PANOPTIC BRIDGE MANAGEMENT

Capturing Network Rail's assets for better management and maintenance

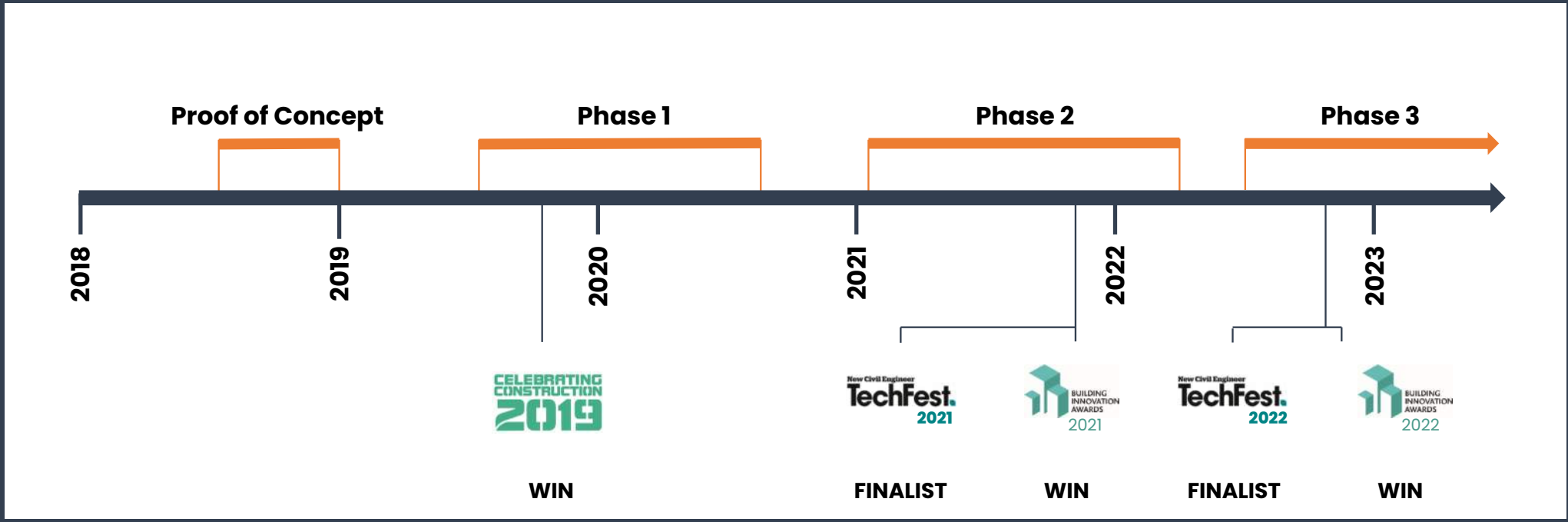
Technical Authority

Waldeck

NTU Nottingham Trent University

BIRMINGHAM CITY University

THE PROJECT


Proof of Concept
Phase 1
Phase 2
Phase 3
2018
2019
2020
2021
2022
2023
CELEBRATING CONSTRUCTION 2019
New Civil Engineer TechFest 2021
BUILDING INNOVATION AWARDS 2021
New Civil Engineer TechFest 2022
BUILDING INNOVATION AWARDS 2022
WIN
FINALIST
WIN
FINALIST
WIN

THE TEAM

Veronica Ruby-Lewis
Associate Director/Lead BIM Consultant

Amy Cheeseman
Head of Digital Capture

2018 - Present

- Digital capture
- Development of workflow and methodology
- Project management
- Algorithm development
- Development of asset visualiser
- Support of BCMI calculation integration

2019 - Present

- Machine learning for defect recognition
- Supporting development of asset visualiser
- Supporting development of algorithm
- BCMI calculation integration

2021 - Present

- Development of web based 360-degree virtual tour environment for examinations

SCOPE

The challenges...

1. There are currently many different methods used across the business to manage and maintain these structures, with varying levels of efficiency.

2. Access for examination of visible and hidden structural elements can prove challenging.

3. Methods utilised are subjective.

PROOF OF CONCEPT

WHAT WE DID

As Network Rail look to streamline their monitoring and maintenance of assets, Waldeck's Research and Development team were tasked to undertake an initial study on 6 brick built assets.

The task was to review digital means of inspection, and to develop a proof of concept which provided demonstratable results.

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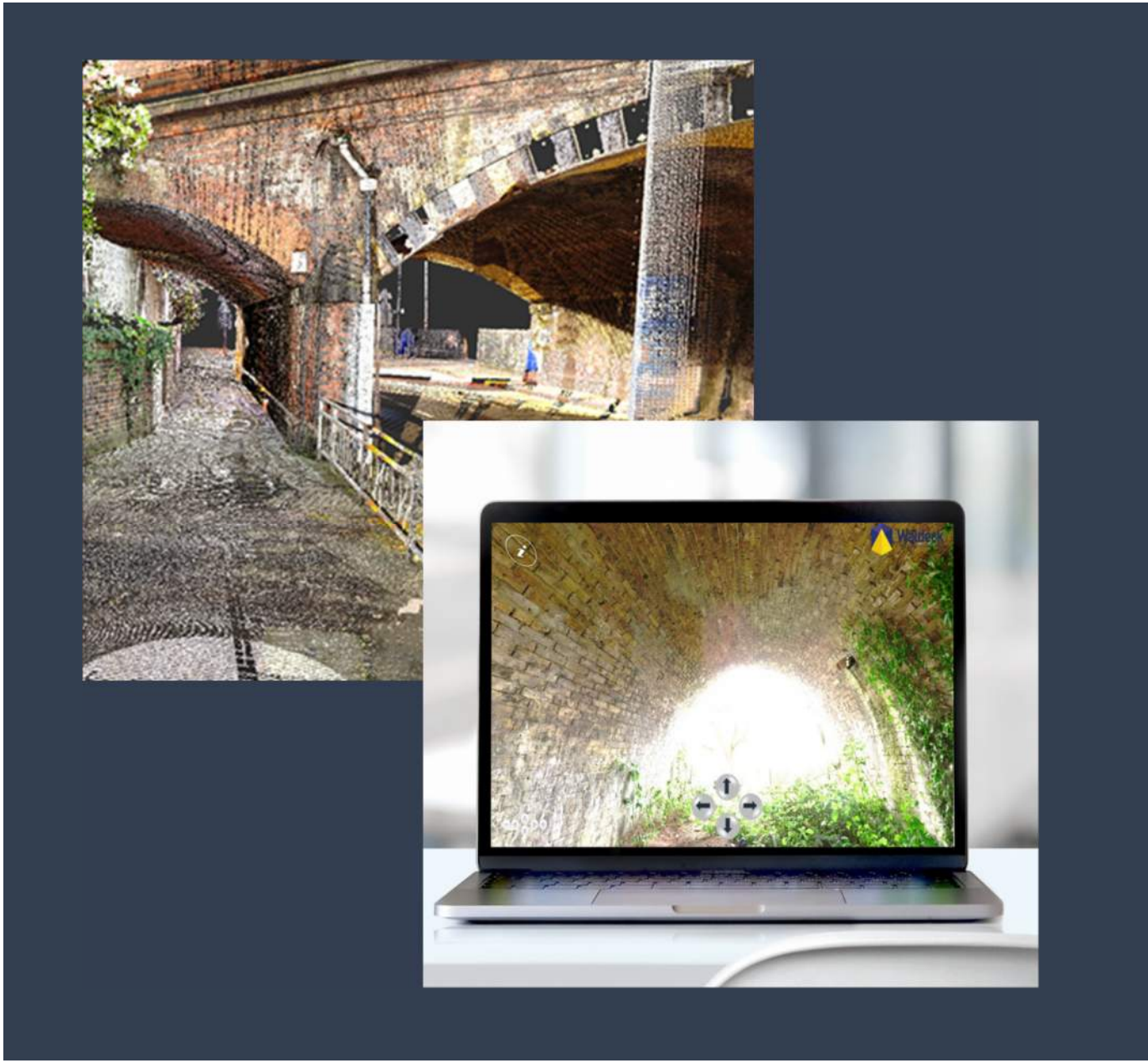
PROOF OF CONCEPT

SURVEY OUTPUTS

- Colourised geolocated point cloud
- Panoramic imagery
- 360 degree annotated virtual tour condition reports



PHASE 1

- Expanded proof of concept works to further 44 structures
- Expanded to include concrete structures
- Further testing of environmental influences on data
- Machine learning for defect recognition

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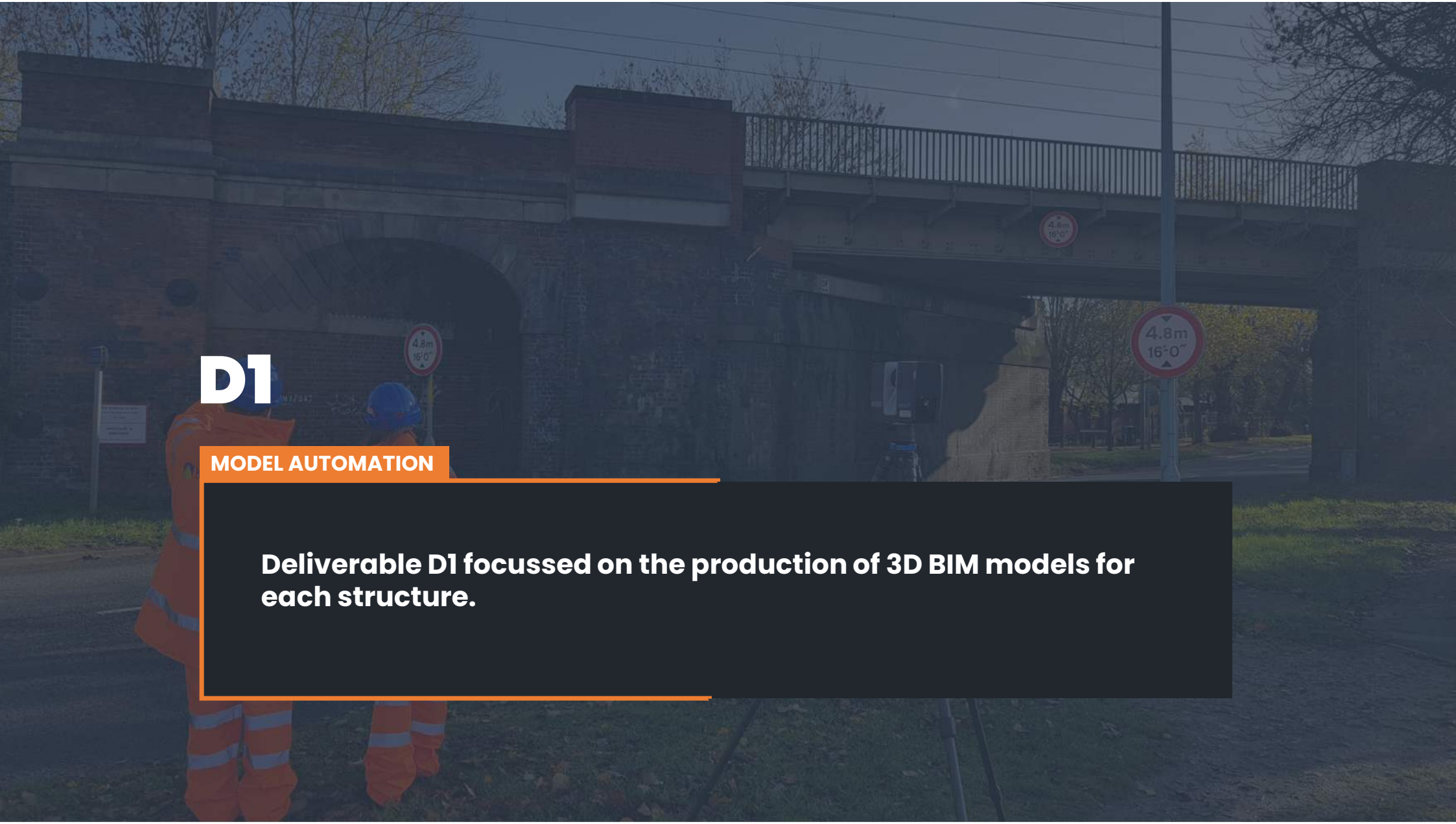
PHASE 1

Average 15 scans per structure

Average 250million points per structure

Night captures

Topside Drone and TLS Capture



D1

MODEL AUTOMATION

Deliverable D1 focussed on the production of 3D BIM models for each structure.

