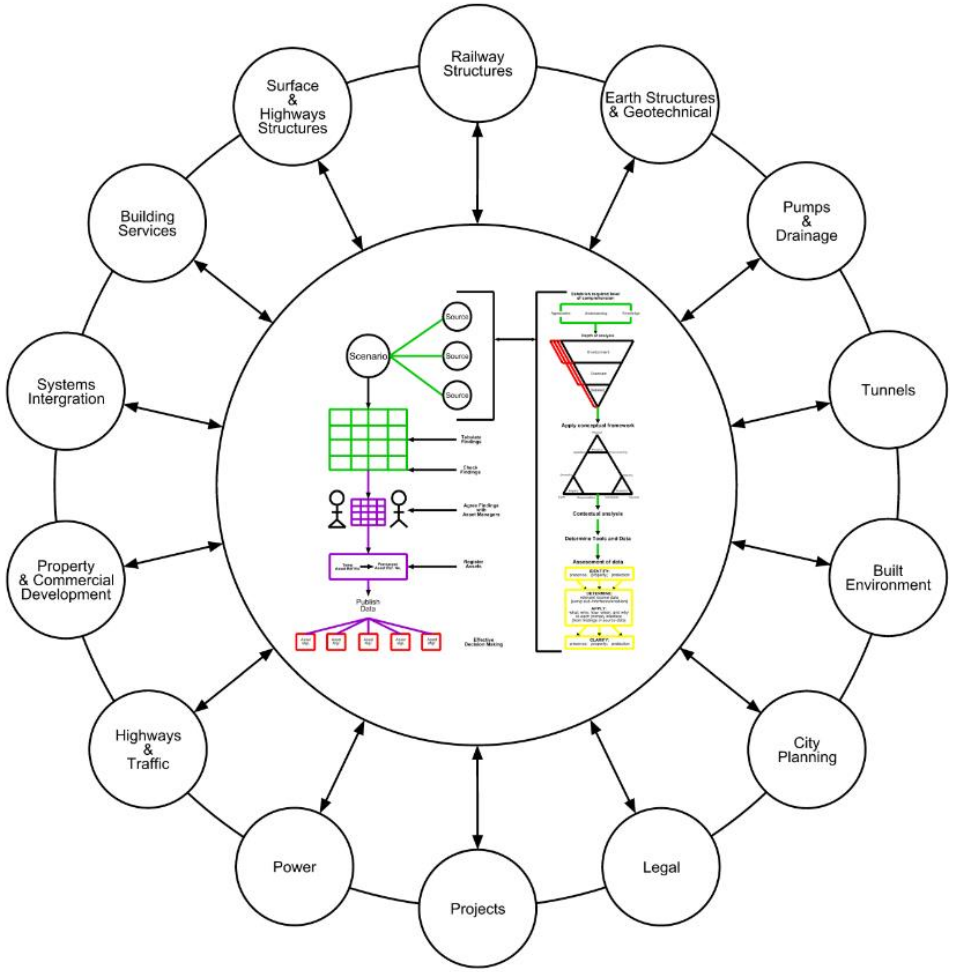






Asset ref. no.	The identifying code for transport organisation assets/infrastructure
AIR ref. no.	A temporary code where there is no identifying code for transport organisation assets/infrastructure
Location code	A code identifying a section of road/railway between or at key locations
Type of asset	Standardised 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

