

CitA
BIM GATHERING



Building Capabilities in Complex Environments

CitA BIM Gathering 2017, Croke Park, November 23rd & 24th, 2017

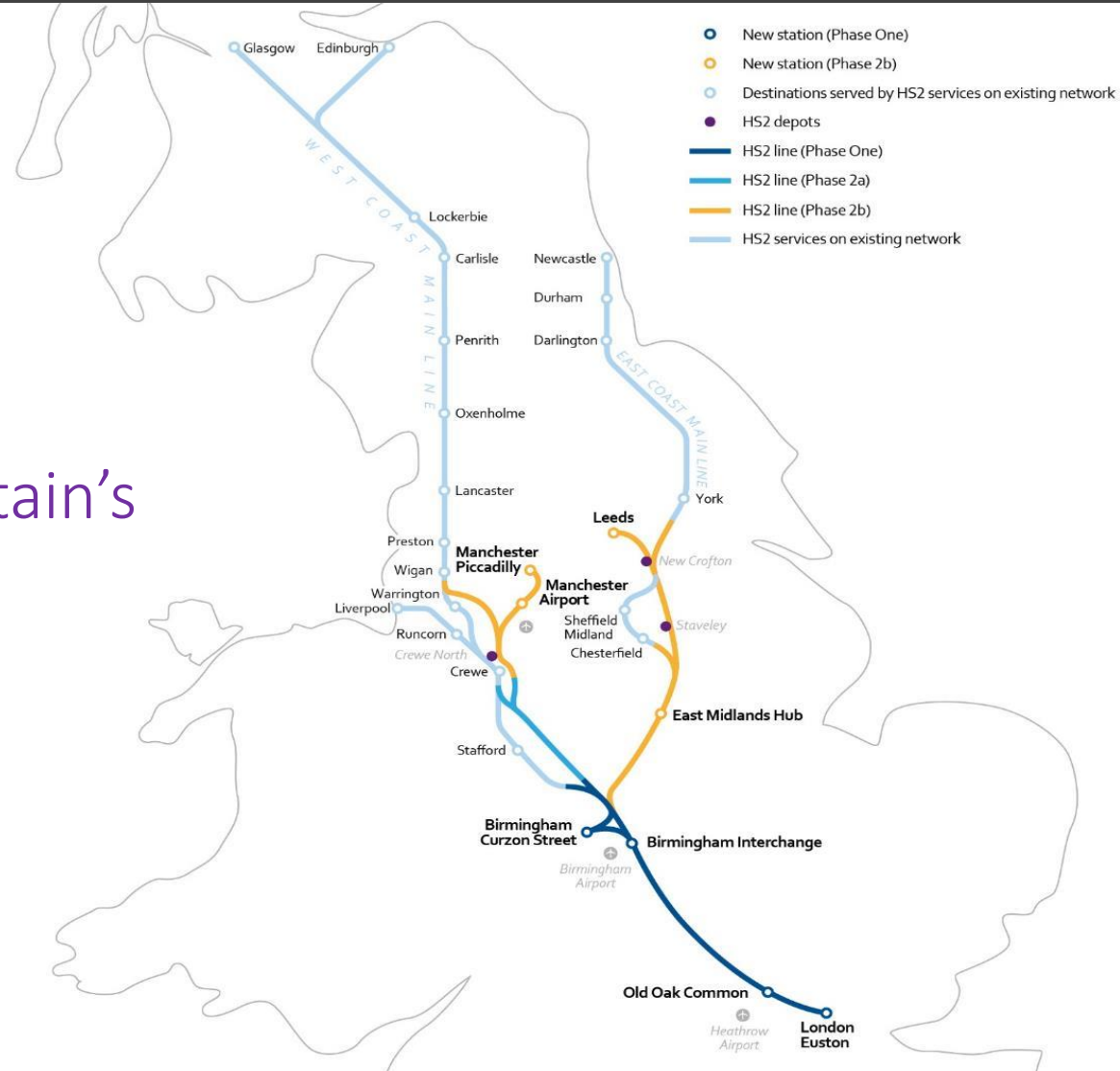
Cita
BIM GATHERING



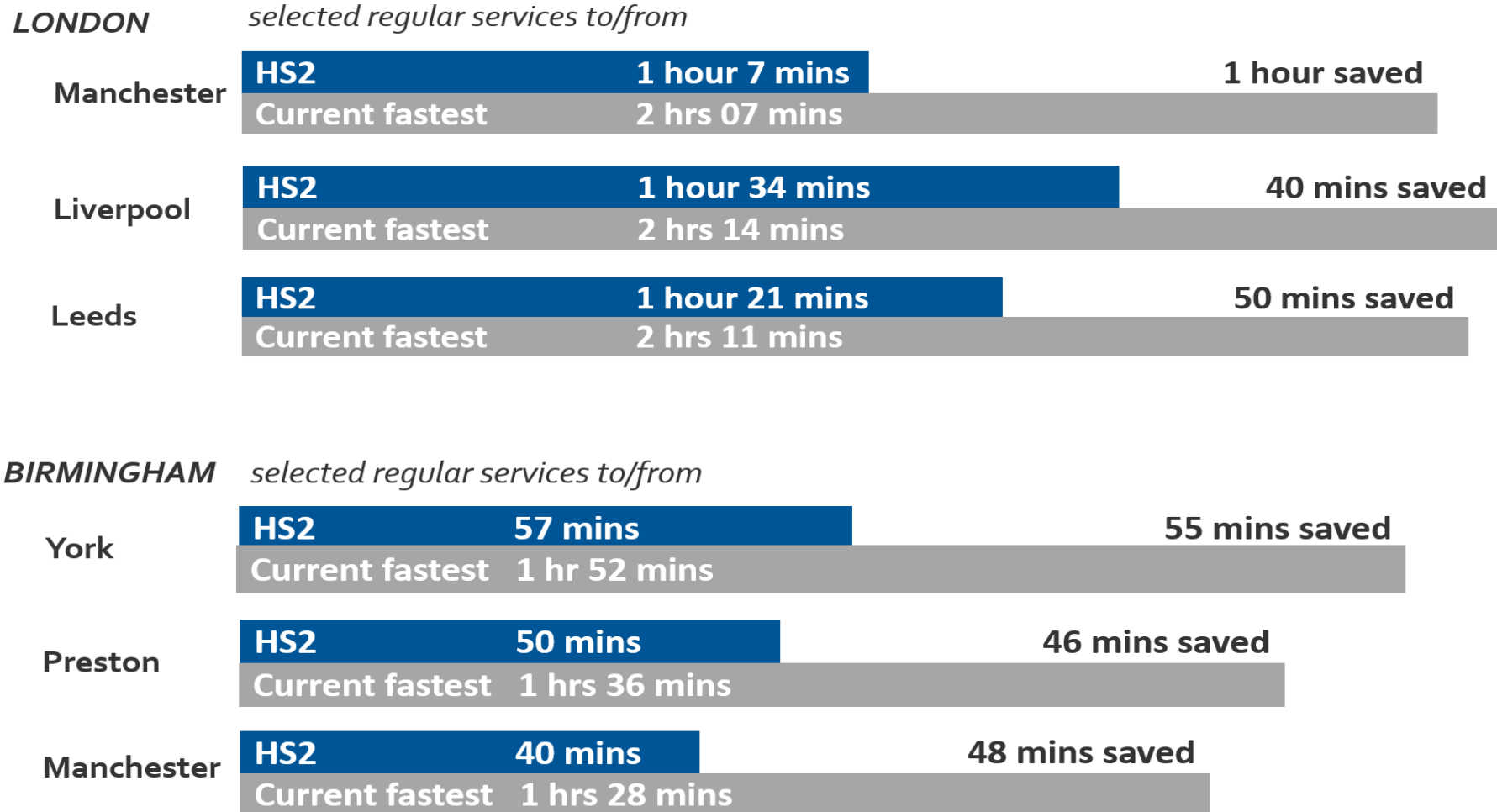
HS2's approach to BIM and Beyond...



