



Best Practice BIM for Infrastructure

Paul King, Bentley Systems

An isometric aerial illustration of a city. In the center is a large stadium with a green field. To the left is an airport with several planes on the tarmac. To the right is an industrial area with large cooling towers and smokestacks. A river flows through the city, with a bridge crossing it. In the foreground, there are construction cranes and a large body of water. The background shows a dense urban area with many skyscrapers.

Role of the owner

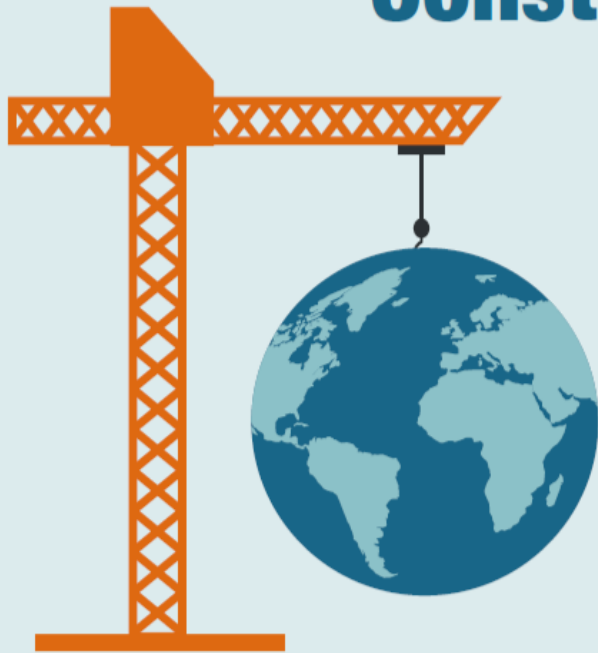
Defining better business outcomes from projects

Delivering the project

Reducing risk and cost and improving safety

Supporting the supply chain

Helping teams to better meet the owner's required outcomes



Construction matters for the world economy

... but has a long record of poor productivity

Construction-related spending
accounts for

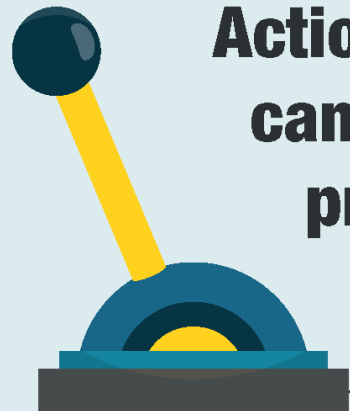
13% of the world's GDP

...but the sector's annual productivity
growth has only increased

1% over the past 20 years

\$1.6 trillion of additional value added could be
created through higher productivity,
meeting half the world's infrastructure need

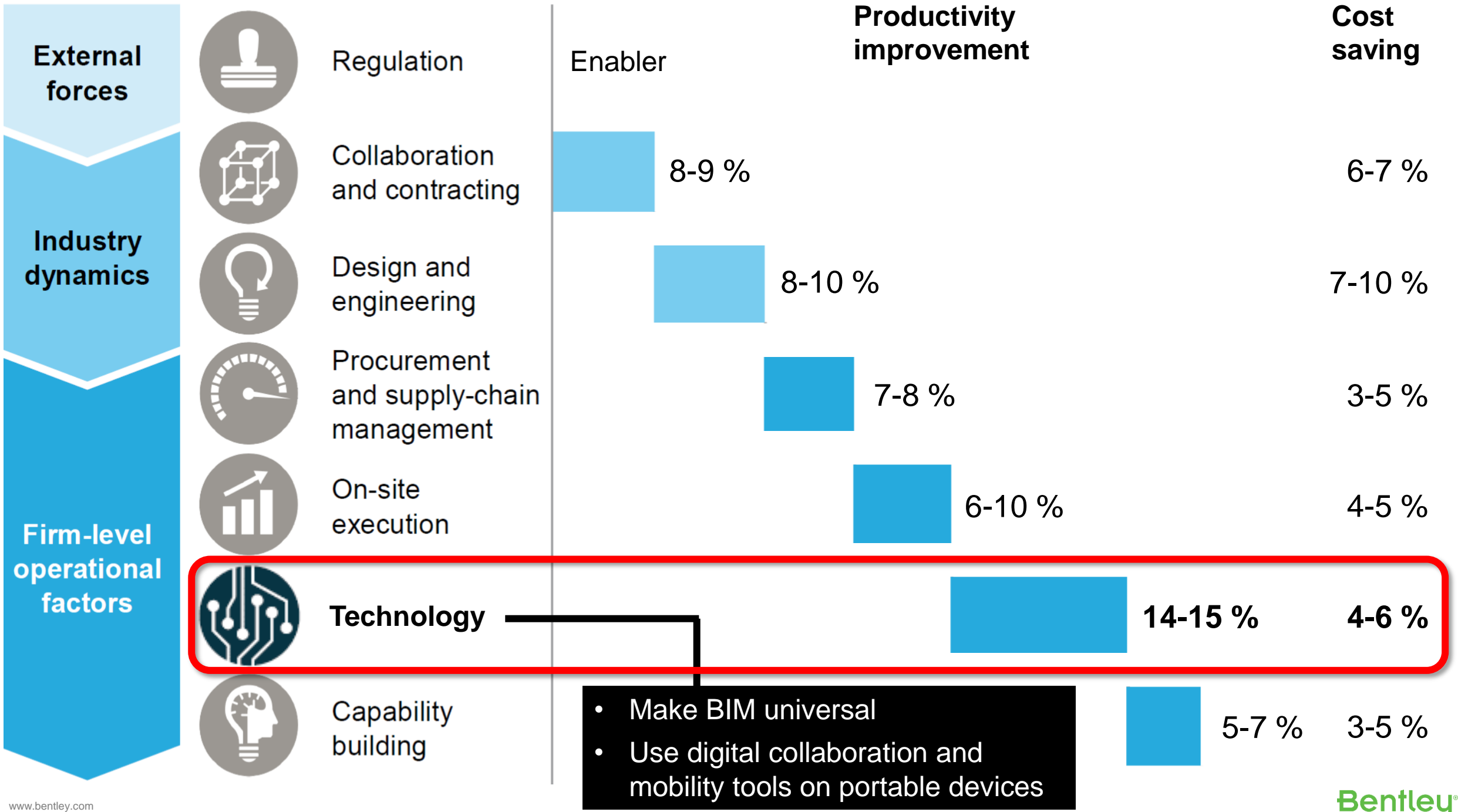
McKinsey & Company, 2017



Action in **seven areas**
can boost sector
productivity by
50–60%

- Reshape regulation
- Rewire contracts
- Rethink design
- Improve procurement and supply chain
- Improve onsite execution
- **Infuse technology and innovation**
- Reskill workers





Lower costs

33%

reduction in the initial cost of construction
and the whole life cost of built assets

Faster delivery

50%

reduction in the overall time, from inception to
completion, for newbuild and refurbished assets