D1

Model Automation

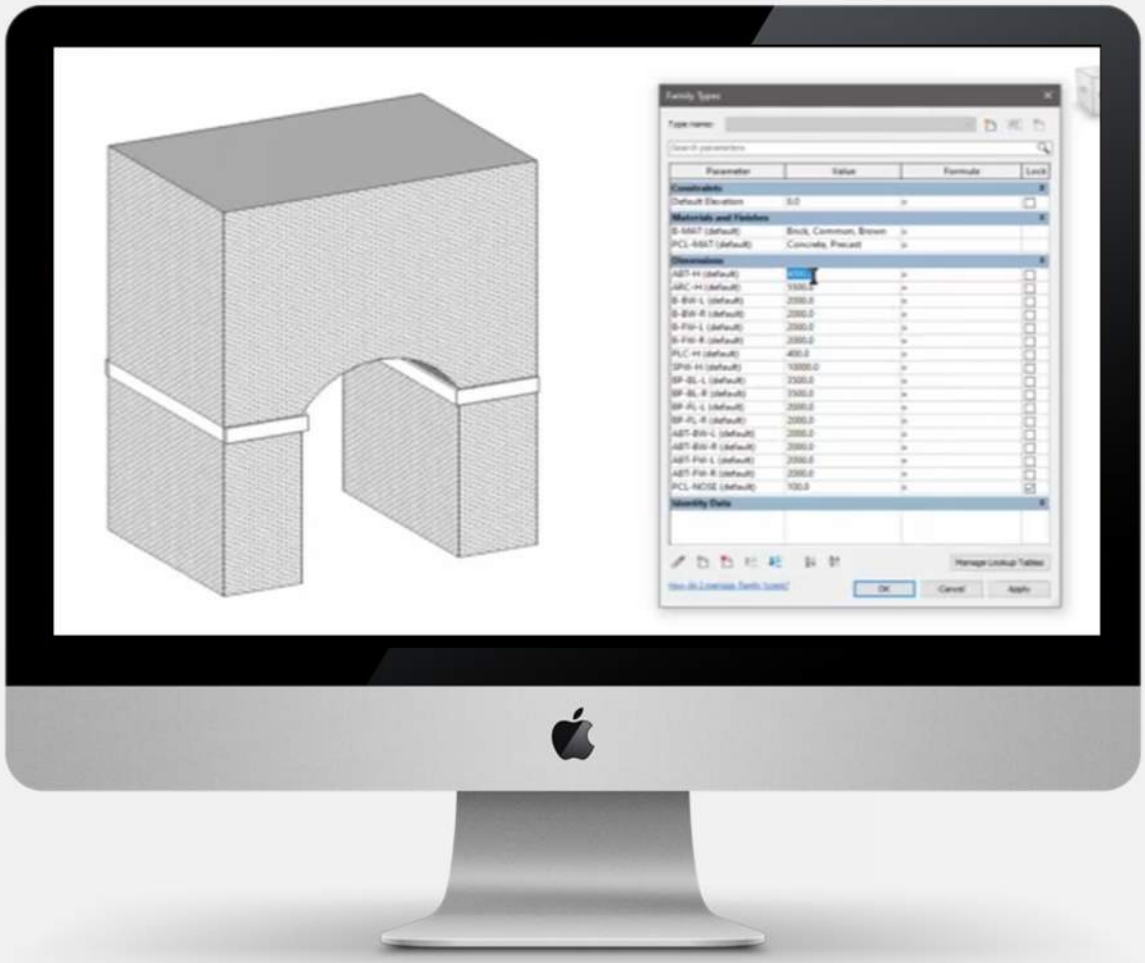
1. Implement BIM into the workflow.

2. All the bridge components fully intelligent and parametric.

3. Develop a single algorithm which works for typical bridge types.

4. Improve the application of the algorithm.

BIM Components:

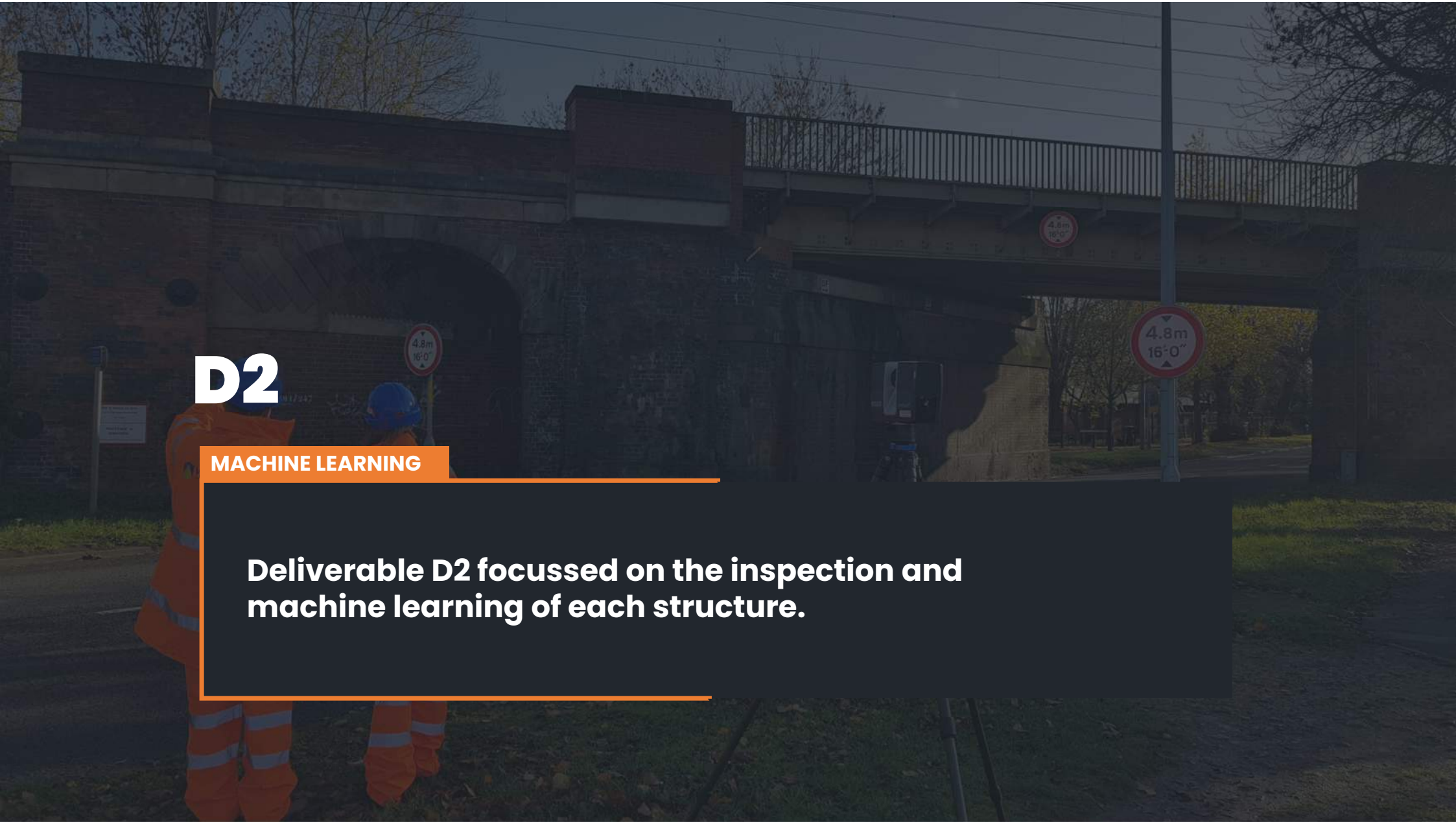


D1

Model Automation

- Utilised parametric components
- Semi-autonomous
- Works with raw point cloud - no editing/cleaning of points required

Algorithm Workflow:



D2

MACHINE LEARNING

Deliverable D2 focussed on the inspection and machine learning of each structure.

D2

Model Machine Learning
Training Data Set (2)