HS2: the new backbone of Britain's rail network









Birmingham
campus

The National College for High Speed Rail will **attract new talent** and **train the existing workforce** with **over 1,000 graduates** a year



Doncaster
campus

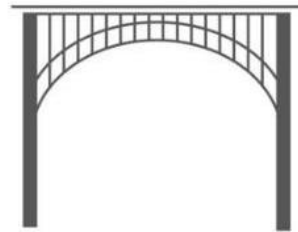




DESIGN &
SERVICES



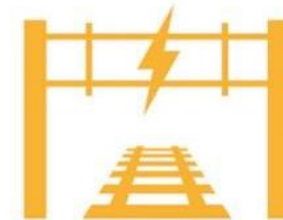
TUNNELS



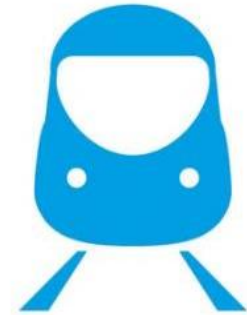
SURFACE
ROUTE



STATIONS

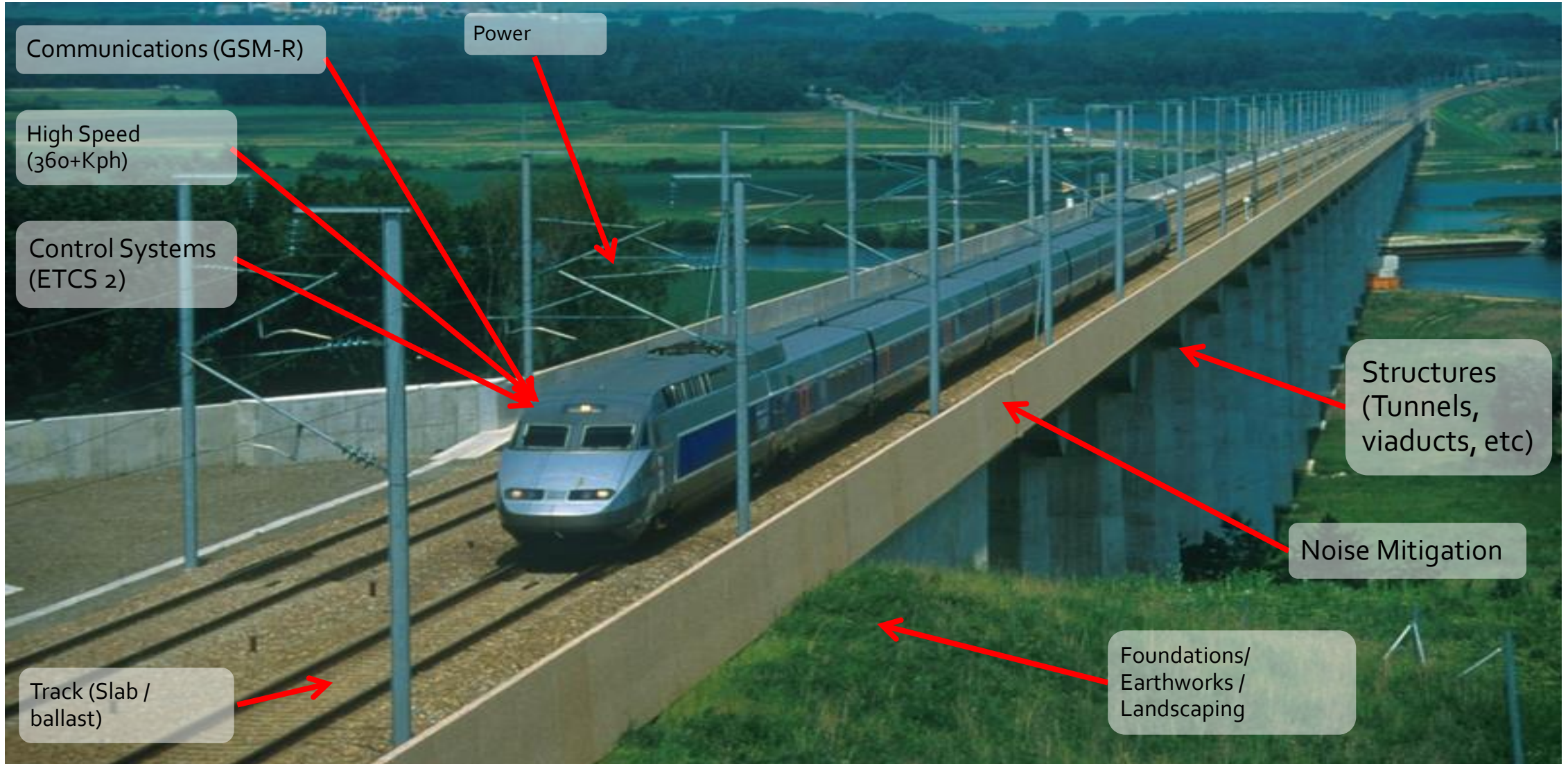


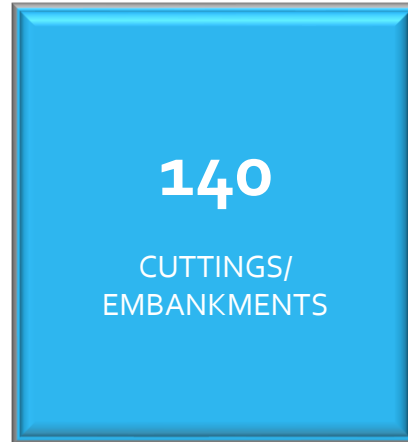
RAILWAY
SYSTEMS

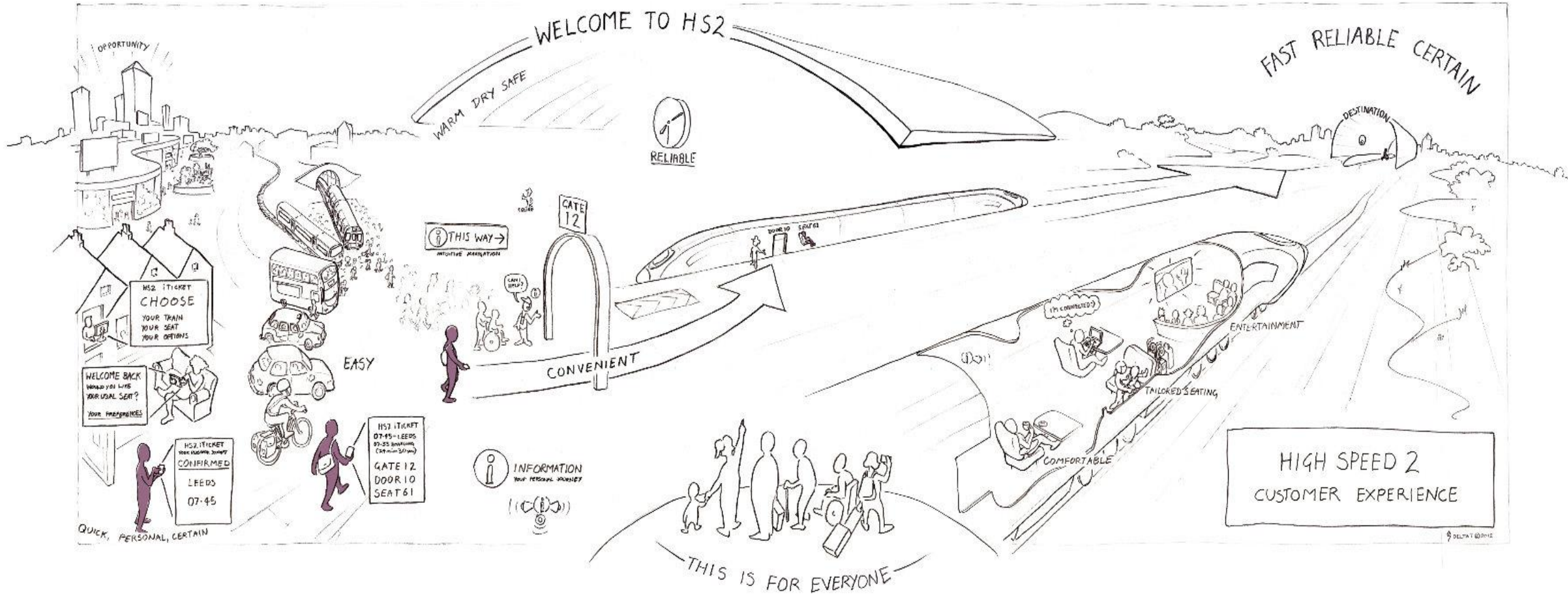


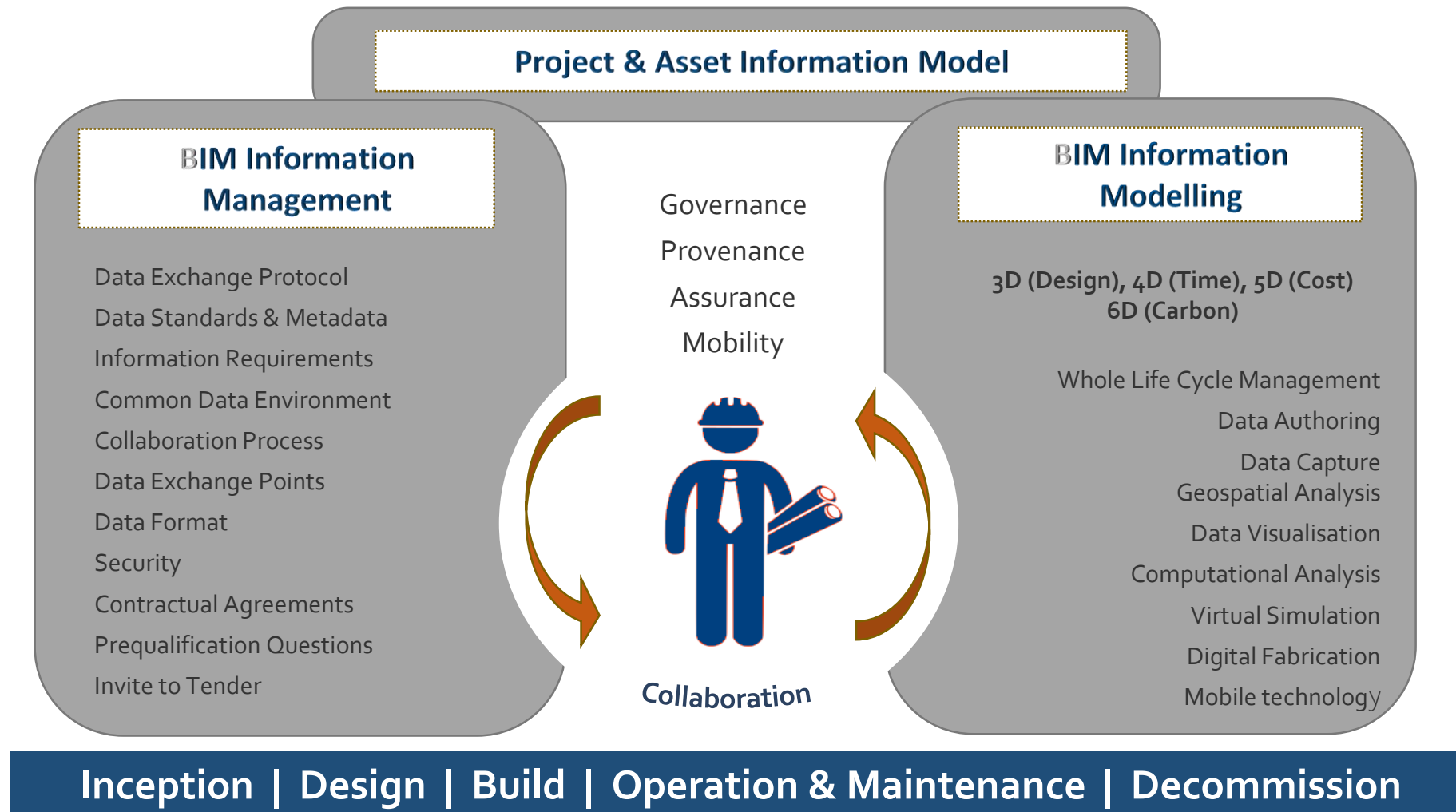
ROLLING
STOCK

HS2 – A Complex System



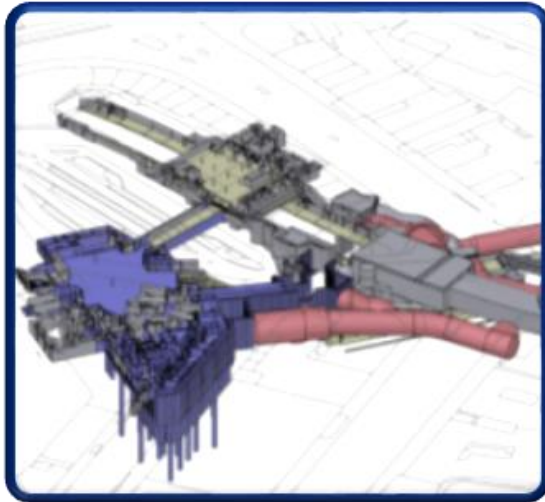






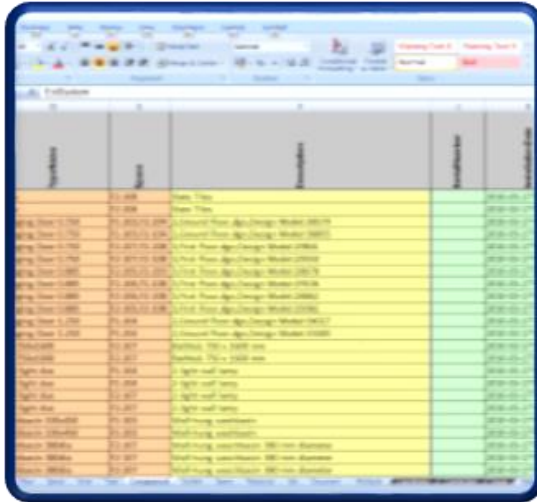