Lower emissions

50%

reduction in greenhouse gas emissions
in the built environment



HM Government

Industrial Strategy: government and industry in partnership

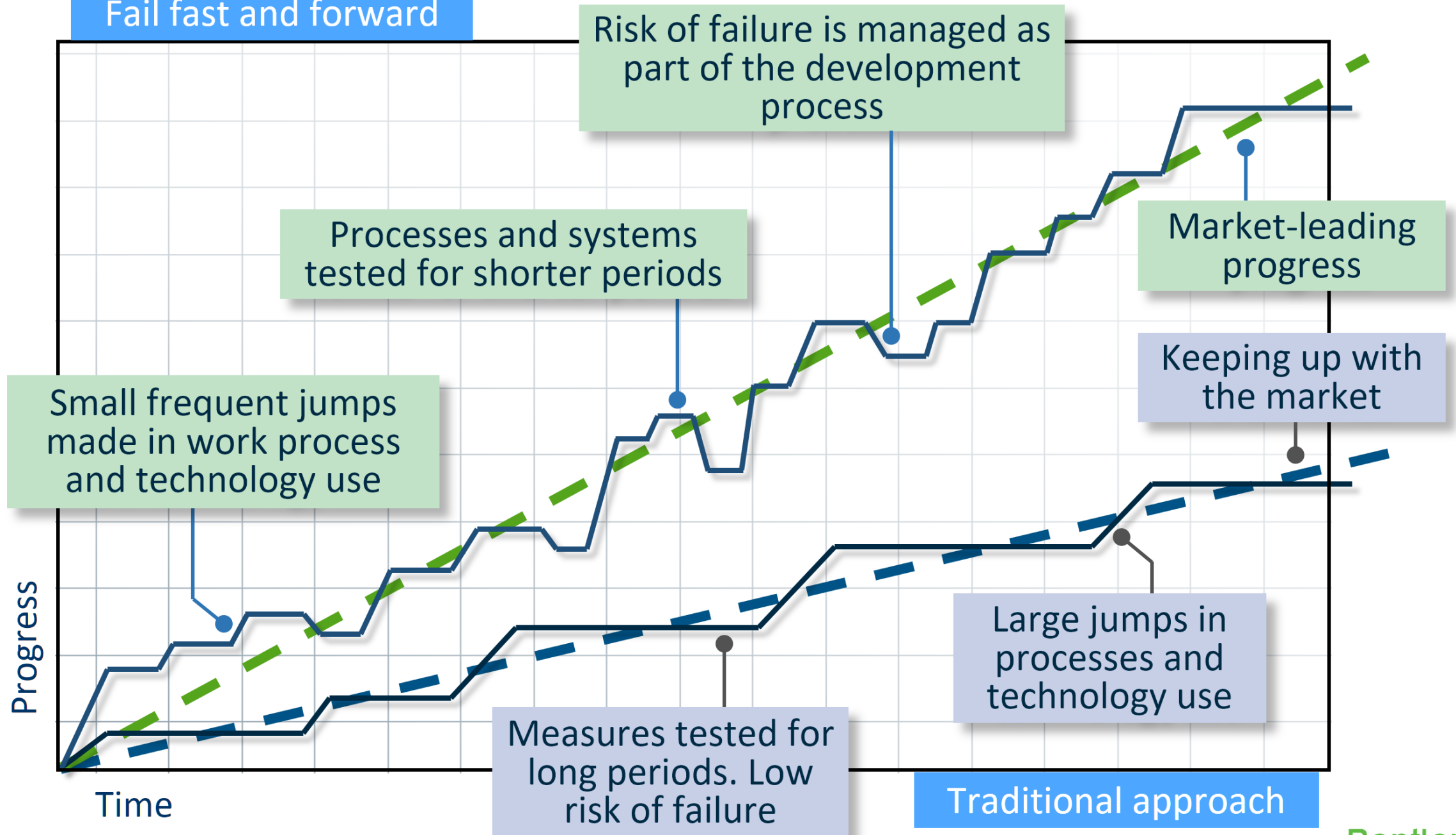


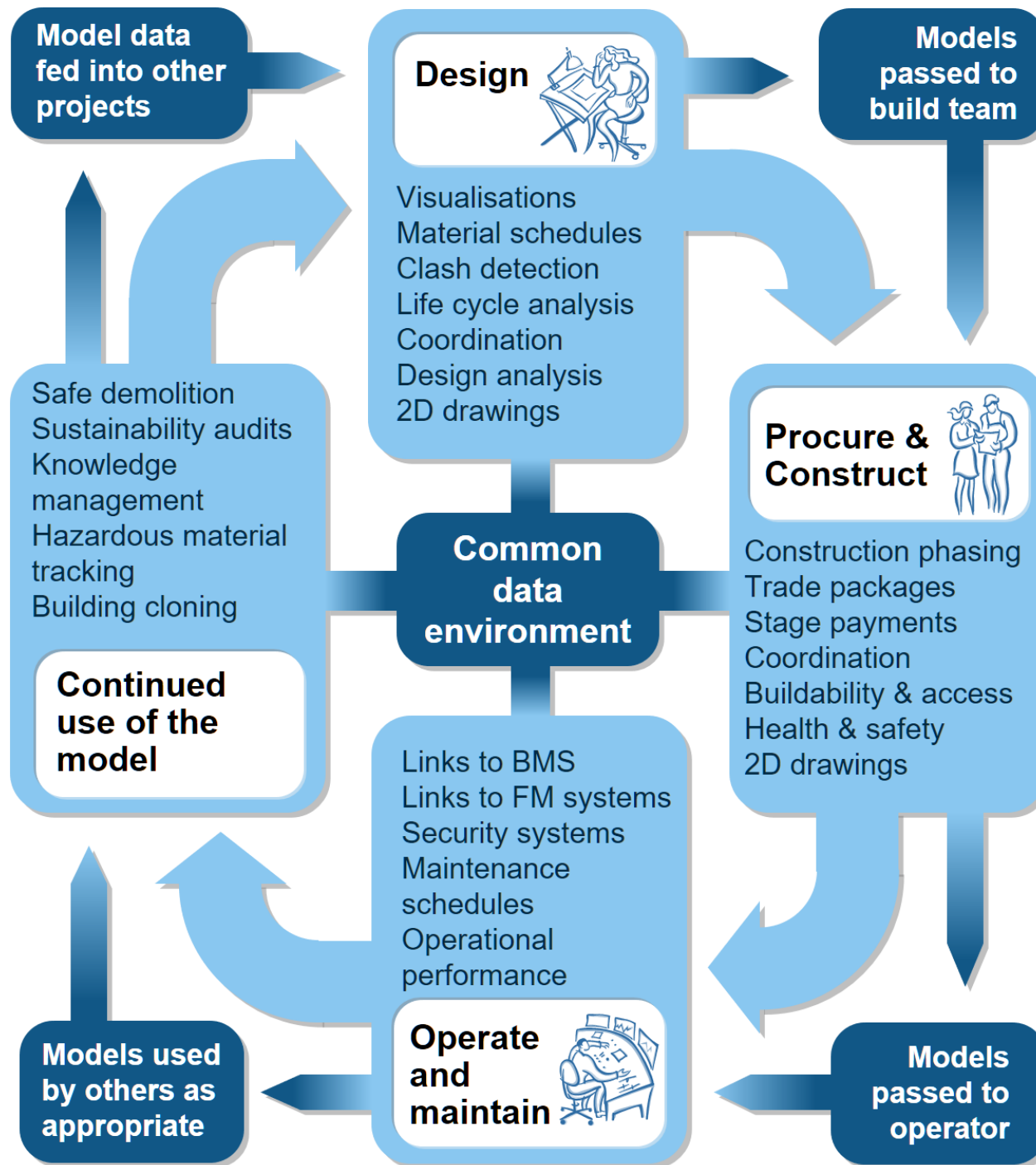
Construction 2025

Going Digital



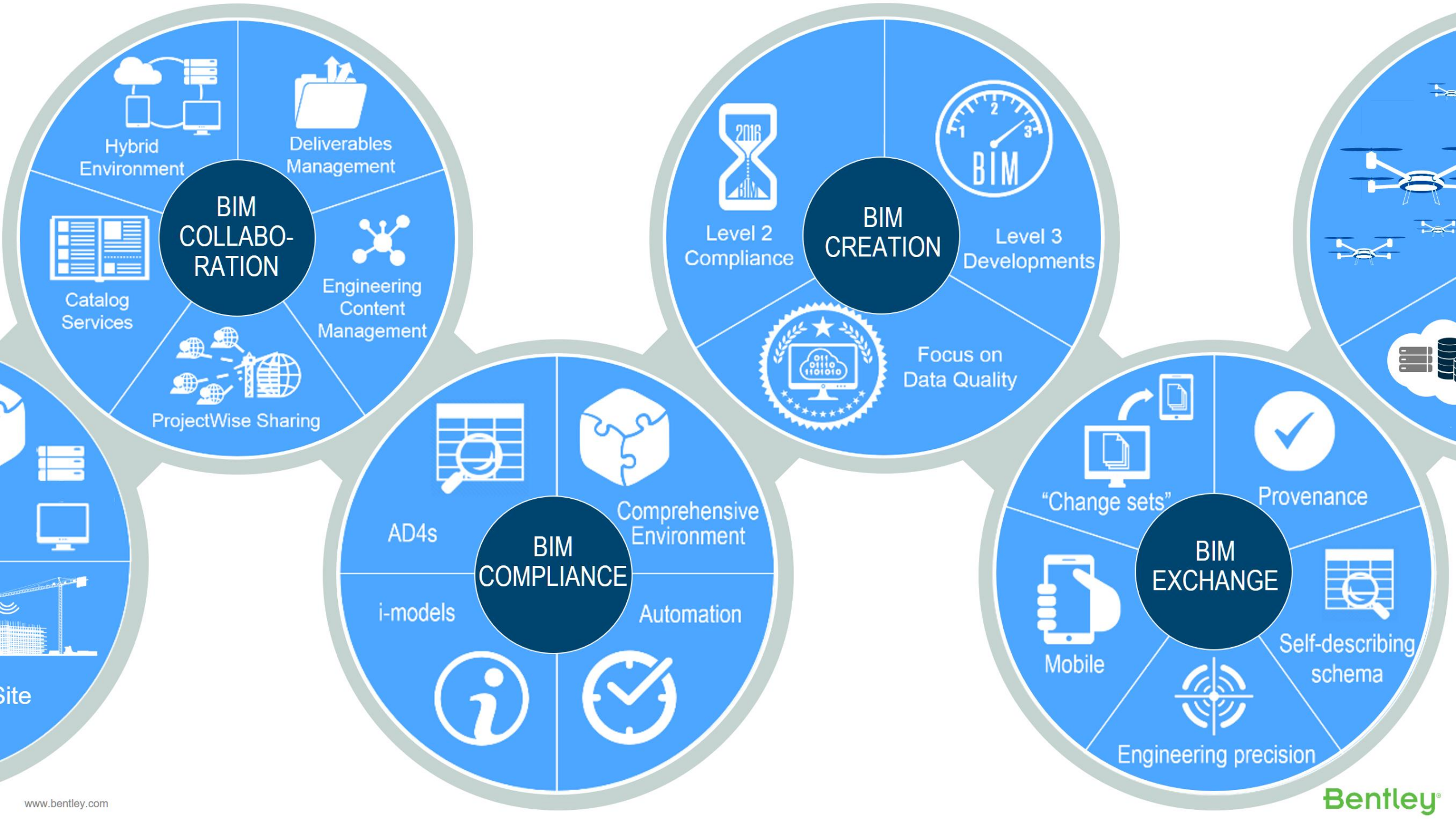
Fail fast and forward





**Process of generating
& managing asset data
over its life cycle using
model-based
technologies linked to
a database of reliable
information**



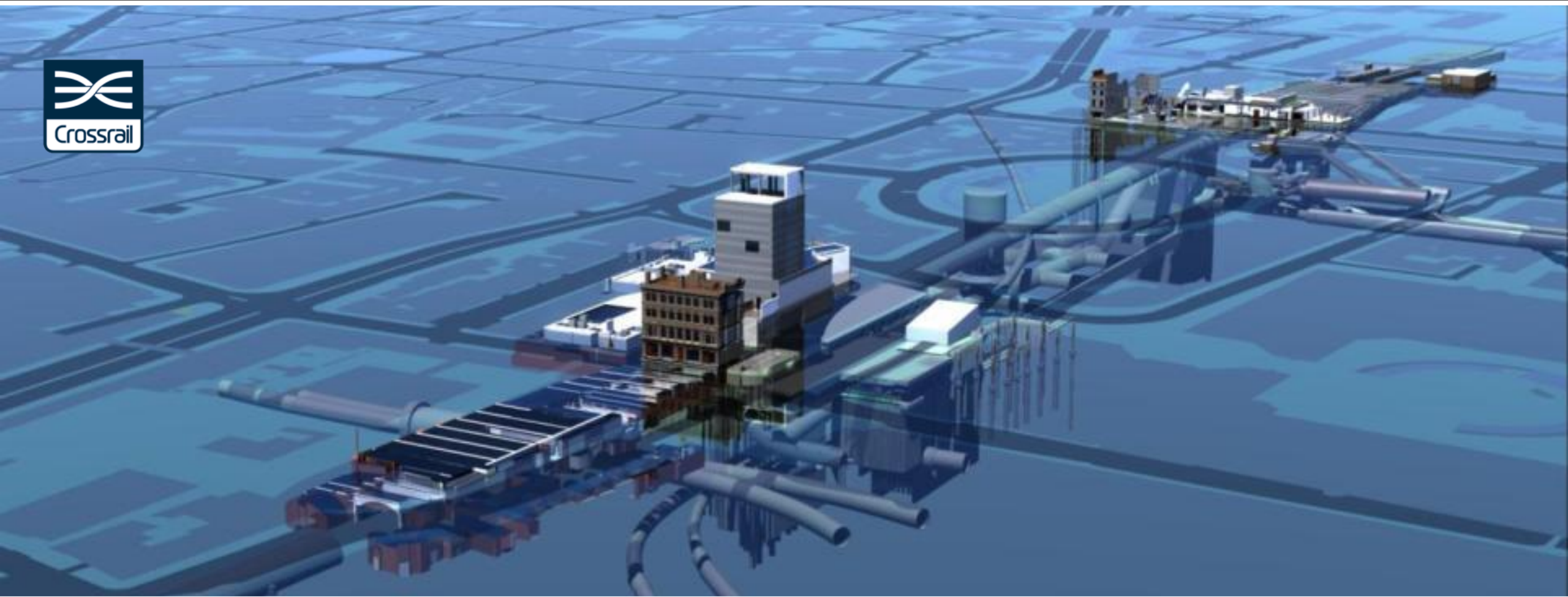




Role of the owner

Defining better business outcomes from projects

To create an integrated design, facilitating multidisciplinary collaboration through the life of the project, becoming the base for an asset management system