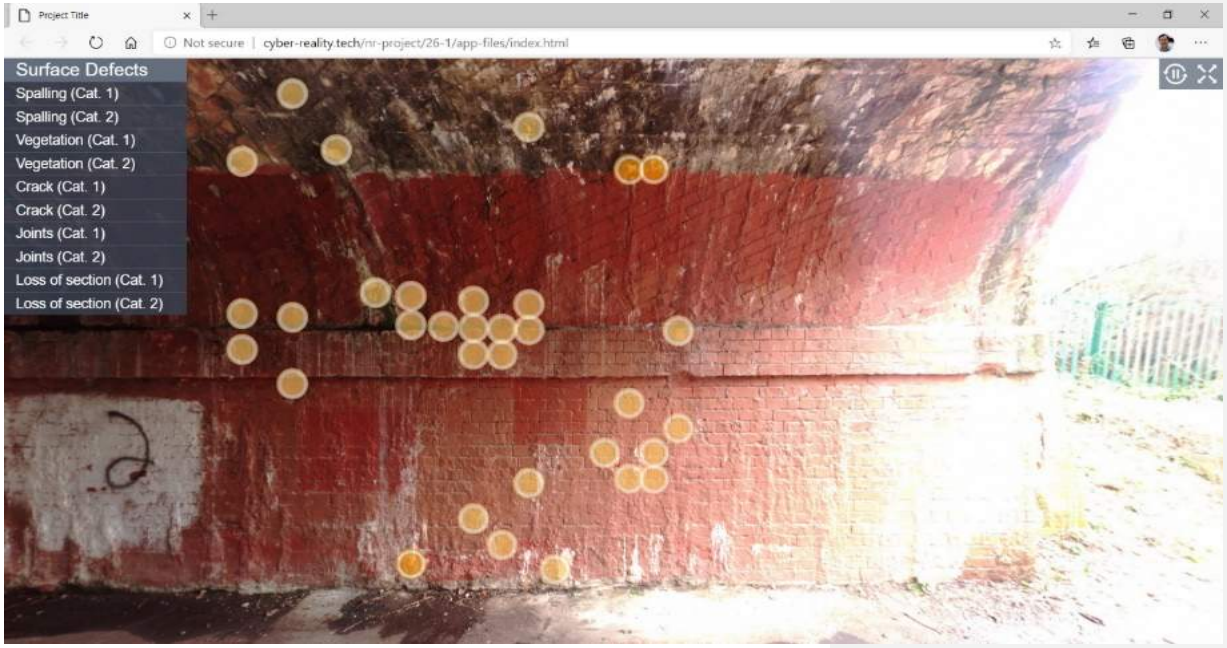
Vegetation samples

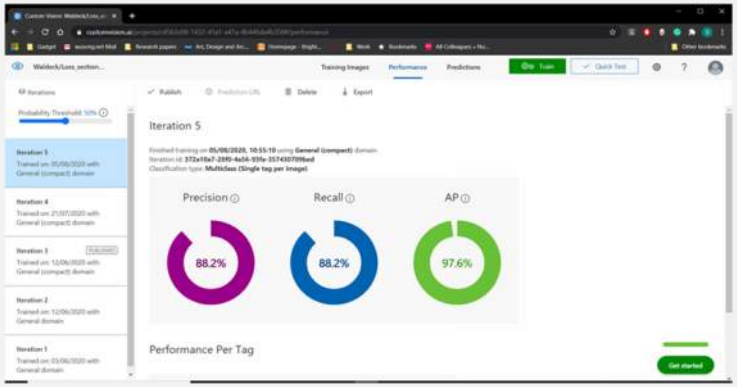
Spalling samples

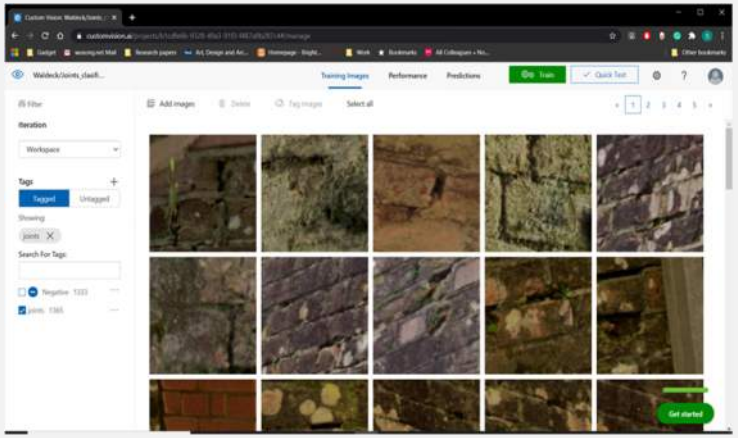
D2

Model Machine Learning

Defect detection using AI







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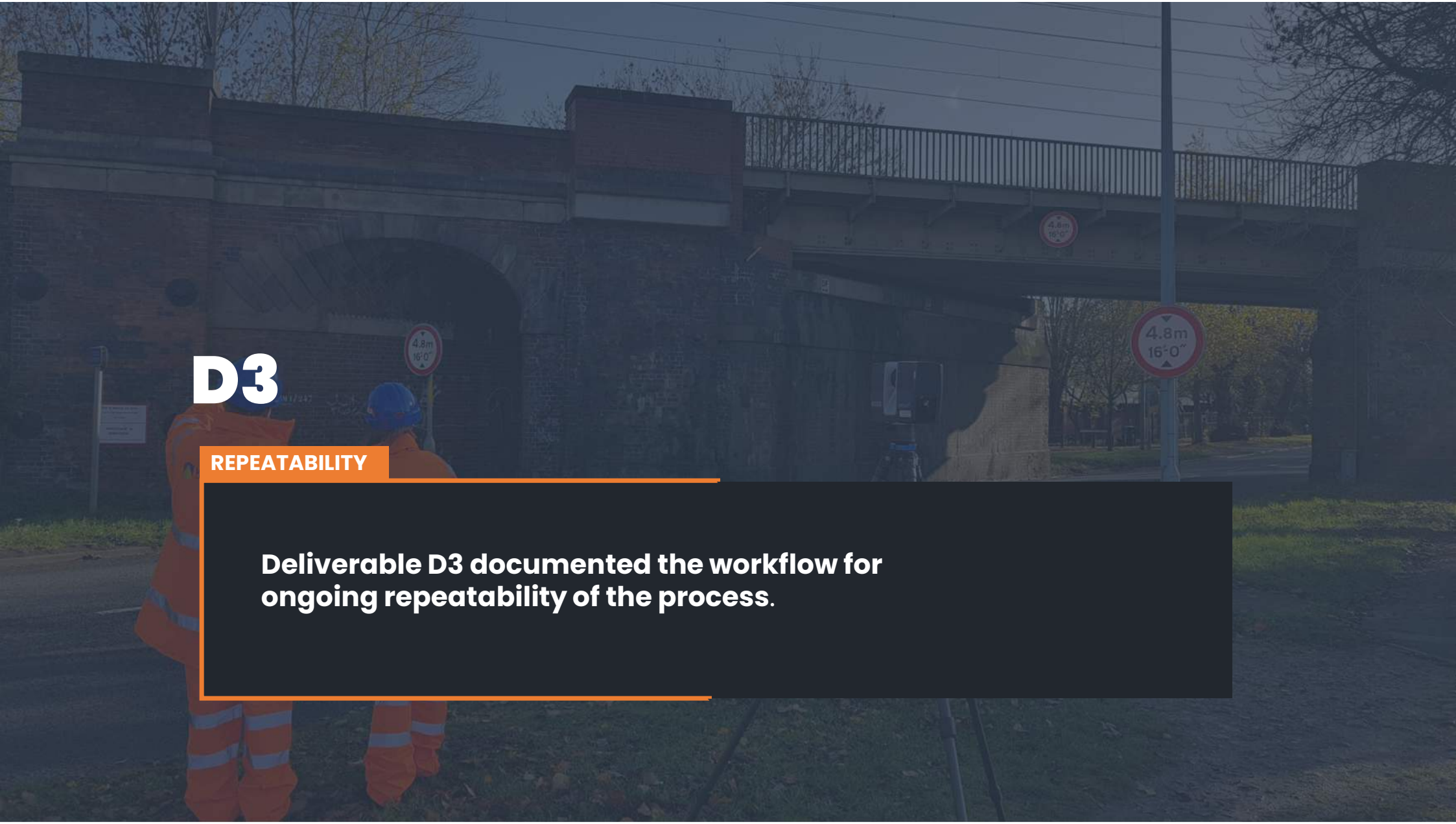


D3

REPEATABILITY

Deliverable D3 documented the workflow for ongoing repeatability of the process.

D3

Repeatability, Environmental Influences & Scaling

Light Levels

Environment

Rain Intensity

Topside Data Set Comparison

D4

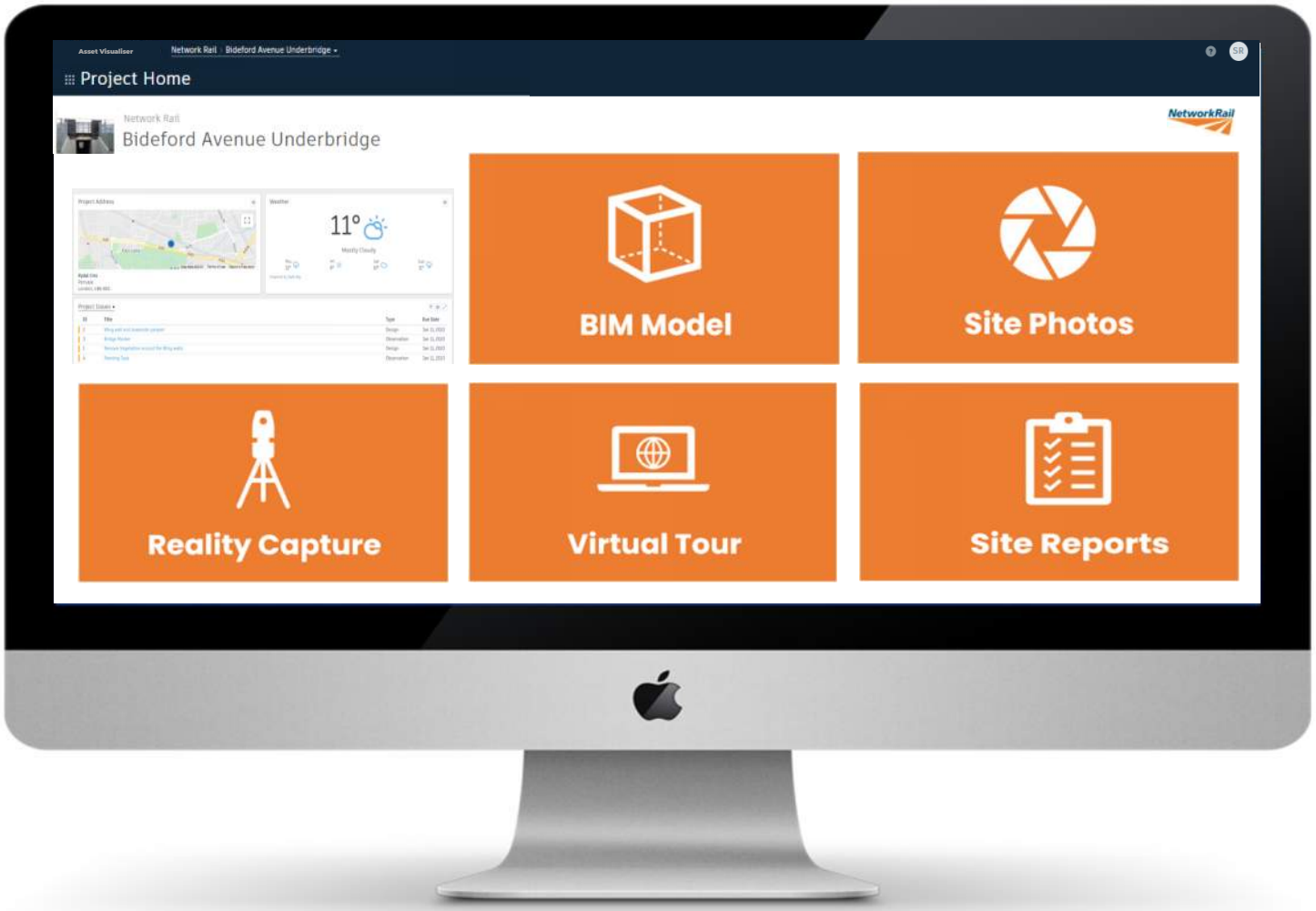
ASSET VISUALISER

Deliverable D4 entailed the production of annotated 3D visual reports which provided a holistic view of the structure and its defects.