THE INFORMATION MODEL



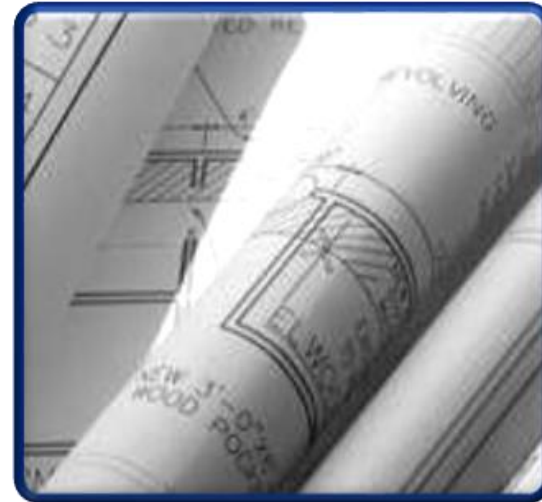
Graphical & Spatial
Data

CAD and GIS



Non-Graphical Data

Asset Register



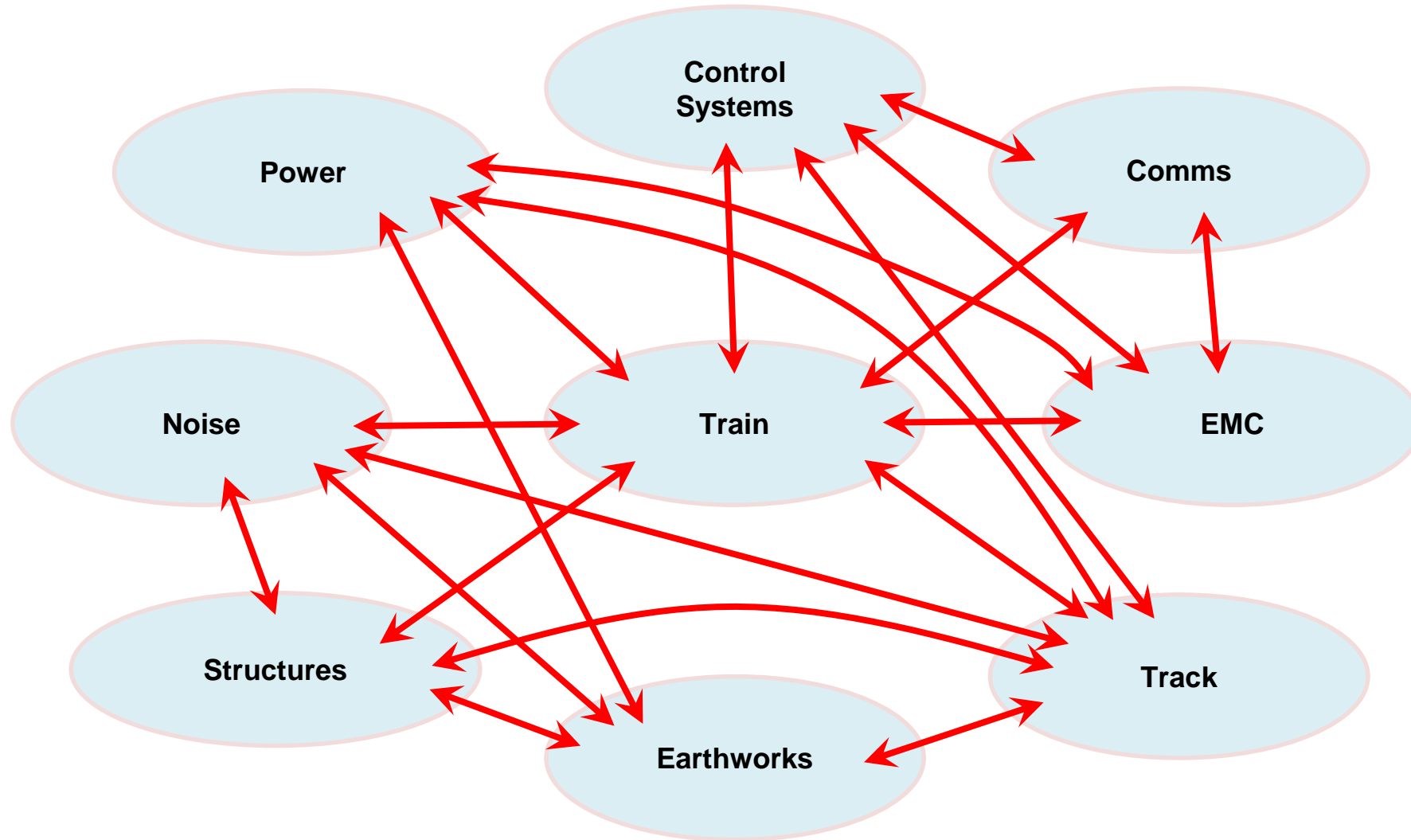
Documentation

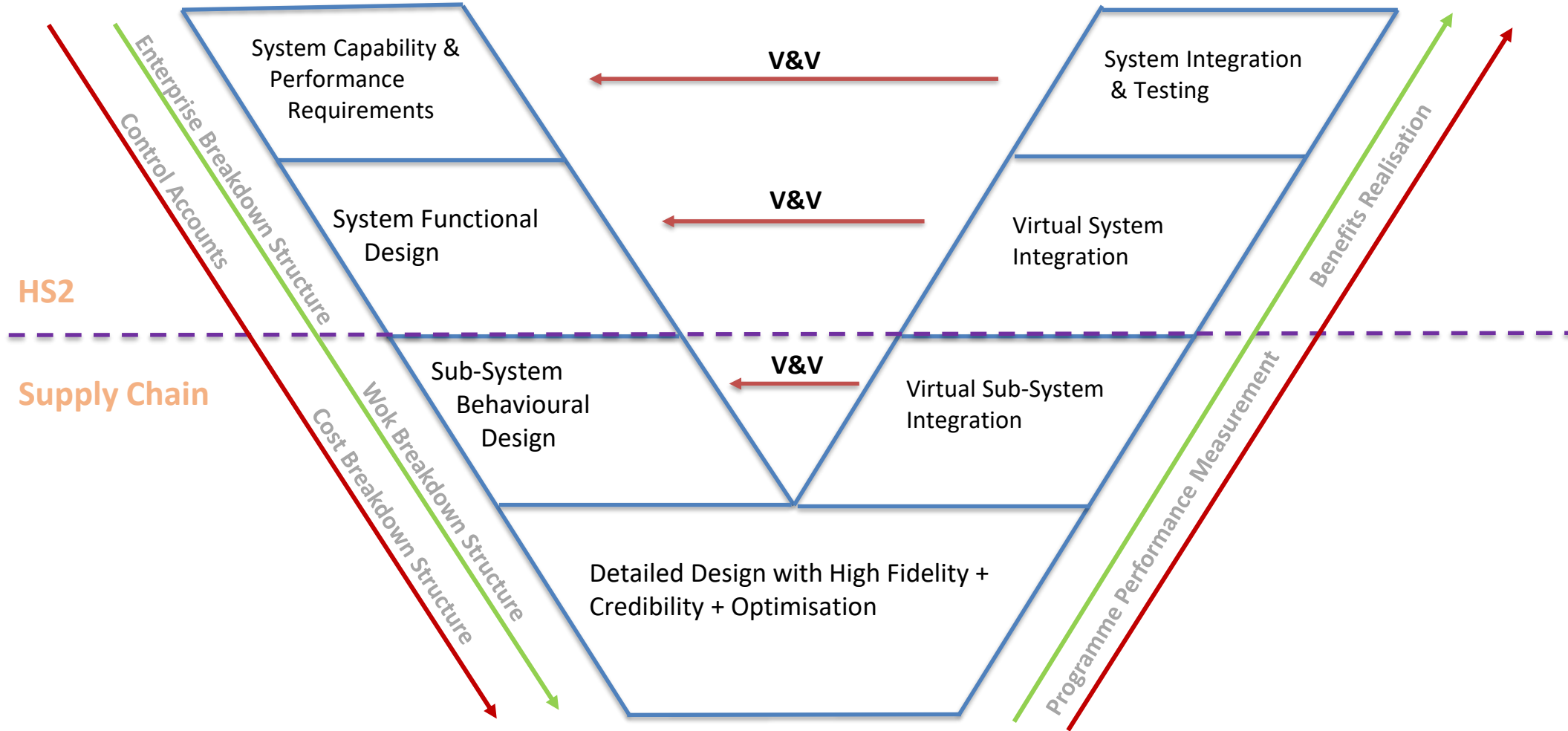
Enterprise Bridge

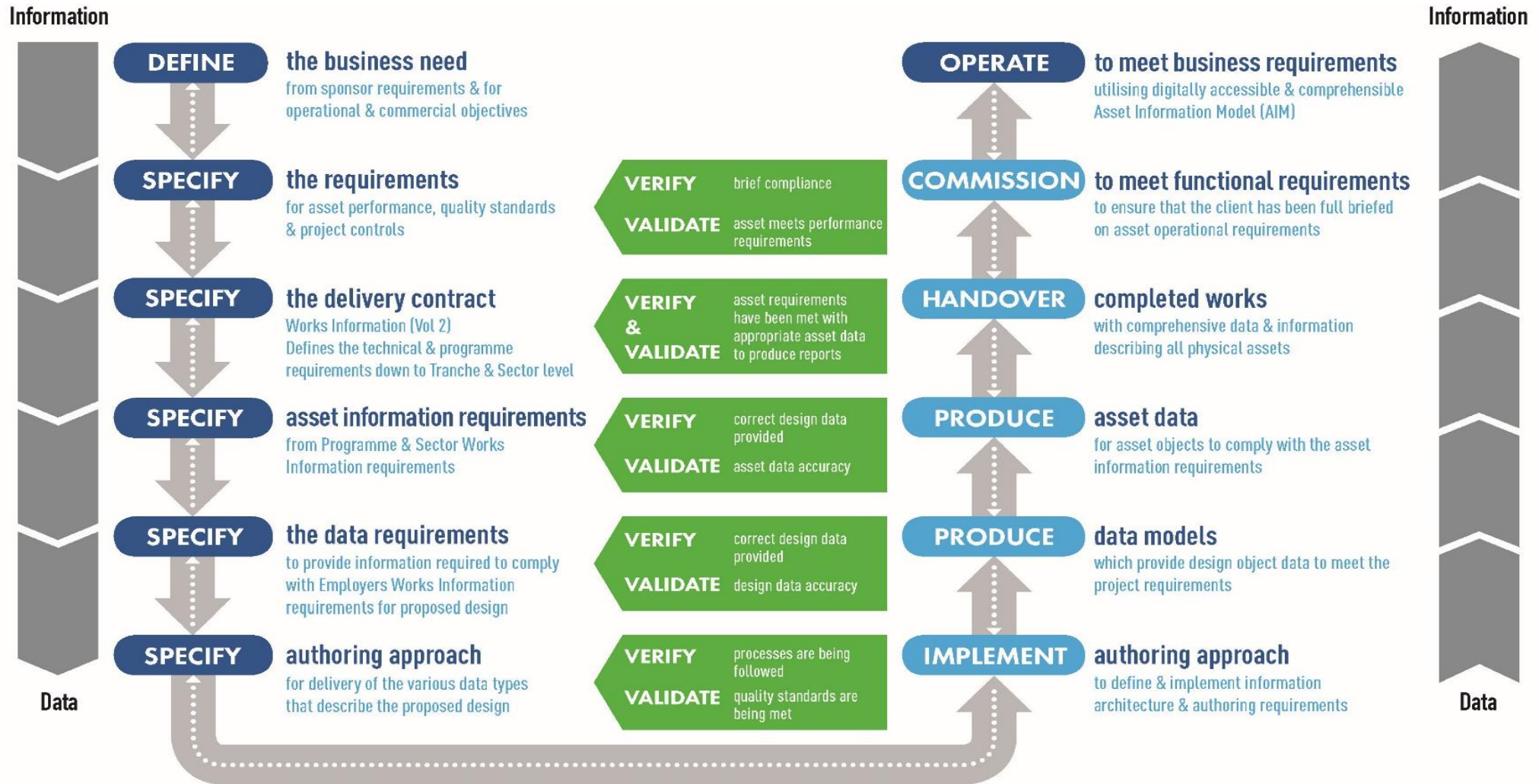
gViewer



A **systemic** and **temporal** digital representation of the physical and operational railway, along with **information** on its functionality and utilisation through an **integrated environment** in which **high quality, reliable** and **accurate graphical and non-graphical data** is made available to **everyone** through an **appropriate, secure, role-based, user-focused** interface for **exploitation**.