Government as a client can derive significant improvements in cost, value and carbon performance through the use of open sharable asset information

21 km new twin-bore railway

90 km existing surface network

9 new sub-surface stations

28 surface station upgrades

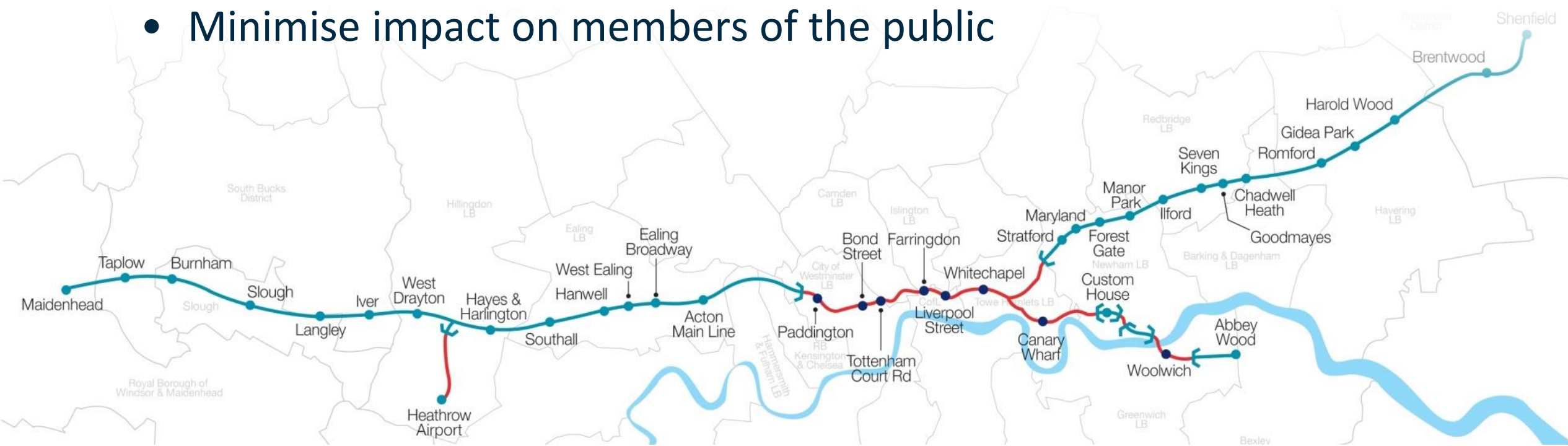
11 major reconstructions

16 new bridges

1 hi-tech control centre



- Improve cost and time certainty – protect public money
- Improve understanding of risks
- Maintain quality and environmental standards
- Increase the efficiency within the delivery supply chain
- Have transparent and controlled change management
- Minimise impact on members of the public