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



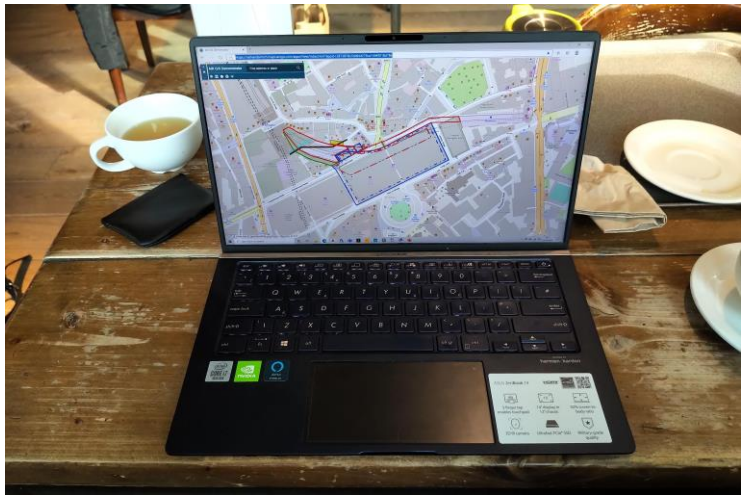
Workflow showing how the AIR processes contribute to asset and interface management.
Source: Darroch, 2020.

But that interface data needs to be accessible

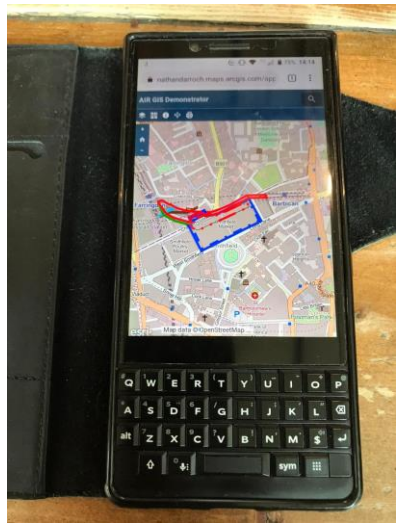
The multi-disciplinary nature of interface data needs to be accessible by:

- many and varied disciplines that influence transport and urban interface management;
- practitioners with varying levels of knowledge and experience of the interfaces outside of their own discipline;
- people with many and varied abilities to use available software (3 & 4D modelling tools, CAD, GIS);
- people in a variety of working locations (onsite, in an office, at home, in a café);
- using different tools to access the data (PC, lap-top, tablet, phone).

The interface data must therefore be presented simply in an easy to use and easy to access format:



AIR GIS



Sharing interface data benefits organisations and their stakeholders

Access to and sharing of interface data via the AIR GIS can contribute to:

- more effective implementation of BIM, 3 & 4D modelling, and asset data management;
- more effective implementation of asset and urban management processes;
- the increased safe presence and operation of transport infrastructure and its environment;
- the development of effective sustainable transport and urban management policies and planning;
- the effective creation of and amendment to the interfaces between new transport infrastructure and its environment;
- subsequent organisational cost and time savings;