B Build / Construction **C** Commercial **D** Dimensional **F** Functional **G** Geospatial **M** Manufacturing **O** O & M **S** Sustainability

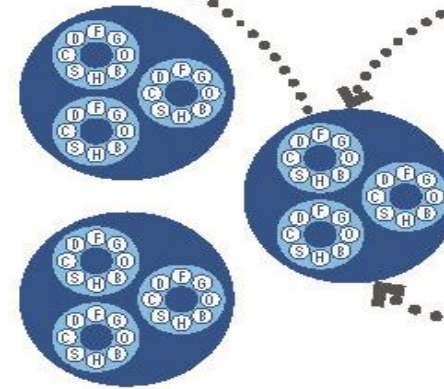
System

Combined asset elements



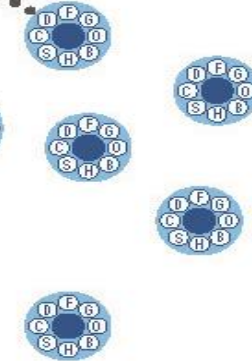
Elements

Combined asset components



Components

Individual part



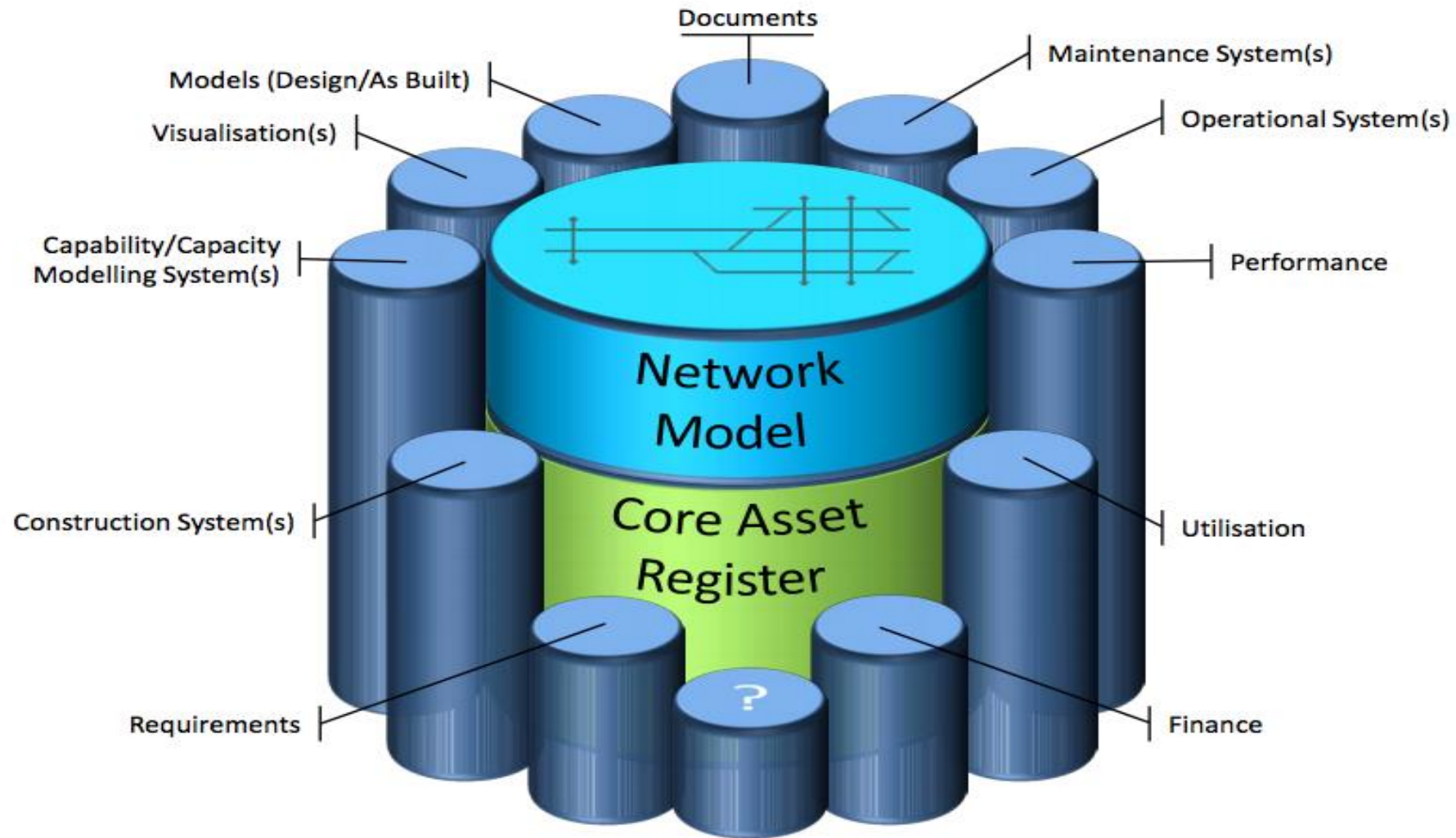
Primary Asset Example : Bridge



Element Example : Bridge Deck



Component Example : Barrier





A
R

< View Asset location

Asset HS2-000000143 > **Legacy ID** 012-S4

Asset name Westgate Vent Shaft

Asset class Shaft (CV-US-SH) >

Route Main Line (London Euston – Wigan WCML Connection) >

Start chainage 13.000 **End chainage** 13.000 **Track** All

Owner HS2 **Hybrid bill code** 1/1 **Has DES entry**

Asset builder Audit history Historical comparison

Attributes

Attribute	Value
OSGB Easting	517,944
OSGB Northing	182,777

Relationships

Linear relationships

Links

Link type	System	Address
DES	eB	C221-MMD-TN-DES-010-400007
Document	eB	https://viewer.hs2.org.uk/Silverlight/?runWorkflow=InterfacelN&s=65&I=Design%20Element%20Statement%20(DES)%20Areas&c=DES_AssetID&v=HS2-000000143



A
R

e
B

View Asset location

Asset: Legacy ID:

Asset name:

Asset class:

Route:

Start chainage: End chainage: Track:

Owner: Hybrid bill code: Has DES entry:

Attributes

Attribute	Value
OSGB Easting	517,944
OSGB Northing	182,777

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Linear relationships

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Link type	System	Address
DES	eB	C221-MMD-TN-DES-010-400007
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C221-MMD-TN-DES-010-400007

Number	Revision
C221-MMD-TN-DES-010-400007	P05

Title
Design Element Statement - Westgate Vent Shaft Line of Route ID - BT 015-L5 Chainage Specific ID No VS 012-S4

Class	eB Approval Status
HS2 Classes\Design Element Statement	Approved

Change Controlled	Superseded
No	No

Document Status	Date Actual
Current	26/11/2015 00:00:00

Discipline	Review and Acceptance Status
TN - Tunnels	Code 1 - Accepted

Security Classification	Suitability Status
Internal	Fit for Implementation

Work Package Number/Ref
PH1-FPD

Warning

- No Warnings

Copies

Cross References

Type	Number
Deliverable Schedule Reference	PE.02.001

Document Relationships

Files

Actions	File Name	Application Name	Status	File Size	Description	Checked Out
	C221-MMD-TN-DES-010-400007 [P05] - FPD Design Element Statement - Westgate Vent Shaft Chainage Specific ID No 012-S4.pdf	APPLICATION/PDF	Ready	1Mb		No



A
R

e

gViewer

View Asset location

Asset: HS2-00000143 Legacy ID: 012

Asset name: Westgate Vent Shaft

Asset class: Shaft (CV-US-SH)

Route: Main Line (London Euston – Wigan WCML Connection)

Start chainage: 13.000 End chainage: 13.000

Owner: HS2 Hybrid bill code: 1/1

Asset builder Audit history Historical comparisons

Attributes

Attribute

OSGB Easting

OSGB Northing

Relationships

Linear relationships

Links

Link type	System	Address
DES	eB	C221-MMD-TN-DES-010-400007
Document	eB	https://gviewer.hs2.org.uk/Silverlight/?runWorkflow=Interfacelns&s=65&l=Des20Areas&c=DES_AssetID=v=HS2-00000143

gViewer CORE

Search... Sign out ?