Don't just mandate BIM

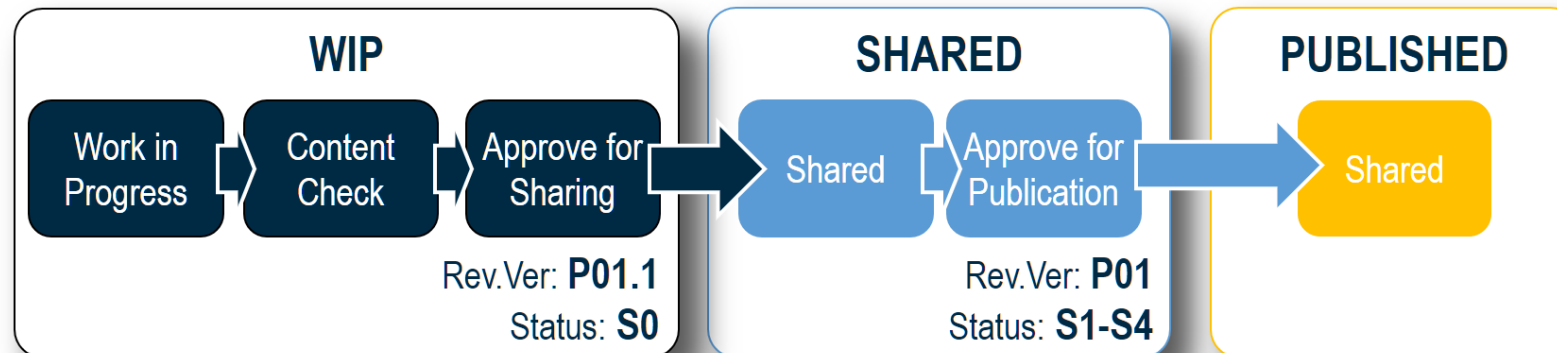
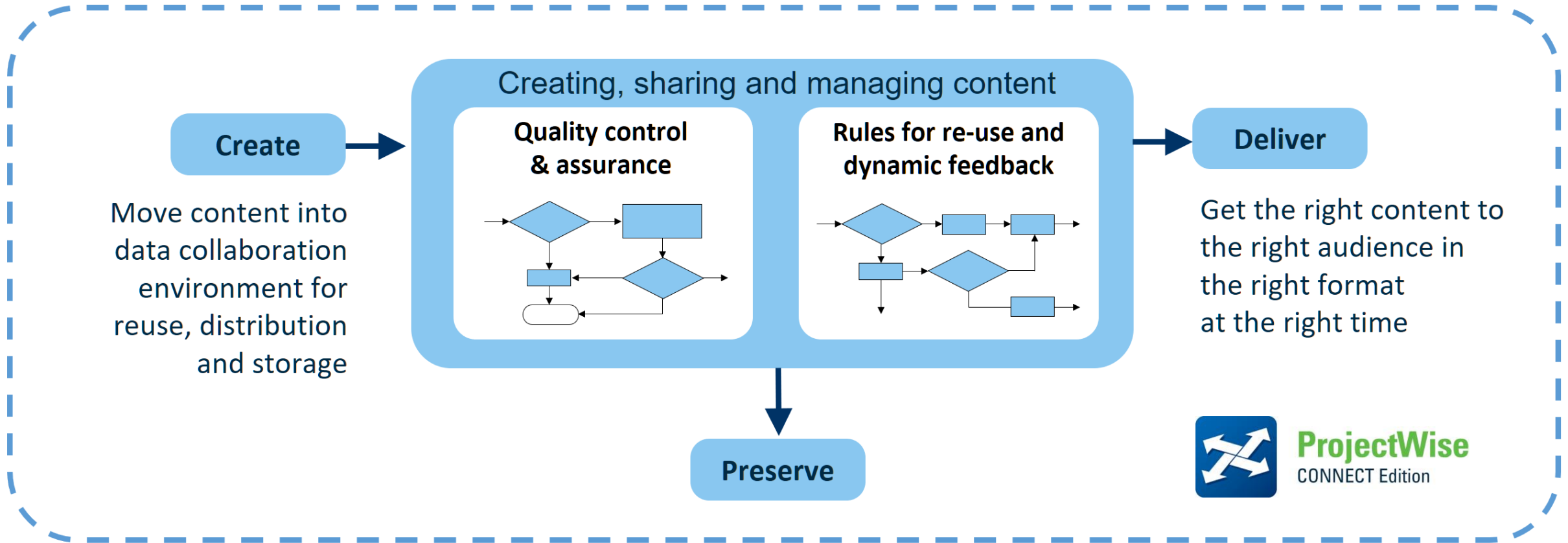
Define requirements

- Methodology and outcomes
- Common data environment
- Start with the end in mind

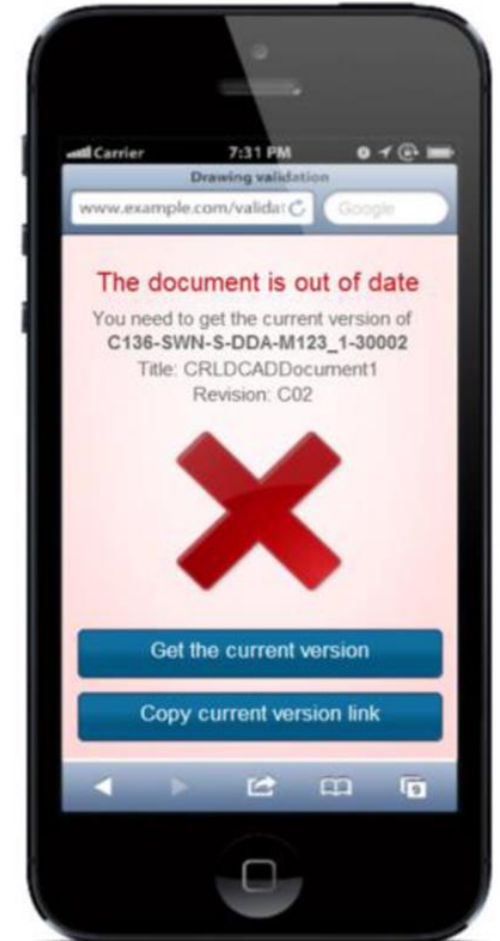
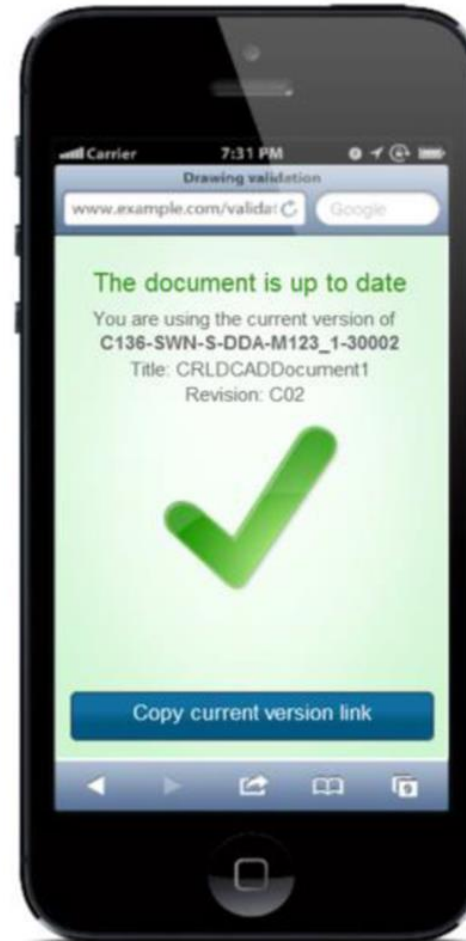
Enforce



Common Data Environment (CDE)



 Crossrail Limited 25 Canada Square Canary Wharf London E14 5LQ © Crossrail www.crossrail.co.uk	Contract : Farringdon Station Design	
	Originator : Scott Wilson Limited	
	Location : Farringdon Stn	
	Title : Eastern Entrance Ticket Hall Level +0 SSL 116.650 Sheet 2 of 2 C435	
	Scale : 1:100@ A1	Drawing and CAD file No : C136-SWN-S



The digital airport

Easily and securely create, manage, share and use information and data that are relevant to the role and appropriate to the task

Common data environment

Brings together information in GIS, drawings, 3D models, business documents and other formats

Enterprise

Connection to
SharePoint,
SAP, Oracle

FM

Integration with
Maximo, SAP,
etc

Mobile

Find, manage,
share and use
information
and data

Business participants

Engineering
Operations
Maintenance
Environmental
Security
Information services
Planning
Finance
Administration
Managers
Directors
Consultants
Contractors
Suppliers

Apps

MicroStation
Bentley Map
AECOsim
AutoCAD
Revit
ContextCapture
Videos
Photos
MS Office
OpenRoads
OpenRail
WaterGEMS
Esri
StormCAD
SewerCAD
ConceptStation
Etc, etc . . .