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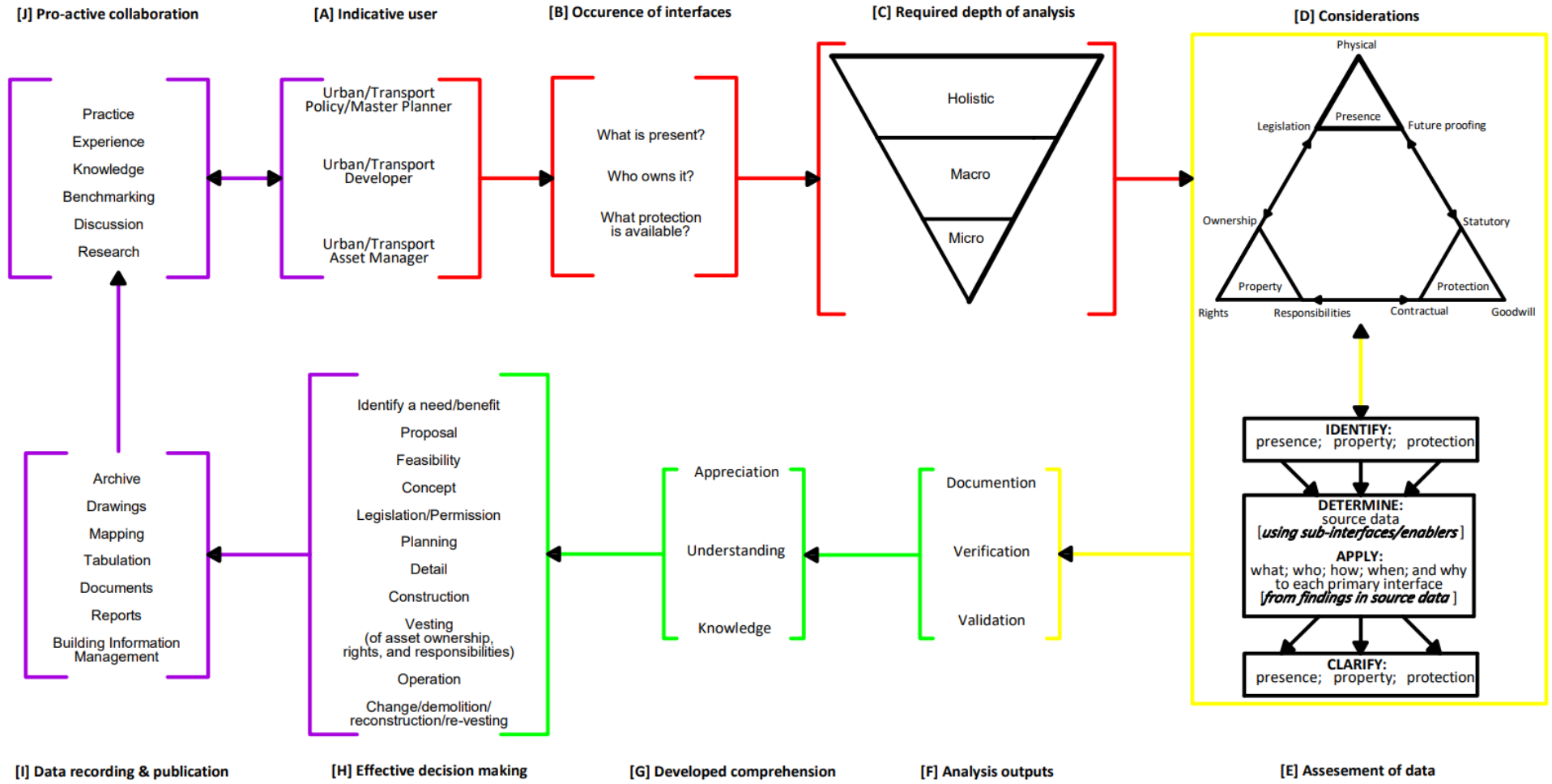
These can only be achieved by having effective standardised approaches to the analysis of the interfaces, data gathering/recording, and sharing of the evidence-based data, across an organisation and with its interfacing stakeholders.

Analysis and sharing of interface data enables effective organisational decision making.

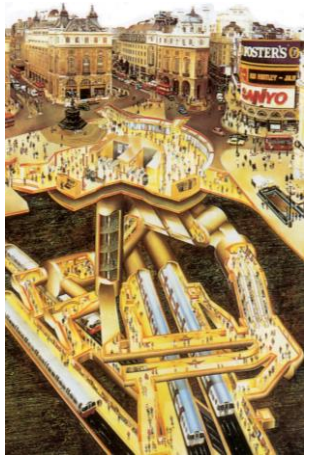


Workflow showing how the AIR processes contribute to asset and interface management.
Source: Darroch, 2020.

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

Working with participating organisations, the AIR research project will:

- apply the AIR processes to selected detailed case studies, which incorporate interconnected and interdependent occurrences of railway-based transport infrastructure interfacing with its environment;
- present the evidence-based findings from the analysis within a bespoke AIR GIS;
- evaluate the findings of the case studies to determine the benefits and limitations of the AIR processes to enabling effective infrastructure interface management;
- 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 participating organisations, across the world.

Potential achievements from the project

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 like further information on the AIR research project:

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.

see, the University of Aberdeen AIR research project website:
https://www.abdn.ac.uk/engineering/research/air-652.php

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

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