D4

Asset Visualiser

ASSET
VISUALISER
Prototype
Dashboard



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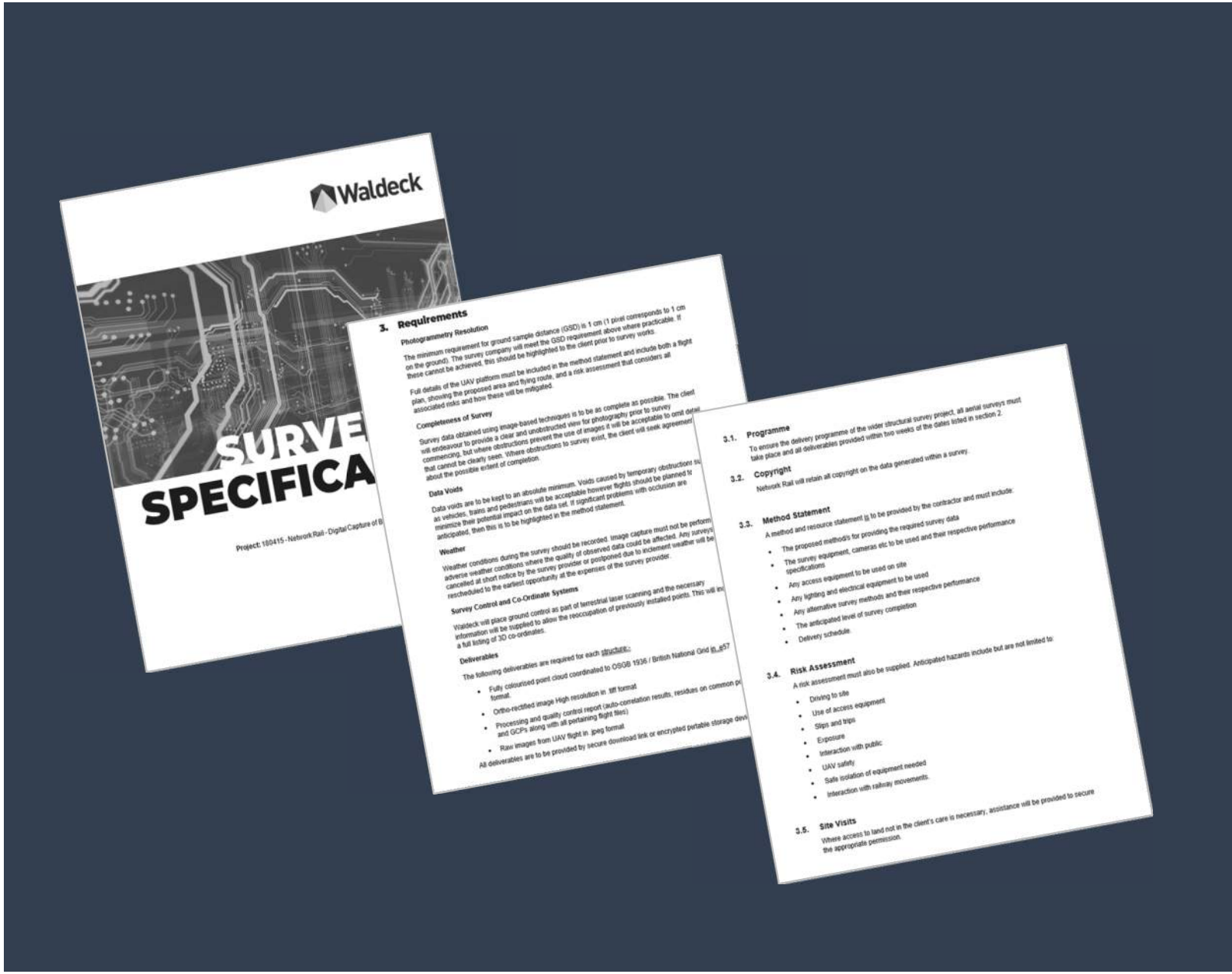
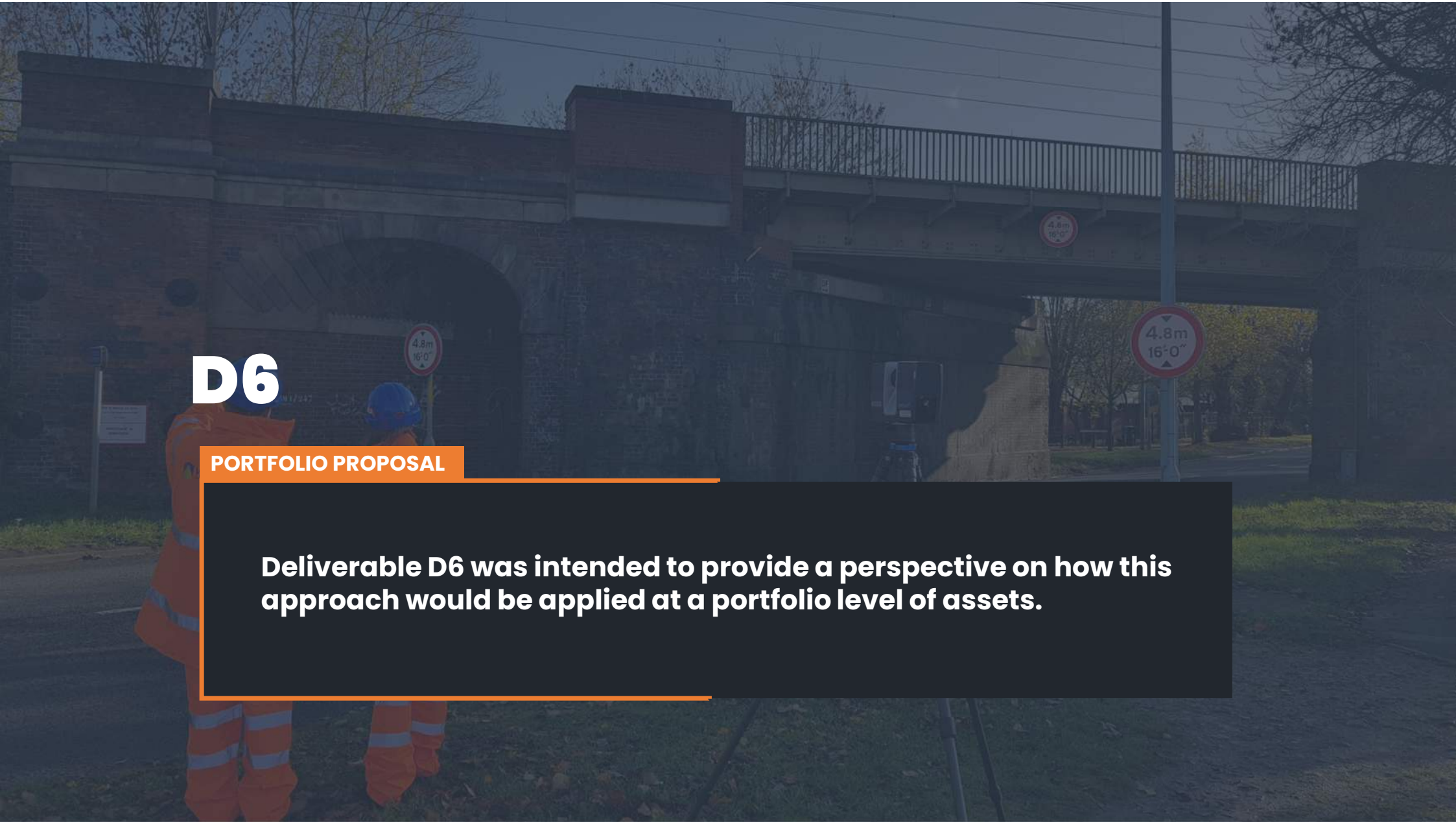
D5

Survey Specification



WALDECK / NETWORK RAIL



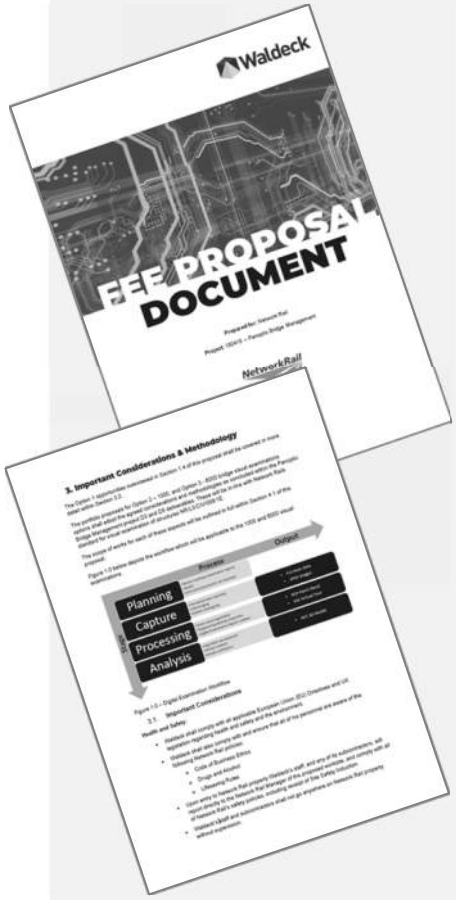
D6

PORTFOLIO PROPOSAL

Deliverable D6 was intended to provide a perspective on how this approach would be applied at a portfolio level of assets.

D6

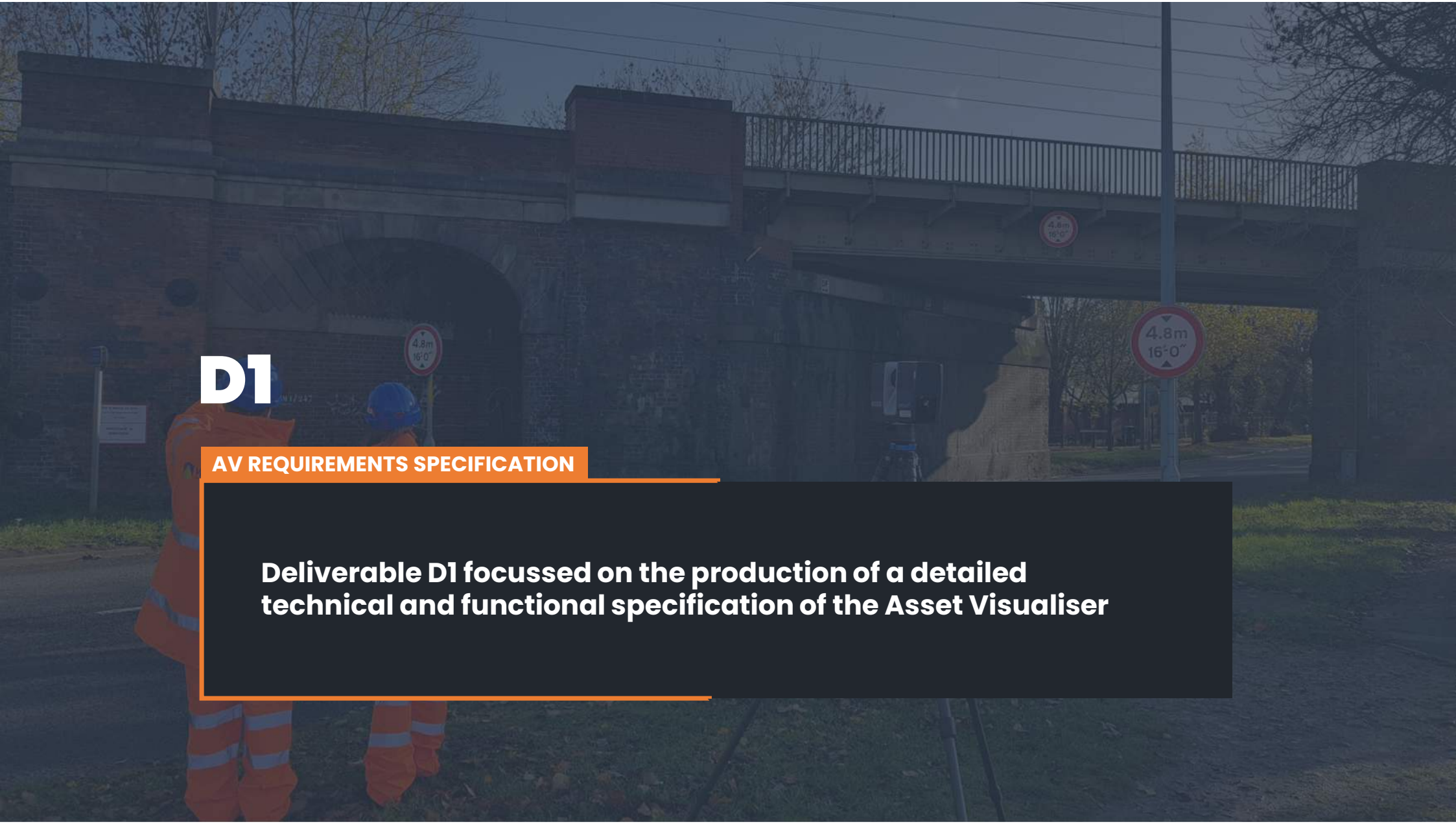
Portfolio Proposal



	Case 1	Case 2	% cost of indicated fee
Number of structures to be surveyed over 52-week period	1000	1000	N/A
Assumed active weeks	50	40	N/A
Number of structures surveyed per week	20	25	N/A
Number of structures surveyed per day	4	5	N/A
Inspection personnel per day	4	5	33%
Data processing personnel per day	2	2.5	16.5%
Qualified Bridge / Structural Engineers per day	1.4	1.7	20.5%
Quality Control personnel per day	0.75	0.95	2%
Project Management personnel per day	0.5	0.625	2%
Technology Wear / Calibration, Accommodation, Travel & Subsistence costs	N/A	N/A	26%