Mapping: master planning,
asset management and
security

Utility infrastructure
design: water, gas and
electric

Civil engineering: bridge
runway, apron, taxiway
and storm drainage

Transportation access and
airport movements

Information and
document control for
collaboration and sharing

Design, review and
construction sequencing

Space analysis: lease
management, security,
and operations

Project Performance Dashboards

Project Collaboration

Design
workflows

Auditing
& version
control

Engineering
production

BIM
compliance

Project Connection Services

Transmittals

Submittals

Project sharing

Issues resolution

RFIs

Construction

Virtual
construction
model

Work
packaging

Installation
work
packages

Measure
progress /
quantities

Enterprise Content Management

Requirements
management

Compliance
management

Specifications
management

Document
control

Records
management

Forms
management

Catalogue
authoring

Tag definition
management

Configuration
management

Data
handover



Interoperability



Desktop, on-premise



Web/mobile



Cloud



Federated data
repositories



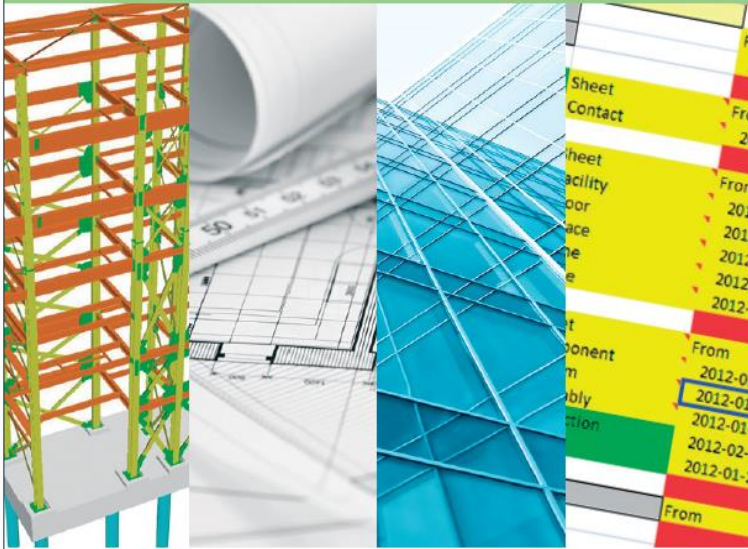
Workflow
management



Business
process

PAS 1192-2:2013

Specification for information management for the capital/delivery phase of construction projects using building information modelling



bsi.

PAS 1192-3:2014

Incorporating Corrigendum No. 1

Specification for information management for the operational phase of assets using building information modelling



bsi.

PAS 1192-5:2015

Specification for security-minded building information modelling, digital built environments and smart asset management



CPNI
Centre for the Protection
of National Infrastructure

bsi.

DRAFT INTERNATIONAL STANDARD

ISO/DIS 19650-1

ISO/TC 59/SC 13

Secretariat: SN

Voting begins on:
2017-02-17

Voting terminates on:
2017-05-11

**Organization of information about construction works —
Information management using building information
modelling —**

Part 1:
Concepts and principles

Part 2:
Delivery phase of assets



BIM

STARTING ON THE RIGHT TRACK TO AN EFFICIENT, SUSTAINABLE FUTURE



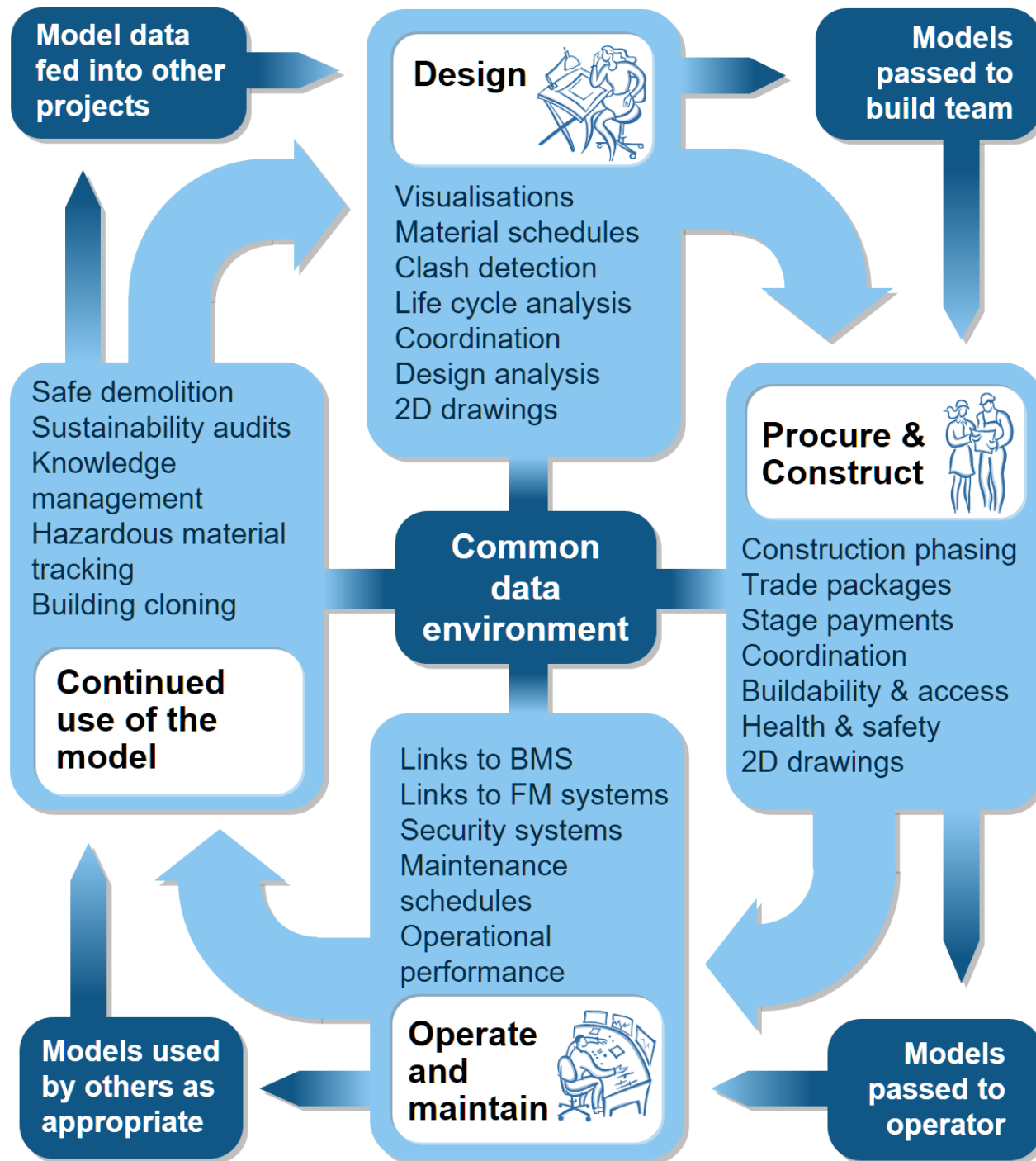
Fiatech™
Innovation that builds the world.

If the owner has to cleanse as-built data once operational
it costs 8X more
than collecting it during project handover



Delivering the project

Reducing risk and cost and improving safety



- Define what's needed
- Develop a plan to deliver it
- Ensure everyone is capable of delivering
- Produce the deliverables
- Manage the documents and data
- Ensure compliance



Multi-discipline rail network design

Optimise rail track layout and design



GIS

Map, manage, analyse, view and interpret the infrastructure around you, regardless of your industry