Getting Around Maps & Data Sources Tasks Analysis

Pan Zoom In Zoom Out Initial Extent Full Extent Previous Extent Next Extent

Point Identify Find Address Location Info Search Tools Information & Actions Help

Scale: 1: 6,780

Jump to a map bookmark...

I want to...

Westgate Vent Shaft
012-S4
HS2-00000143

BRENT LONDON BOROUGH

Linked Out



A
R

e

gViewer

View Asset location

Asset: HS2-000000143

Asset name: Westgate Vent Shaft

Asset class: Shaft (CV-US-SH)

Route: Main Line (London)

Start chainage: 13.000 End

Owner: HS2 Hybrid

Asset builder: Au

Attributes

Attribute

OSGB Easting

OSGB Northing

Relationships

Linear relationships

Links

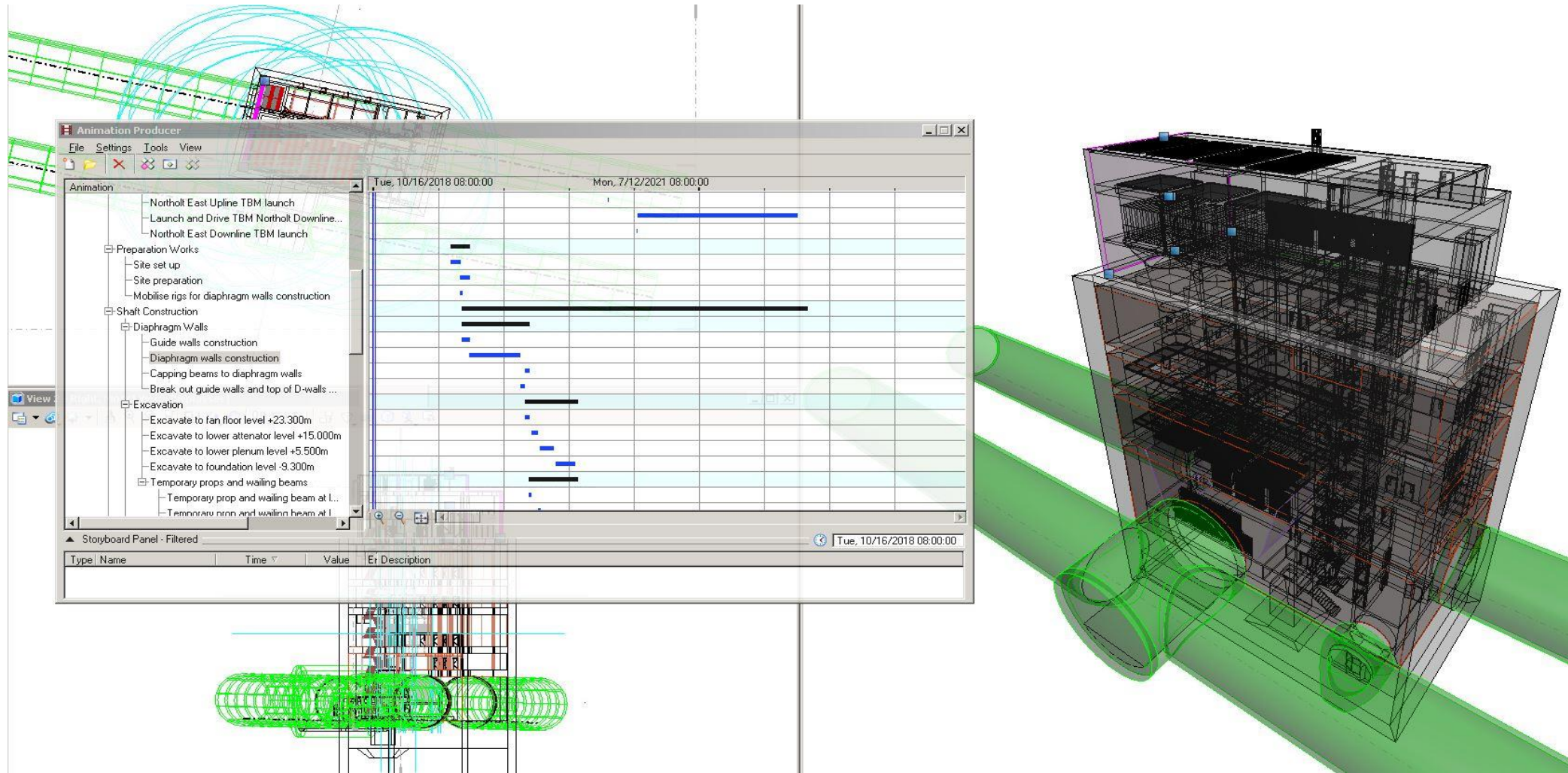
Link type	System	Address
DES	eB	C221-MMD-TN-DES-010-400007
Document	eB	https://gviewer.hs2.org.uk/Silverlight/?runV20Areas&c=DES_AssetID&v=HS2-000000143

3D Viewer

500ft
200m

BRENT
LONDON
BORO

ked Out



Integration with Cost (5D)



CostOS V - [LBA001 - LBA-Test * / SQL Server]

FILE HOME TABLE & LAYOUTS ESTIMATE TOOLS & HELP

Project Cost Estimates Bill Of Quantities Table

Global Settings

Cost Estimating Projects

Enterprise Project Structure

LBA001 - LBA-Test

Project Options

Bill Of Quantities

WGS000 - WGS-Test

Project Options

Bill Of Quantities

Code	Title	BIM Type	BIM Materials	Thickness	Estimated Quantity	Quantity	Unit 1	Plant Rate	Labour Rate
540		Wall	S-G2::S-G25-WallsConcrete	1.0000m	0.00	0.00	M3	0.00	0.00
550		Wall	S-G2::S-G25-WallsConcrete	1.0000m	0.00	0.00	M3	0.00	0.00
560		Wall	S-G2::S-G25-WallsConcrete	1.0000m	0.00	0.00	M3	0.00	0.00
570		Wall	S-G2::S-G25-WallsConcrete	1.0000m	0.00	0.00	M3	0.00	0.00
580		Wall	S-G2::S-G25-WallsConcrete	1.0000m	0.00	0.00	M3	0.00	0.00
590		Wall	S-G2::S-G25-WallsConcrete	1.0000m	0.00	0.00	M3	0.00	0.00
1,420		Wall	S-G2::S-G25-WallsConcrete	1.0000m	0.00	0.00	M3	0.00	0.00
1,430		Wall	S-G2::S-G25-WallsConcrete	1.0000m	0.00	0.00	M3	0.00	0.00
1,440		Wall	S-G2::S-G25-WallsConcrete	1.0000m	0.00	0.00	M3	0.00	0.00
1,460		Wall	S-G2::S-G25-WallsConcrete	1.2500m	1,962.77	1,962.77	M3	0.00	0.00
1,490		Wall	S-G2::S-G25-WallsConcrete	1.0000m	0.00	0.00	M3	0.00	0.00
1,520		Wall	S-G2::S-G25-WallsConcrete	1.2500m	1,962.77	1,962.77	M3	0.00	0.00
1,530		Wall	S-G2::S-G25-WallsConcrete	1.2500m	1,962.77	1,962.77	M3	0.00	0.00
1,560		Wall	S-G2::S-G25-WallsConcrete	1.0000m	0.00	0.00	M3	0.00	0.00
20		Wall	WallComponent::Concrete	0.5000m	0.00	0.00	M3	0.00	0.00
40		Wall	WallComponent::Concrete	0.1500m	0.00	0.00	M3	0.00	0.00
50		Wall	WallComponent::Concrete						