PHASE 2

- Proof of concept solution for asset management, incorporating BCMI and 360-degree imagery captured from drones
- Data specification
- Trials - 3 viaducts in Wales



D1

AV REQUIREMENTS SPECIFICATION

Deliverable D1 focussed on the production of a detailed technical and functional specification of the Asset Visualiser

D1

Software Requirements Specification for AV

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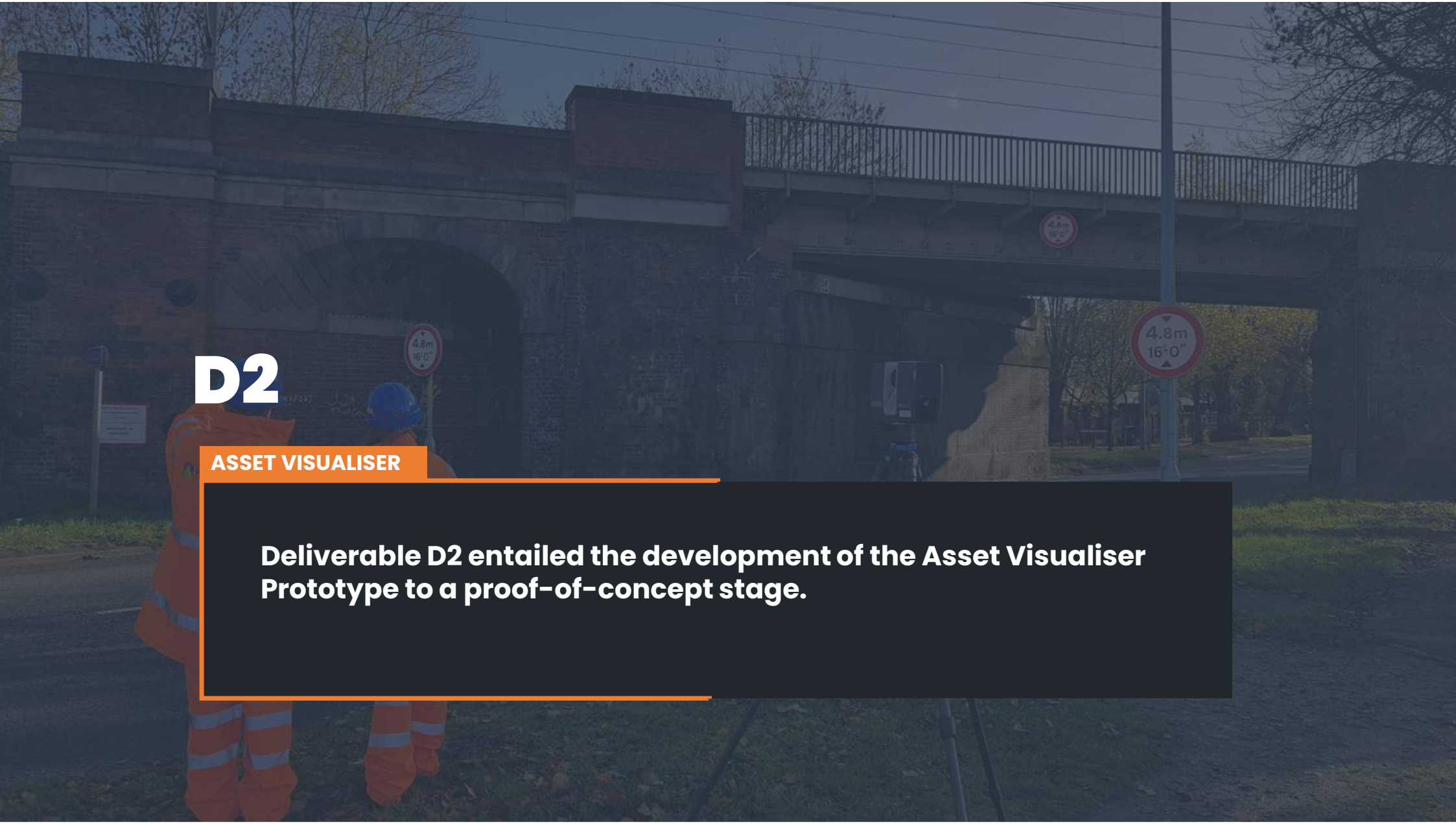


D2

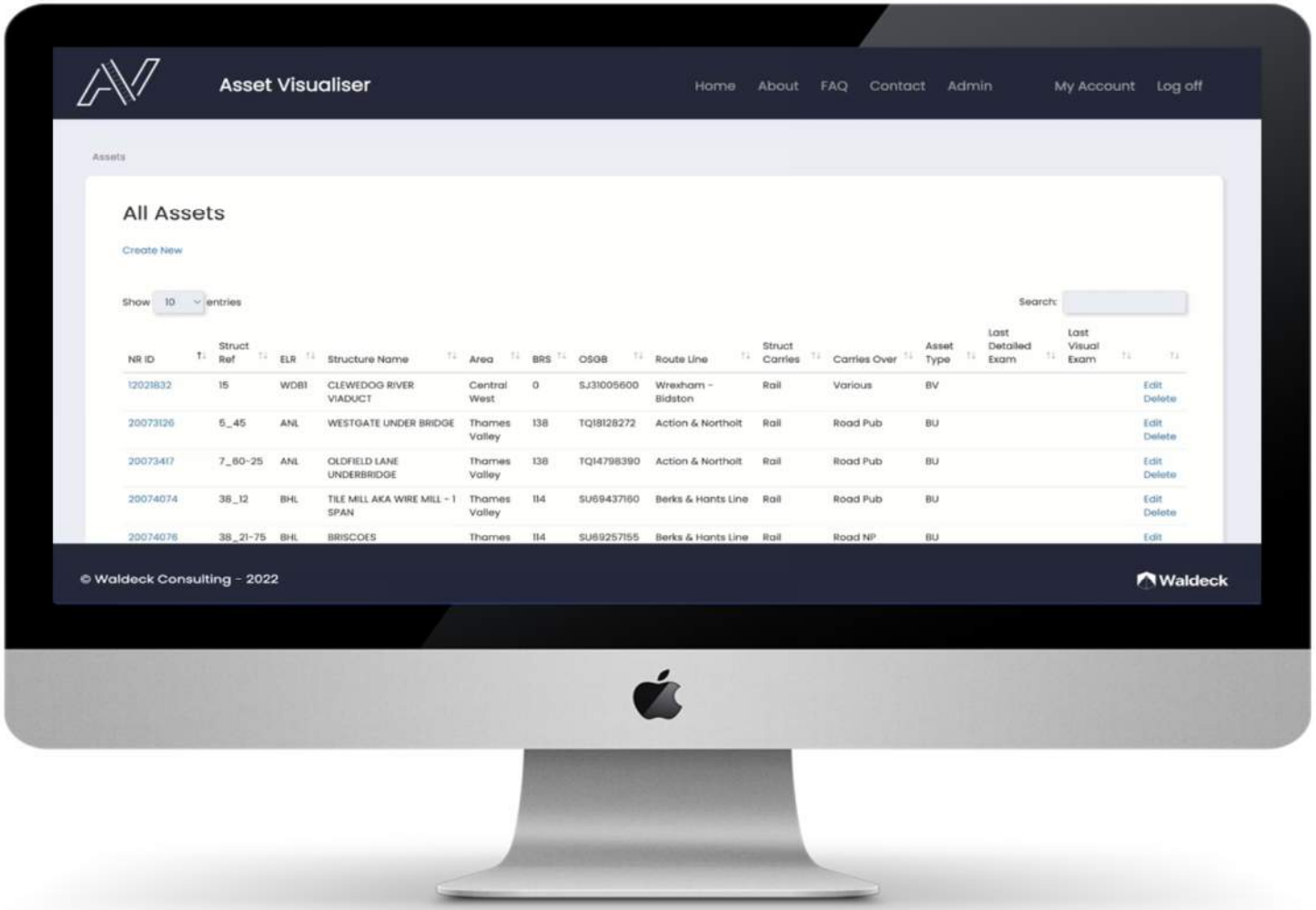
ASSET VISUALISER

Deliverable D2 entailed the development of the Asset Visualiser Prototype to a proof-of-concept stage.

D2

Asset Visualiser

ASSET VISUALISER
Proof-of-Concept
Dashboard



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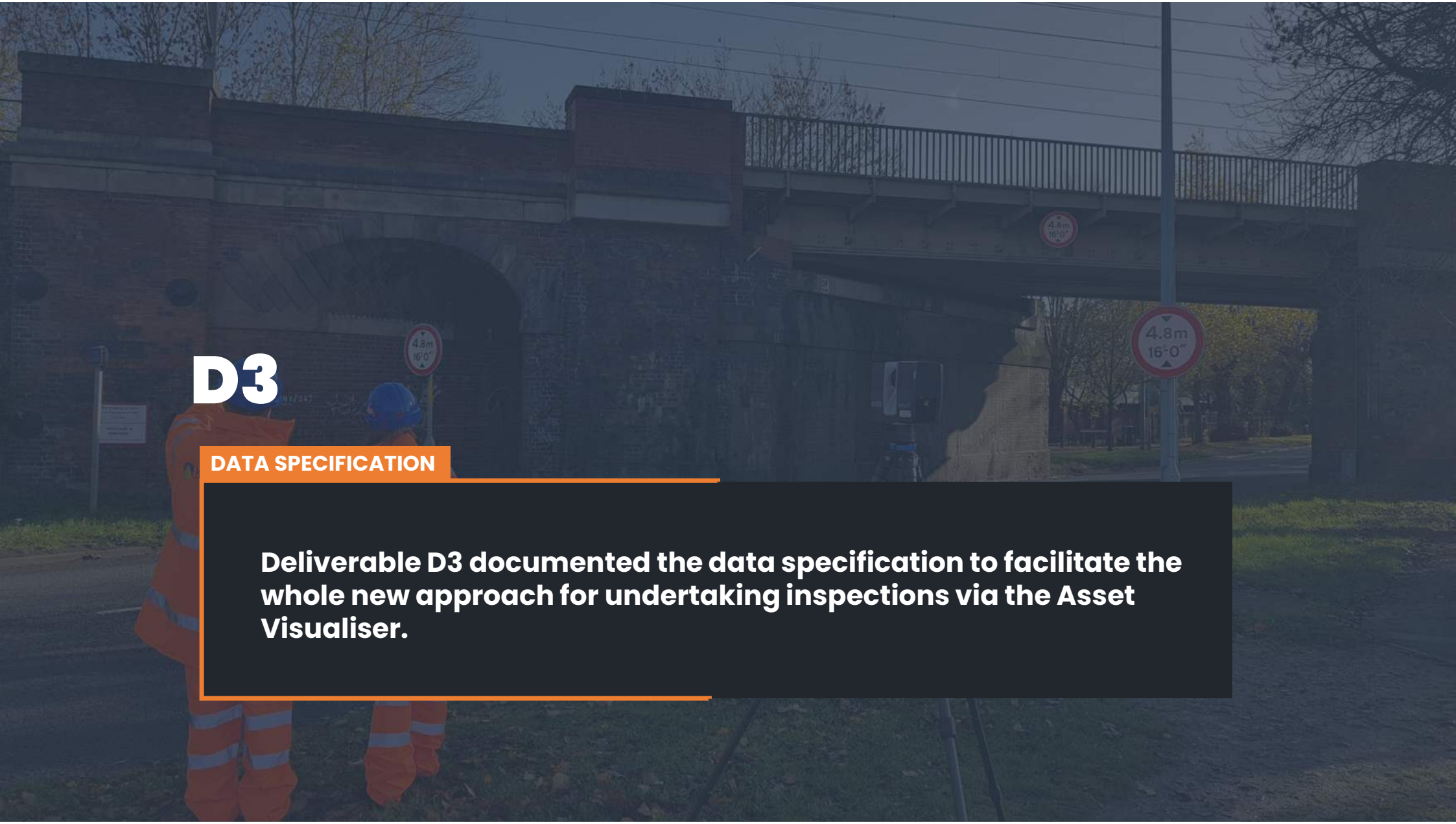


D3

DATA SPECIFICATION

Deliverable D3 documented the data specification to facilitate the whole new approach for undertaking inspections via the Asset Visualiser.