Corridor mapping & analysis

Terrain modelling, corridor mapping and analysis for linear assets



Drainage design & analysis

For networks ranging from civil drainage to complex land development studies



Bridge design & analysis

Multi-disciplinary bridge layout, design and analysis



Tunnel design & analysis

Multi-discipline tunnel layout, design and analysis



Station & platform design & analysis

Integrate platform and station design into rail network infrastructure



ALIM

Manage asset information and related documents through the lifecycle



Transportation inspection

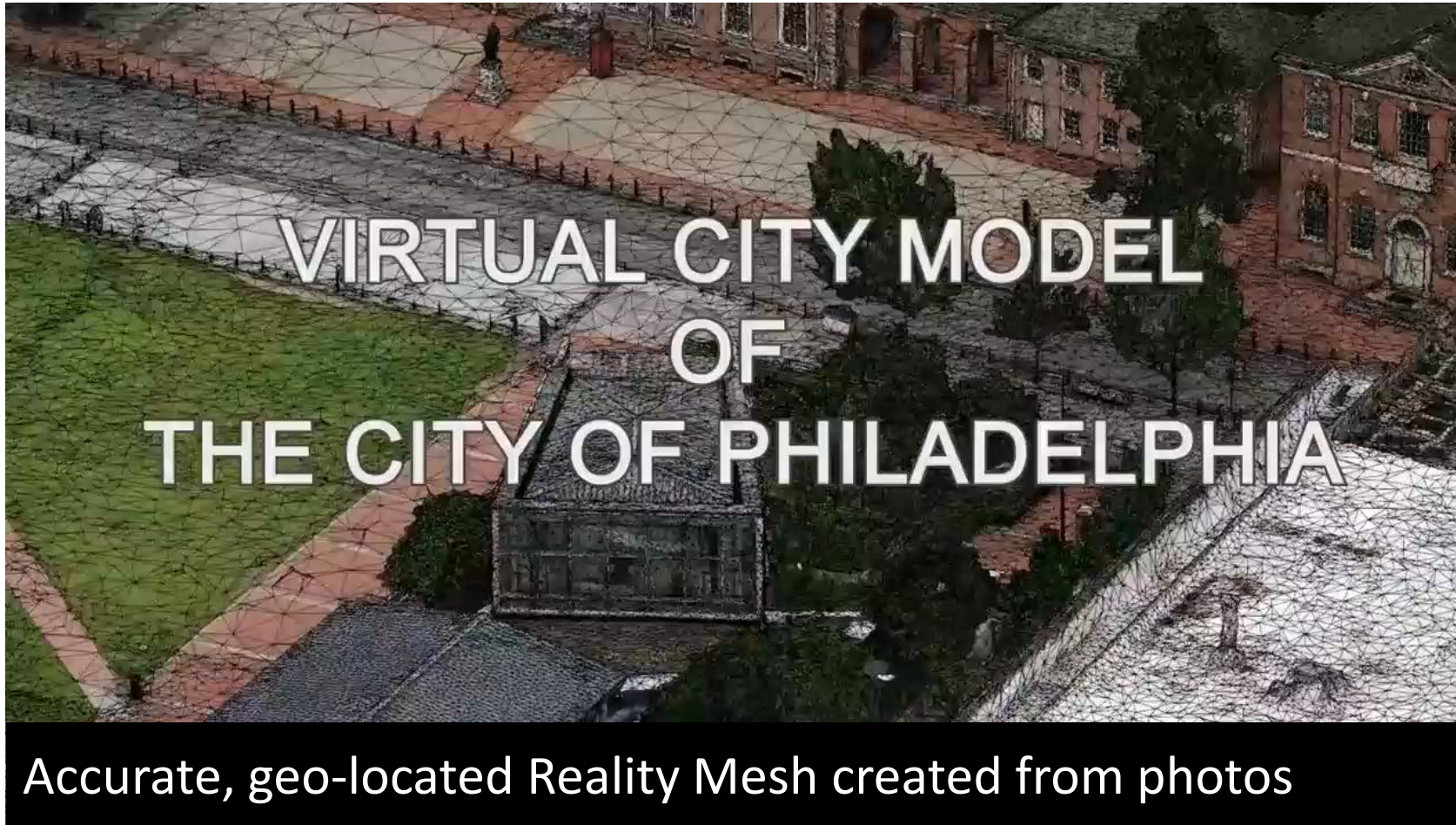
Infrastructure inspection across the asset lifecycle



Predictive maintenance

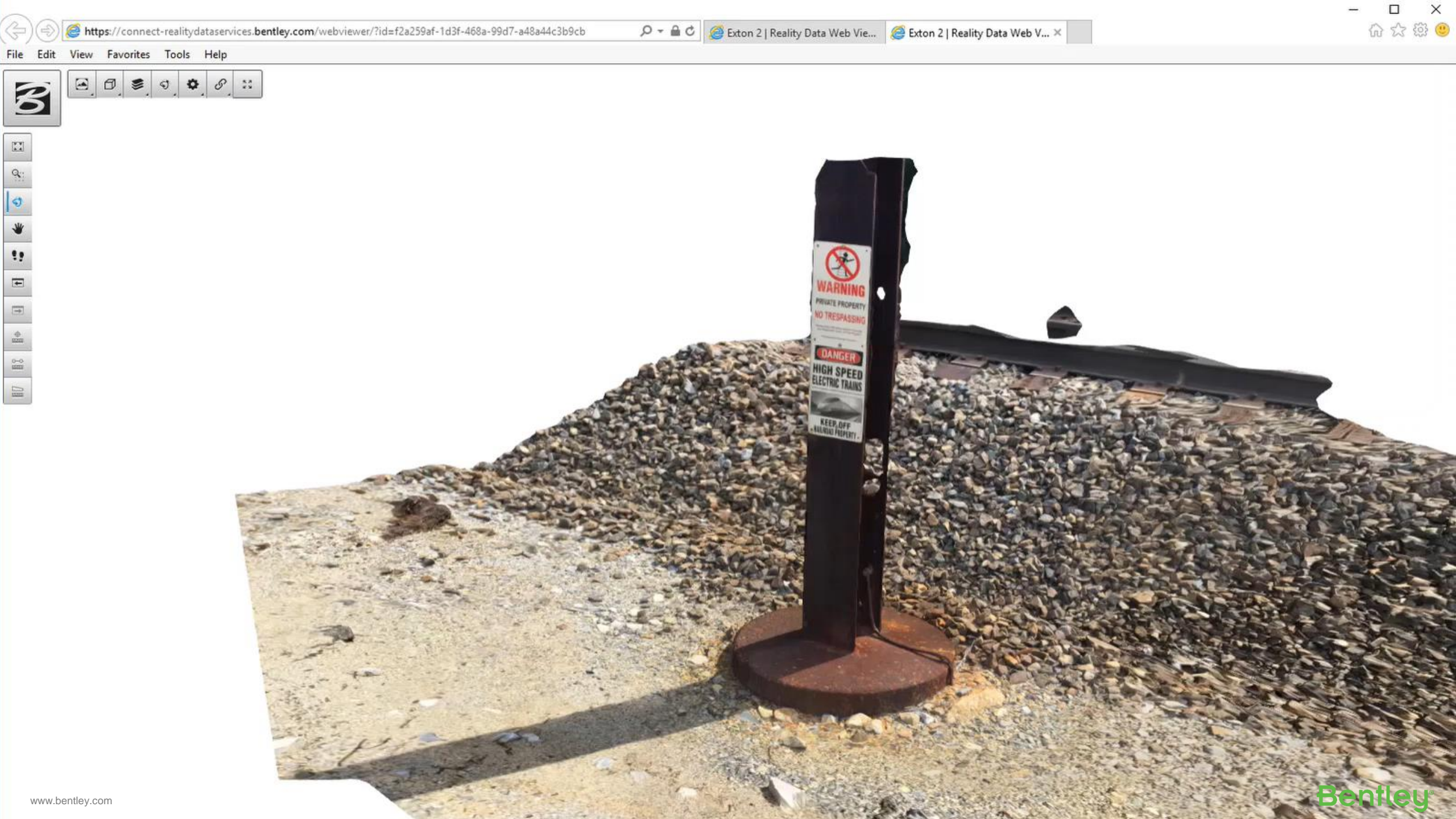
Decision support for railway maintenance

Reality modelling with ContextCapture



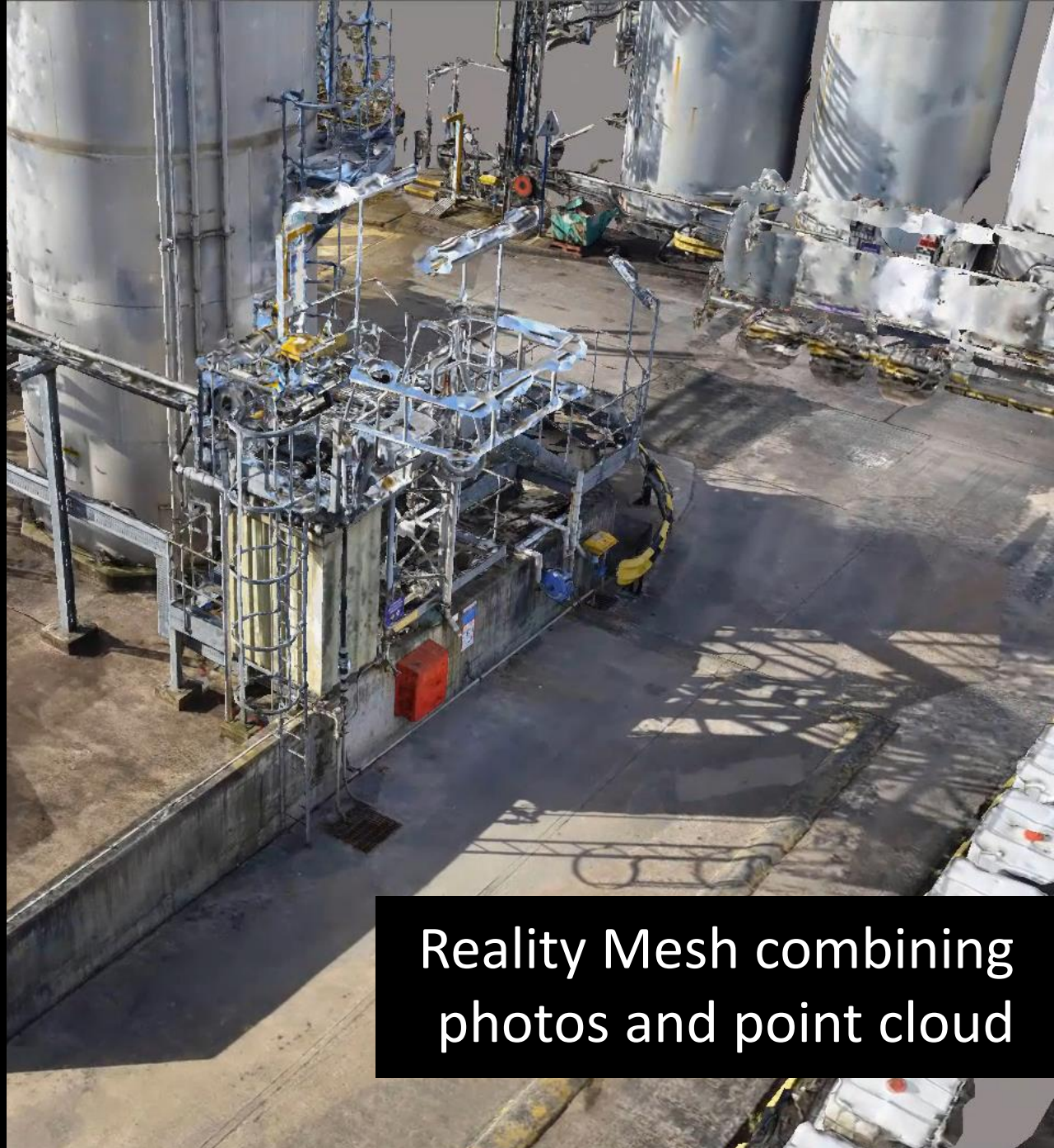




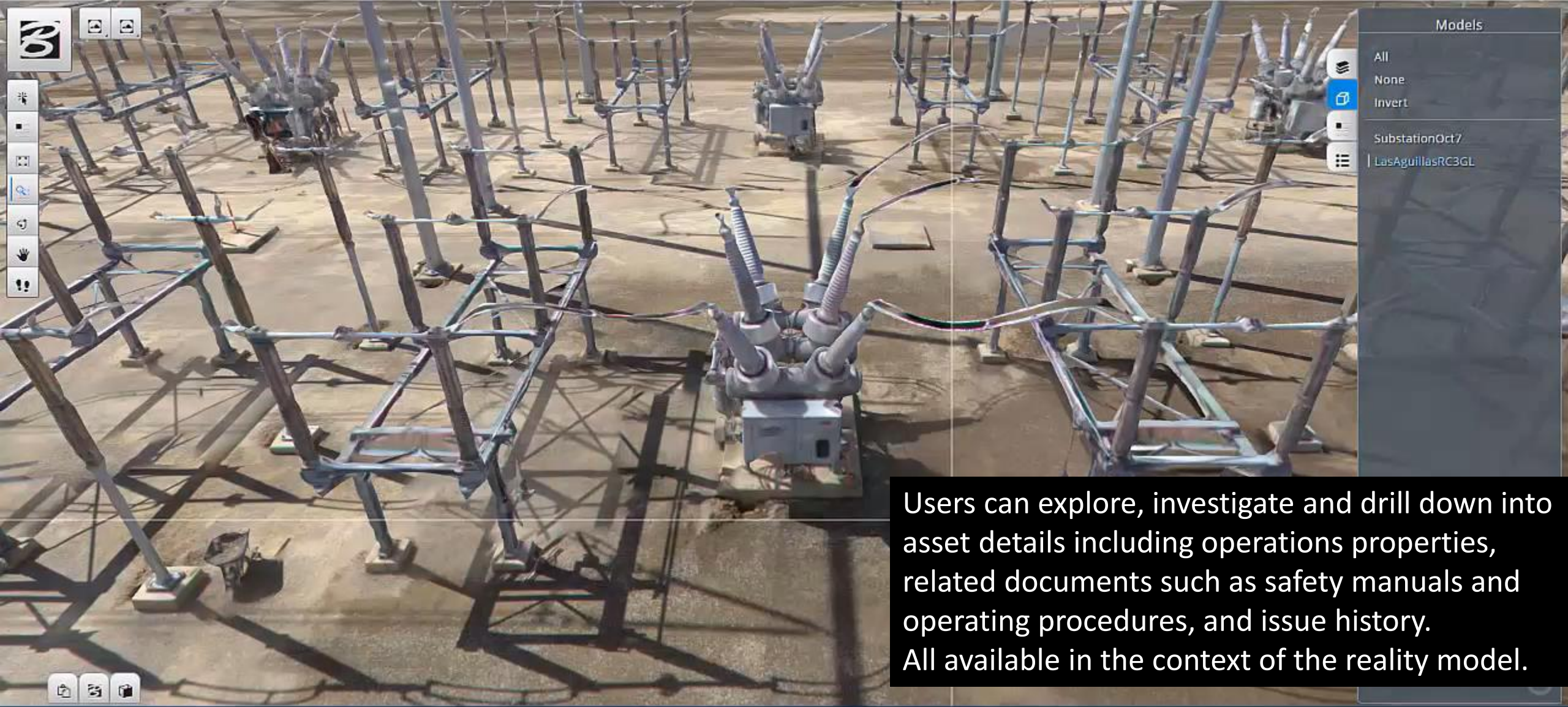




Point cloud



Reality Mesh combining
photos and point cloud



Users can explore, investigate and drill down into asset details including operations properties, related documents such as safety manuals and operating procedures, and issue history. All available in the context of the reality model.