D3

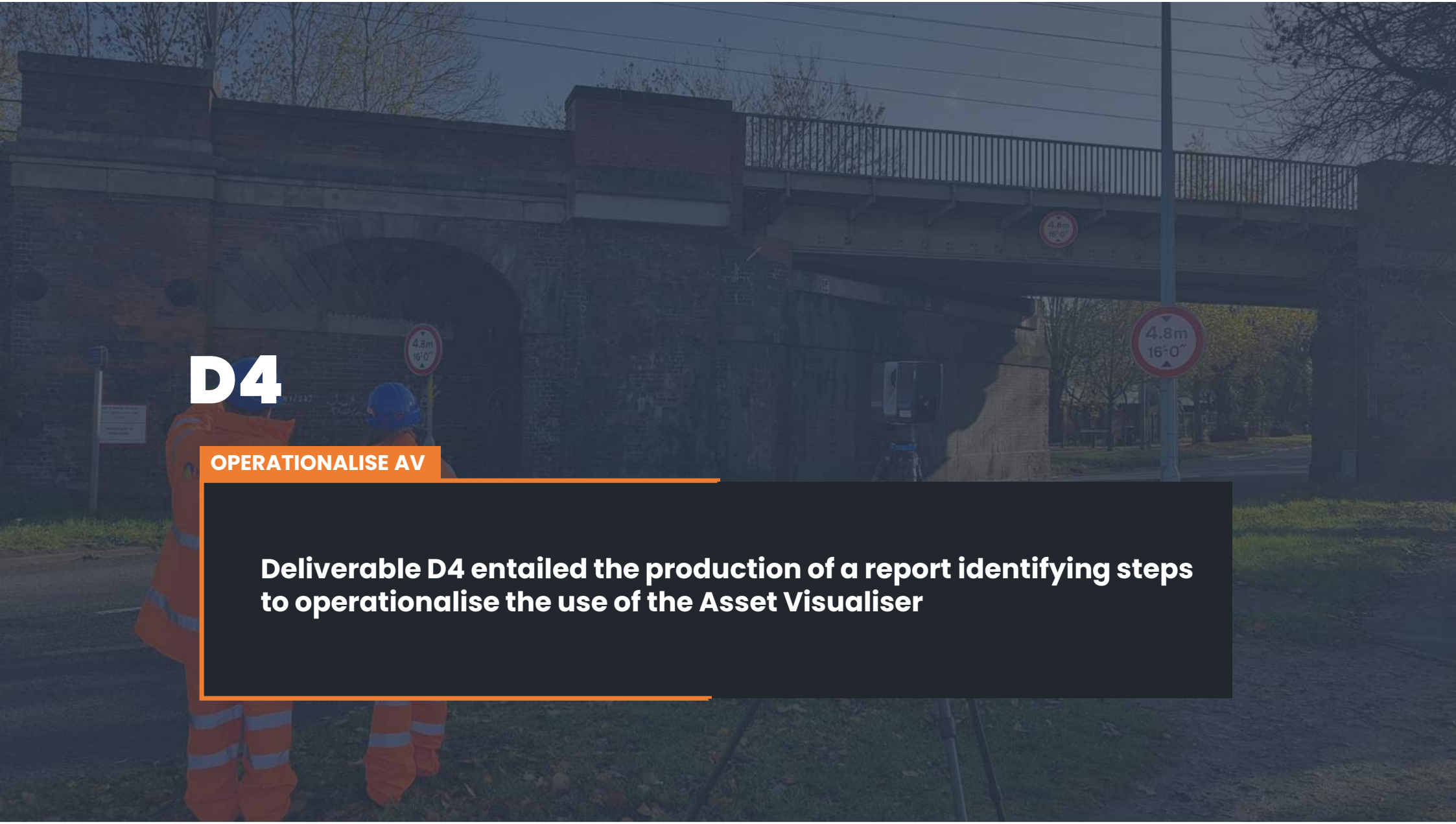
Data Specification

TLS

UAV

BIM Model

Meta Data



D4

OPERATIONALISE AV

Deliverable D4 entailed the production of a report identifying steps to operationalise the use of the Asset Visualiser

D4

Steps to Operationalise Asset Visualier

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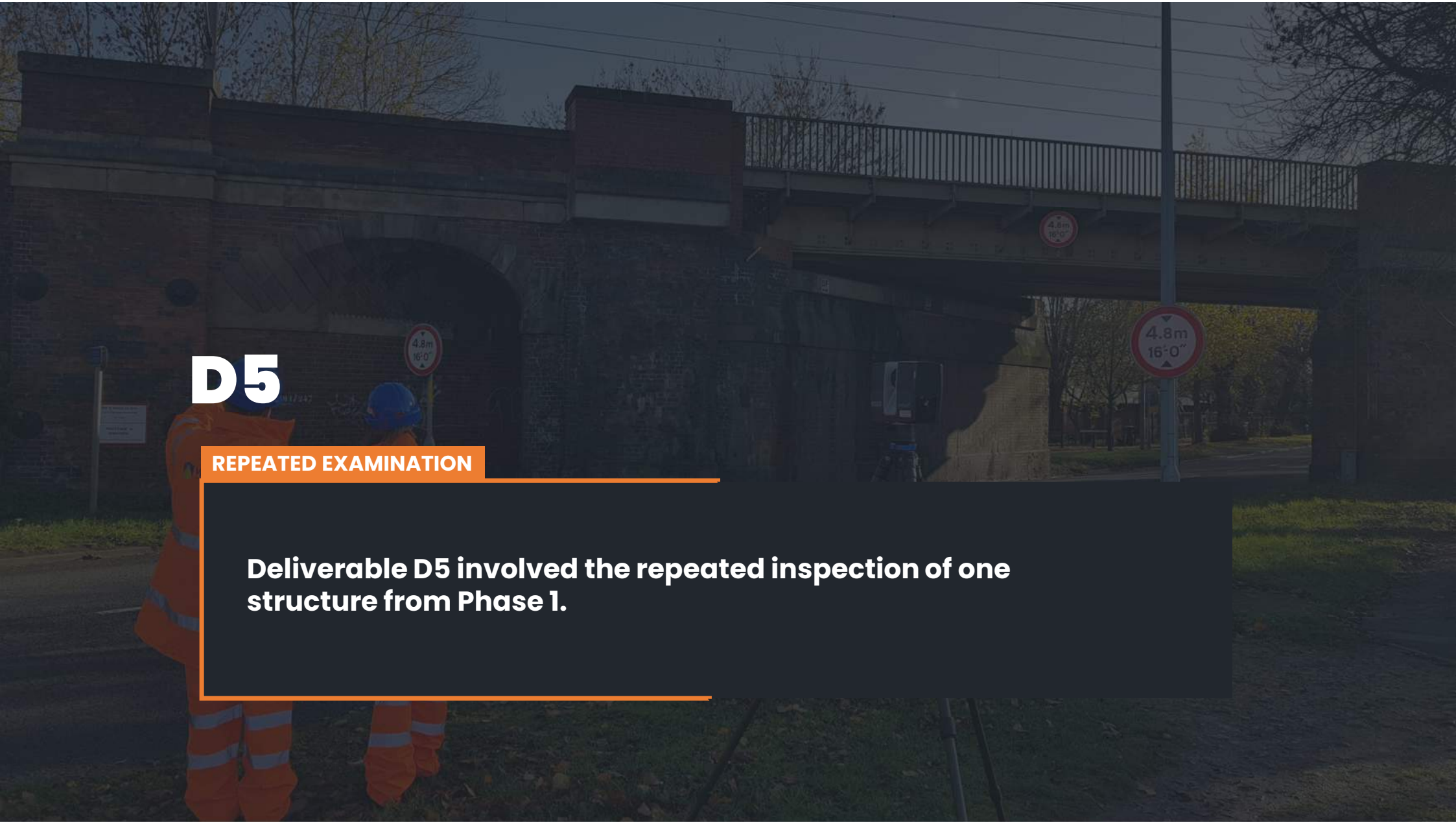


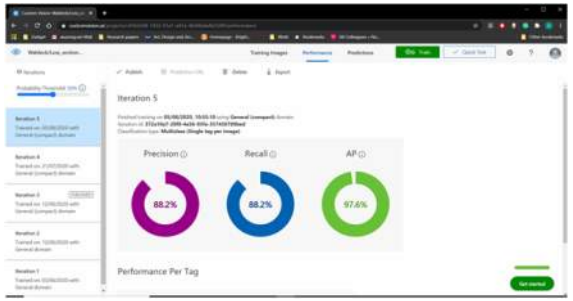
D5

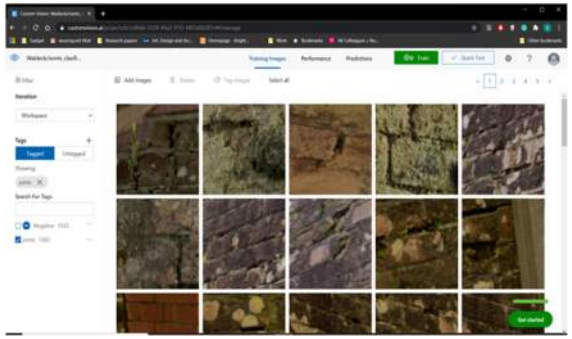
REPEATED EXAMINATION

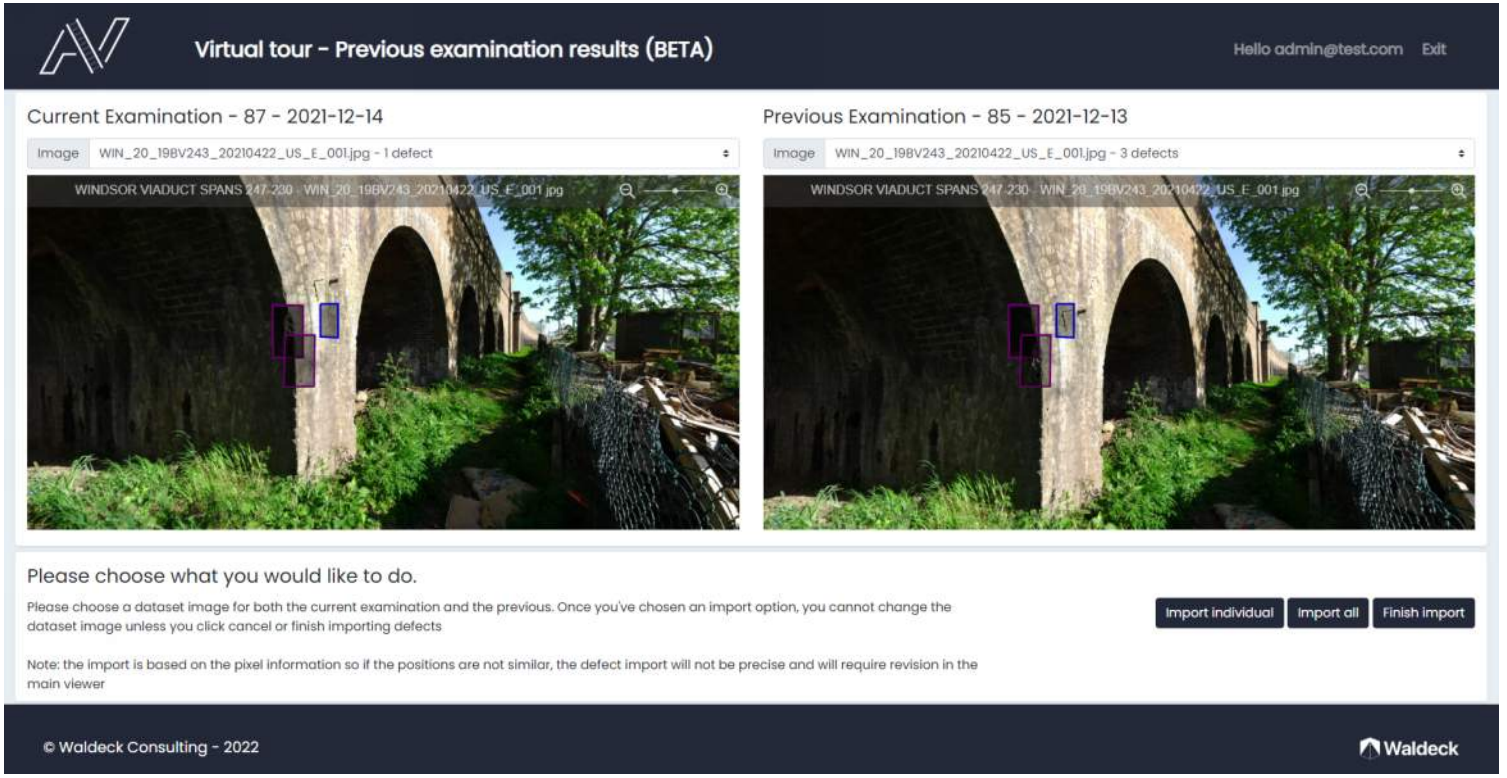
Deliverable D5 involved the repeated inspection of one structure from Phase 1.