Surveying Engineering Construction



CONSTRUCTIONEERING



CONCEPTIONEERING



Surveying Engineering Conception

Surveying Engineering Inspection



INSPECTIONEERING



OPERATIONEERING



Surveying Engineering Operations



CONNECTED
DATA
ENVIRONMENT

Bentley®

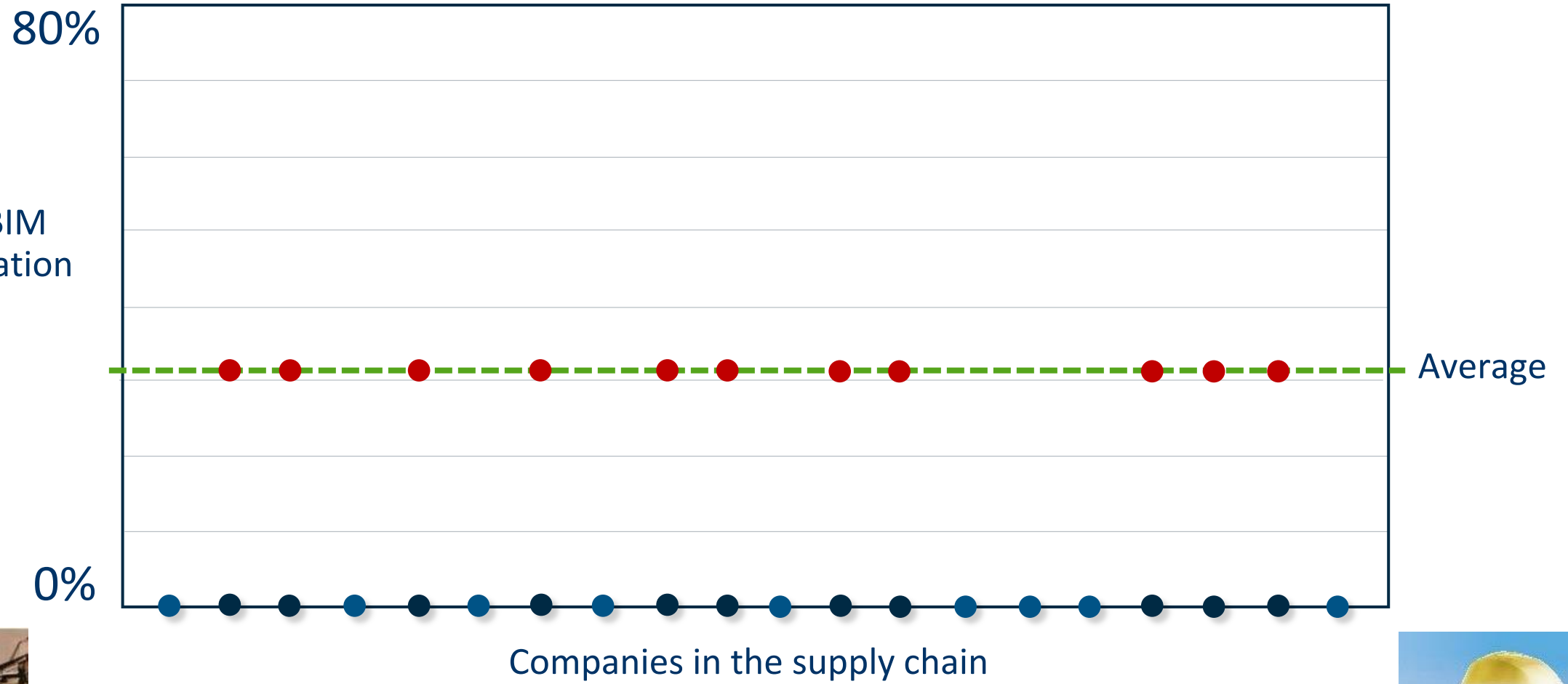


Supporting the supply chain

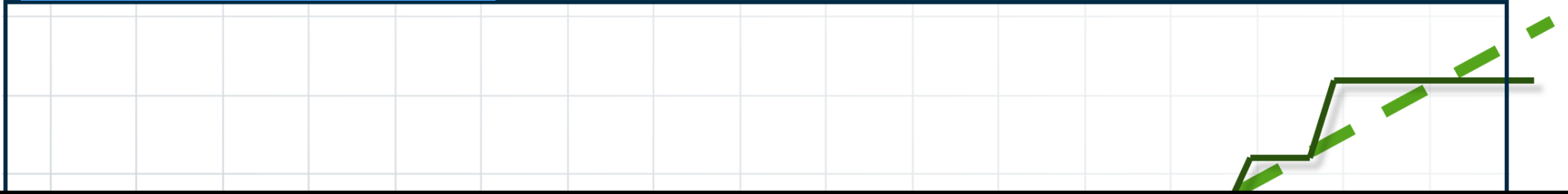
Helping teams to better meet the owner's required outcomes



Degree of BIM
implementation

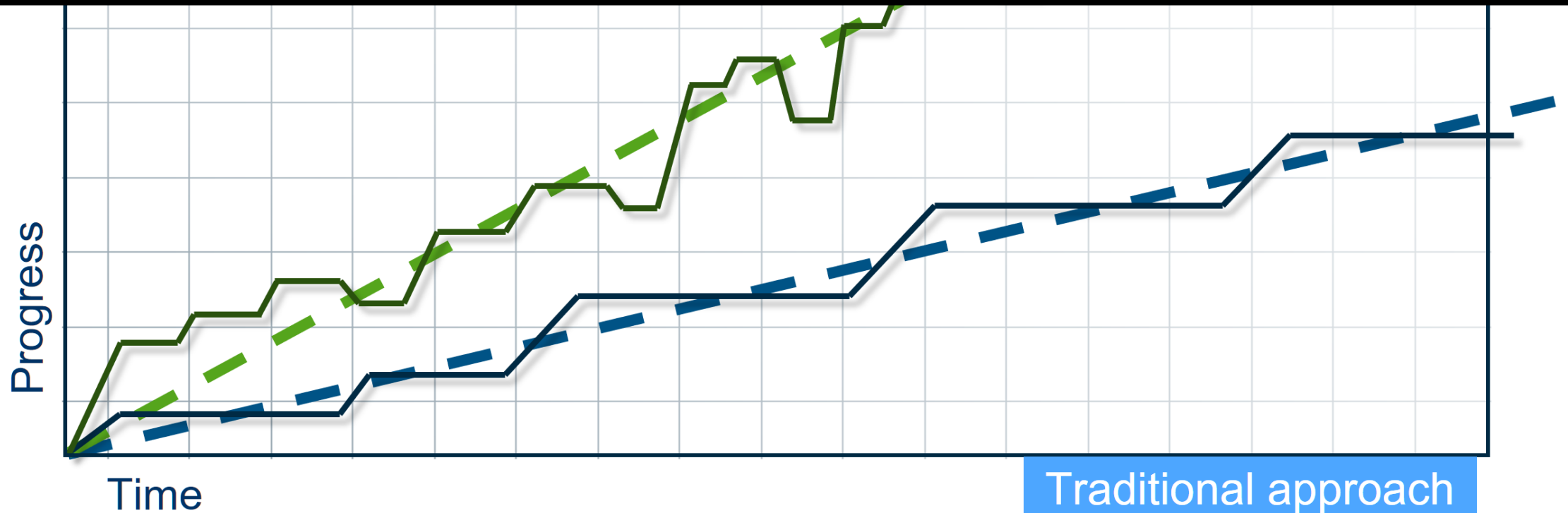


Fail fast and forward



Shoot yourself in the foot . . .

before somebody else shoots you in the head



Traditional approach

The BIM Academy will support the **government construction strategy** by increasing the use of BIM and creating a **lasting legacy of best practice in innovation**

Andrew Wolstenholme
Crossrail CEO

What is the purpose of the Academy?



- Educates, trains and supports
- Enhances supply chain knowledge
- Drives construction industry innovation in BIM
- Software and best practice
- Knowledge capture and transfer to other projects.

How does the Academy look?



What is the Academy achieving?

- Educating, training and supporting
- Fostering R&D
- Capturing two-way industry feedback
- Enhancing your BIMBOK[©]
- Benchmarking





Technical Directorate

Benchmarking Data Applications & Contract Performance Summaries

Scoring

1-2 Poor	■
3 Concern	■
4-5 Good	■
World class	■
N/A / TBC	■

Ref	Contractor	Contract	Area	System connectivity	Application usage	Level of system support	Correct use of application	Use of 4D	BIM in Delivery	IT system reliability	Applications set up	Level of system support	Correct use of EDMS by Delivery	Correct use of EDMS by Tier 2	Level of support	Accessibility	Degree of use	Effectiveness of use	Contractor engagement
1			West							3	3	3	3	1	5	4	5	4	4
2			Central	4	4	5	4	3	4	3	3	3	3	3	4	4	5	4	3
3			East	4		4				3	3	3	2	3	5	4	3	4	3
4			East	4	4	5	4		4	3	2	3	3	3	5	3	1	4	4
5			Central	5	4	5	4	3	1	3	5	3	3	1	3	4	2	2	4
6			Central	4	3	5	3	3	2	3	4	3	3	2	3	3	1	1	3
7			West	5	4	4	5	4	5	3	3	3	3	1	3	4	3	3	2
8			Central							3	3	3	3	3	5	4	5	4	
9			West	4	4	5	4	3		3	3	3	3	1	3	4	1	1	
10			Central	4	4	4	5			3	3	3	3	2	3				2
11			West	3	3	3	3	2	2	3	3	3	3	3	3	3	2	1	2
12			West	4	4	4	5	3	1	3	3	3	3	3	4	4	5	4	4
13			Central	3	3	3	3	4	4	3	3	3	4	3	2	4	1	2	2
14			Central	5	4	4	4	3	4	3	3	3	3	3	3	5	1	3	3
15			Central	3	3	3	3	1	4	3	3	3	3	3	4	4	3	3	3
16			Central	4	5	4	4	3	4	3	3	3	3	3	3	4	5	4	4
17			Central	3	3	3	3	1	3	3	3	3	3	3	4	4	1	2	2
18			Central	4	4	5	4	3	5	3	3	3	3	3	4	4	2	1	3

Why have your own Academy?

Manage RISK

Educate your supply chain

Brief them on your vision

Explain their contractual obligations

Help them understand why

Coach and train

Show them how to use software and processes

Experiment and sandbox

Take advantage of new technology

Assess the impact of new standards

An aerial, long-exposure photograph of a complex highway interchange at night. The image shows multiple levels of overpasses and ramps, with light trails from cars creating vibrant streaks of white, blue, and red. The roads are illuminated by overhead lights, and the overall scene conveys a sense of constant motion and urban infrastructure.

In conclusion . . lessons learned

Don't just mandate BIM

**Do be brave and prepared
to shoot yourself in the foot**

**Beware anyone who tells
you it's easy!**

- Define what's needed
- Develop a plan to deliver it
- Ensure everyone is capable of delivering
- Produce the deliverables
- Manage the documents and data
- Ensure compliance





Best Practice BIM for Infrastructure

Paul King, Bentley Systems

BINA

INITIATIVES

Envisioning Engineering Intelligence

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