D5

Repeated Examination







Welsh Trials

Loughor

200m long

Spans across water and land

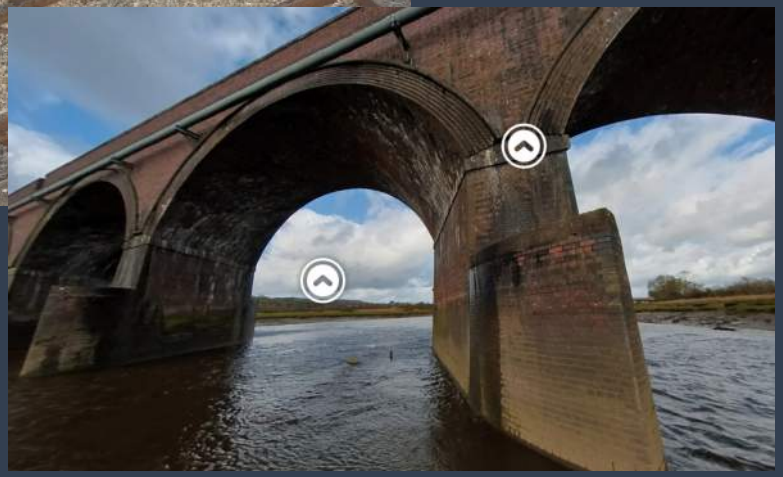
Boat used to capture spans

360 Camera Drone Capture

Welsh Trials

100 mega-pixel photos

1.13billion points



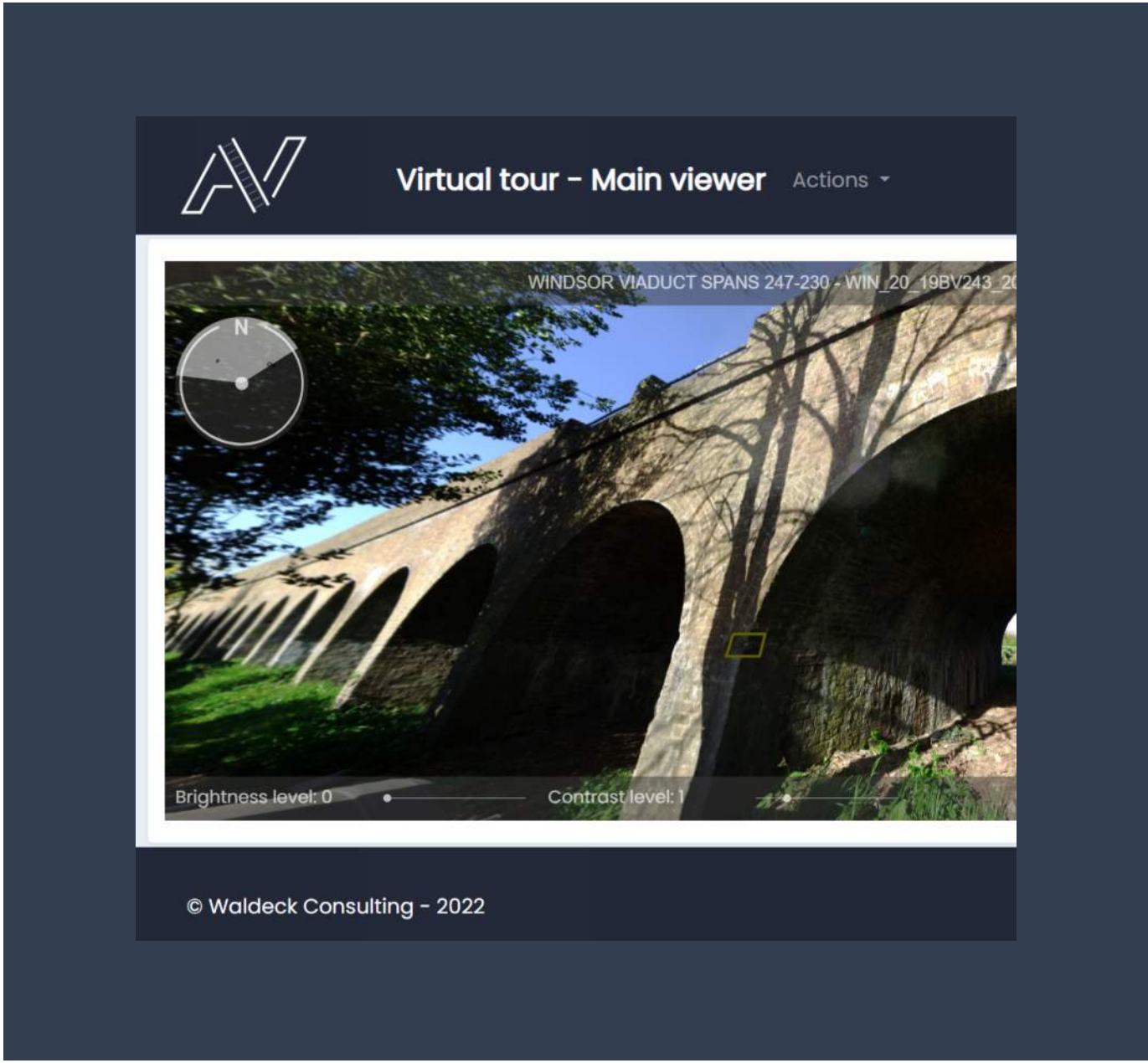
Boat used to capture spans

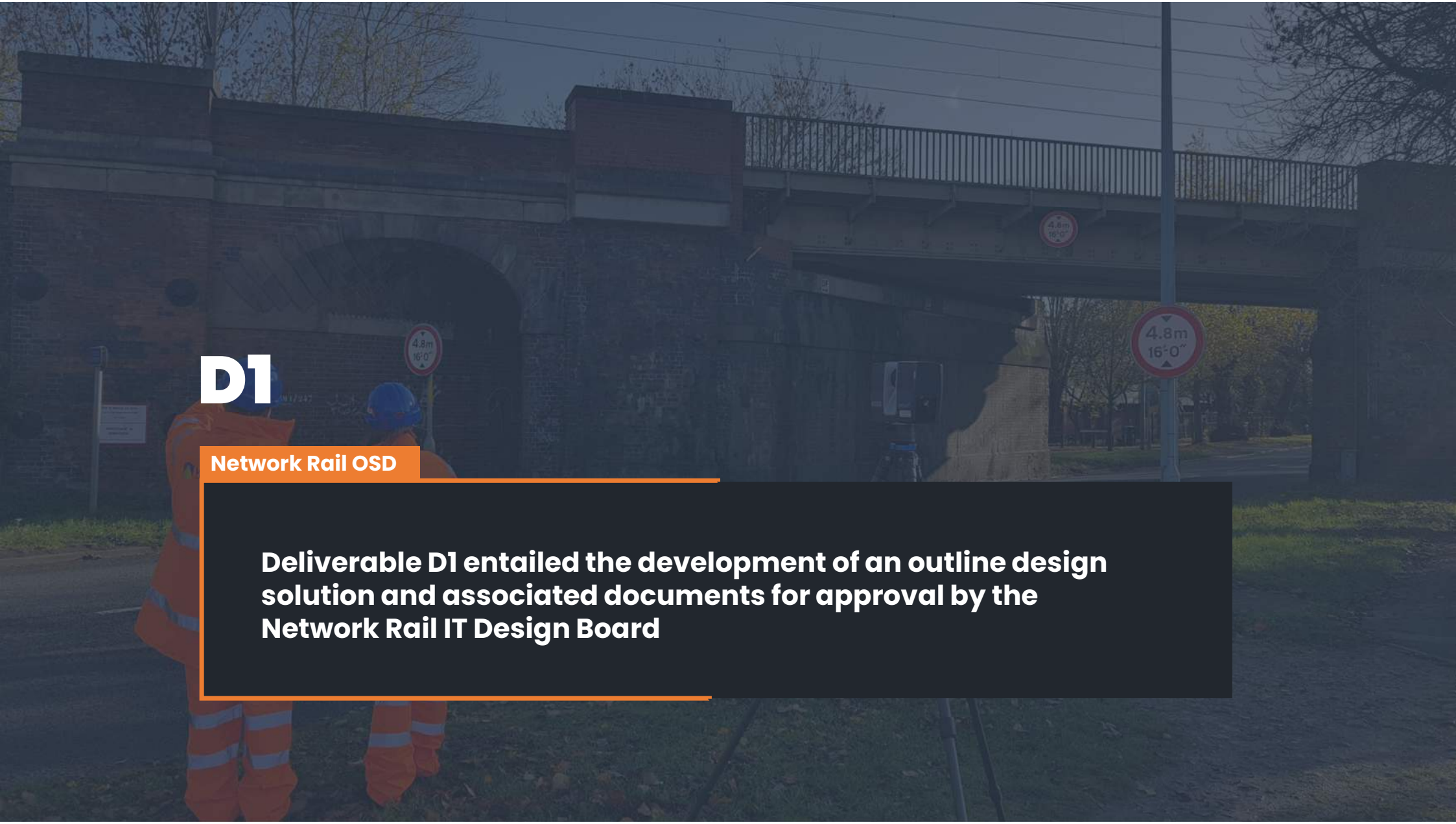
WALDECK / NETWORK RAIL

PHASE 3

- Network Rail's long term vision for digital examinations is to integrate the visualiser into the asset management solution being built under the Intelligent Infrastructure Programme.

- Phase 3 of the Panoptic Bridge Management project provides Network Rail with an interim solution.

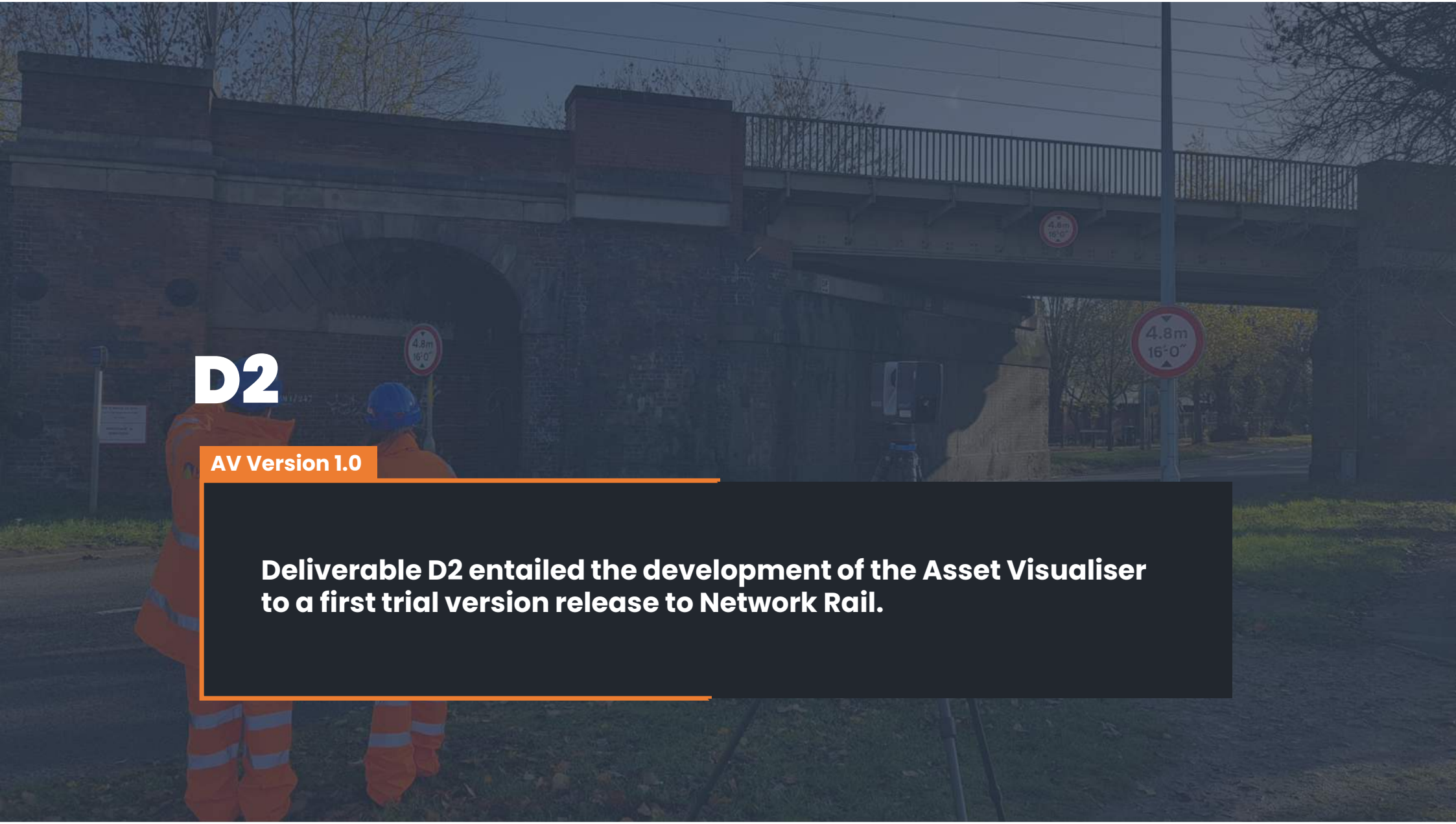




D1

Network Rail OSD

Deliverable D1 entailed the development of an outline design solution and associated documents for approval by the Network Rail IT Design Board



D2

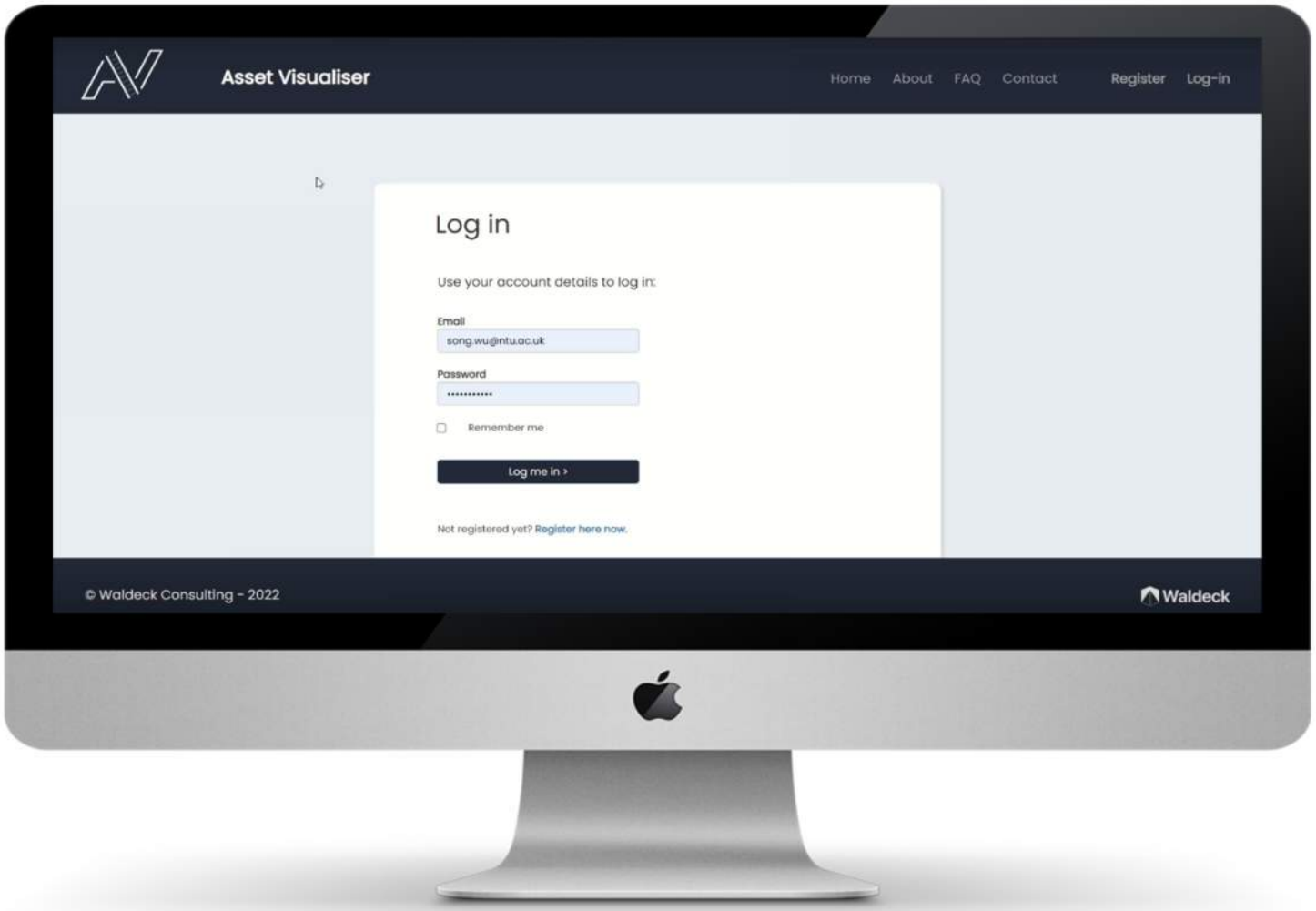
AV Version 1.0

Deliverable D2 entailed the development of the Asset Visualiser to a first trial version release to Network Rail.

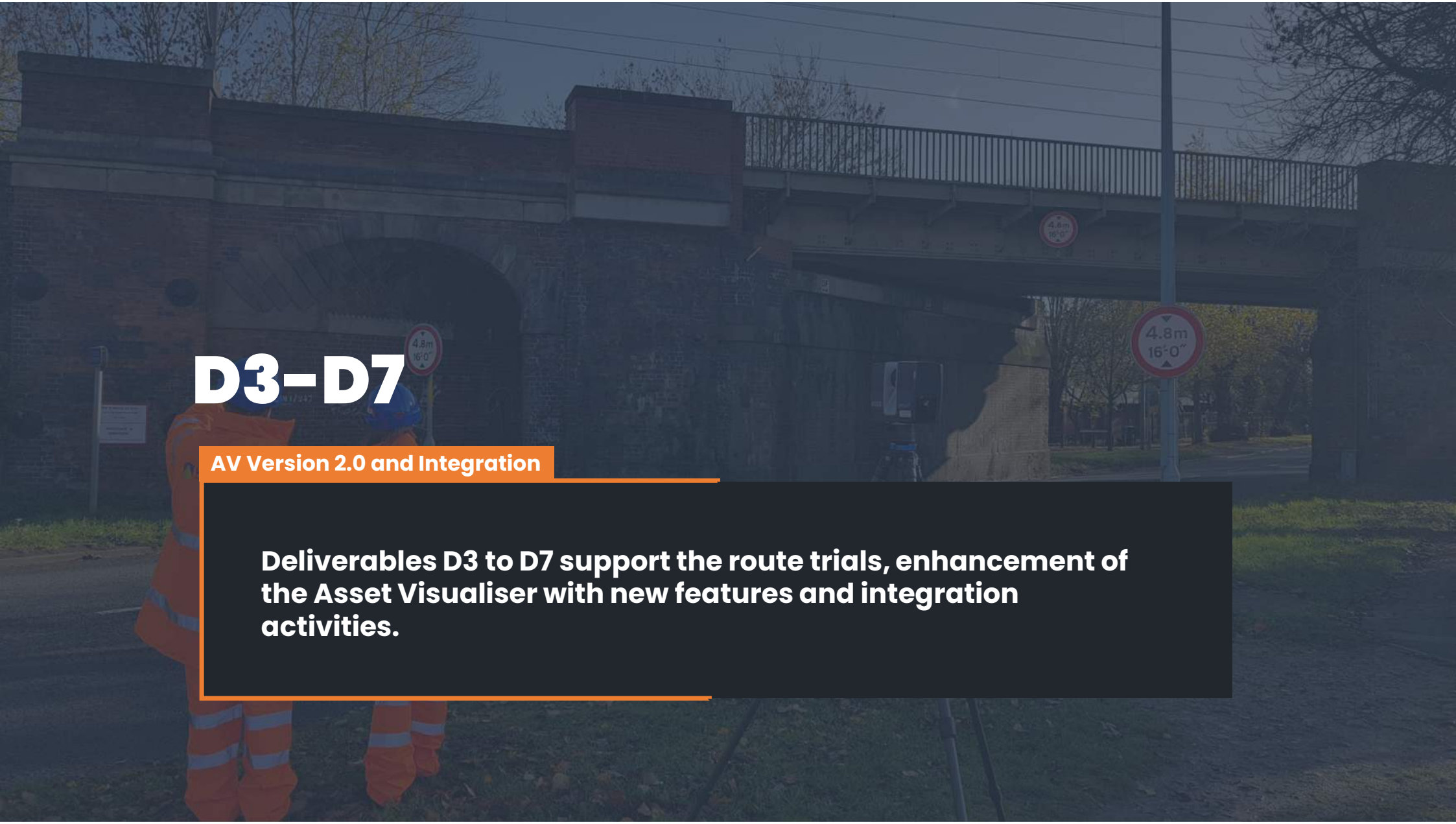
D2

Asset Visualiser

ASSET VISUALISER
Version 1.0



WALDECK / NETWORK RAIL



D3-D7

AV Version 2.0 and Integration

Deliverables D3 to D7 support the route trials, enhancement of the Asset Visualiser with new features and integration activities.

Thankyou for your time and we hope you found this presentation of interest.

Technical Authority

Waldeck

NTU Nottingham Trent University

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