Totals

Project WBS 1 / Group Code 3

Assignments - Description

MULTIPLE SELECTION - USE

Description Resources Line Items Plant Subcontractors Labour Mater

For help, press F1

Solibri Model Viewer - C221-MMD-CV-DM3-010-020501-5D

File Model Checking Communication Information Takeoff

Model Tree

C221-MMD-CV-DM3-010-020501-5D

Info

Wall.0.142

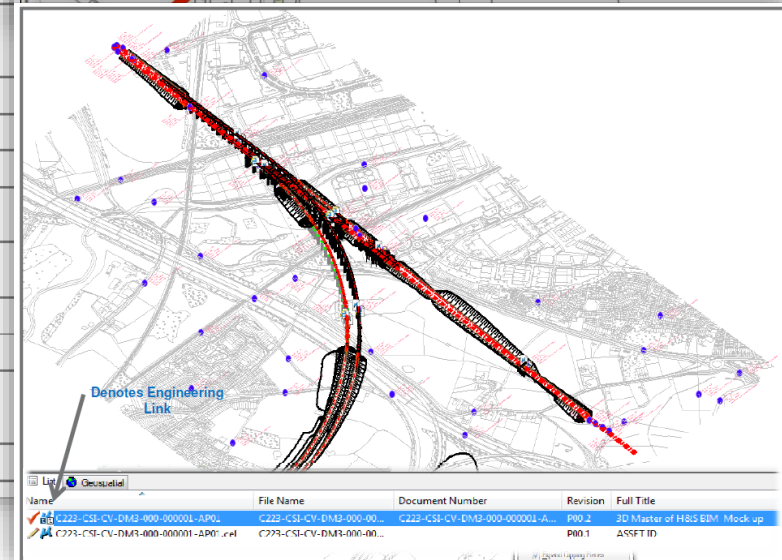
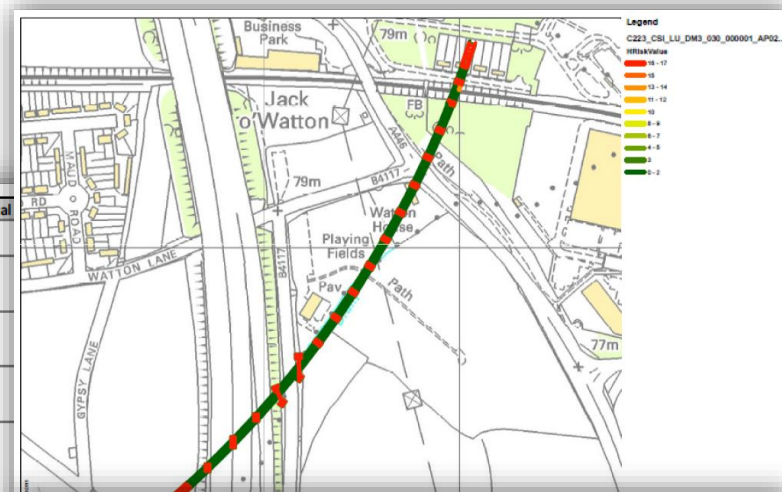
Property	Value
Model	C221-MMD-CV-DM3-010-020501-5D
Discipline	Architectural
Name	Concrete
Type	Concrete
Description	Concrete Wall :0, C221-MMD-CV-DM3-0...
Material	S-G25-WallsConcrete 1.25 m
Layer	S-G2503-M-WallsConcrete
System	
Building Envelope	True
Geometry	Extrusion
Application	AECOsim Building Designer
GUID	1167d6QKD0b8PLf6gEYRsq
BATID	

Welcome to Solibri Model Viewer

Selected: 0



Agent	Pathway	Work	Health outcome	Latency	Severity	Frequency	Rating	Mitigation/ERIC	Expert advice	Residual
Asbestos	inhalation	removal, maintenance	cancers, lung disease	long	4	F	(S x F)	specialist contractors	Hygienist, toxicologist	
Chemicals	absorption, ingestion, inhalation	contaminated land, cleaning, maintenance	cancers, body effects, accumulation, skin	acute and chronic	5	F	(S x F)	lower risk alternatives, buying policy, COSHH	Hygienist, toxicologist	
Compressed Air	air pressure affecting organs	tunnellers, caisson workers	decompression sickness, bone, ears and sinus	acute	5	F	(S x F)	Elimination	OH Doctor, specialist	
Computer/ user interface	musculo-skeletal overuse, ergonomics	designers, managers, supervisors, control rooms	stress, upper limb disorders, headaches, fatigue	chronic	2	F	(S x F)	DSE assessments	OH specialist, Ergonomist, Physiotherapist	
Dust	inhalation	sawing, drilling, mobile work equipment, welding	cancers, lung disease	acute, chronic, long term	5	F	(S x F)	avoid cutting, off site contractors, dust suppression, dampening down	Hygienist, toxicologist	
Fumes	inhalation	sawing, drilling, mobile work equipment, welding	cancers, lung disease	acute, chronic, long term	5	F	(S x F)	avoid cutting, off site contractors, dust suppression, dampening down	Hygienist, toxicologist	
Noise	ambient and industrial noise	impact noise and machinery	tinnitus, hearing loss	acute and chronic	2	F	(S x F)	buying policy, enclosure, dampening, maintenance	Audiometrist, specialist	
Radiation (ionising)	absorption, ingestion	x rays	radiation sickness	chronic	4	F	(S x F)	enclosure	Radiation officer	
Radiation (non ionising)	absorption	working outside	skin cancers	latent	4	F	(S x F)	cover up, avoid midday work	Occupational health specialist	
Repeated moving/handling, lifting	musculo-skeletal overuse, ergonomics	digging, carrying, erecting	overuse syndrome, back pain	acute and chronic	3	F	(S x F)	use smaller weights, mechanical handling, more space requirements	Ergonomist, OH specialist	
Resins, two pack paint	inhalation	painting, epoxy	asthma, allergic response, irritation	acute and chronic	4	F	(S x F)	buying policy, less hazardous paints, enclosure	Hygienist, toxicologist	
Shift work	circadian rhythms	tunnellers, road workers	cancers, fatigue	unknown	4	F	(S x F)	Type of shift programme	OH Doctor	
Stress		overload, pressure, events, support	mental health issues, depression, anxiety	chronic	2	F	(S x F)	stress RA	Psychologist, Counsellor	
Vibration	direct transmission of vibration	sit on vehicles, hand held equipment	low back pain, HAVs, white finger	chronic	2	F	(S x F)	bench mounted tools, maintenance of tools and consumables	OH Doctor	
Zoonosis	ingestion, inoculation	outside workers, GI, ground workers	disease, death, disability	acute	3	F	(S x F)	Avoid, vaccinations	Local GP/Hospital, OH specialist	





DATB KinoDB - AIMS

ESRI ArcGIS & gViewer

Bentley ProjectWise

835

primary assets

0.6bn

spatial records

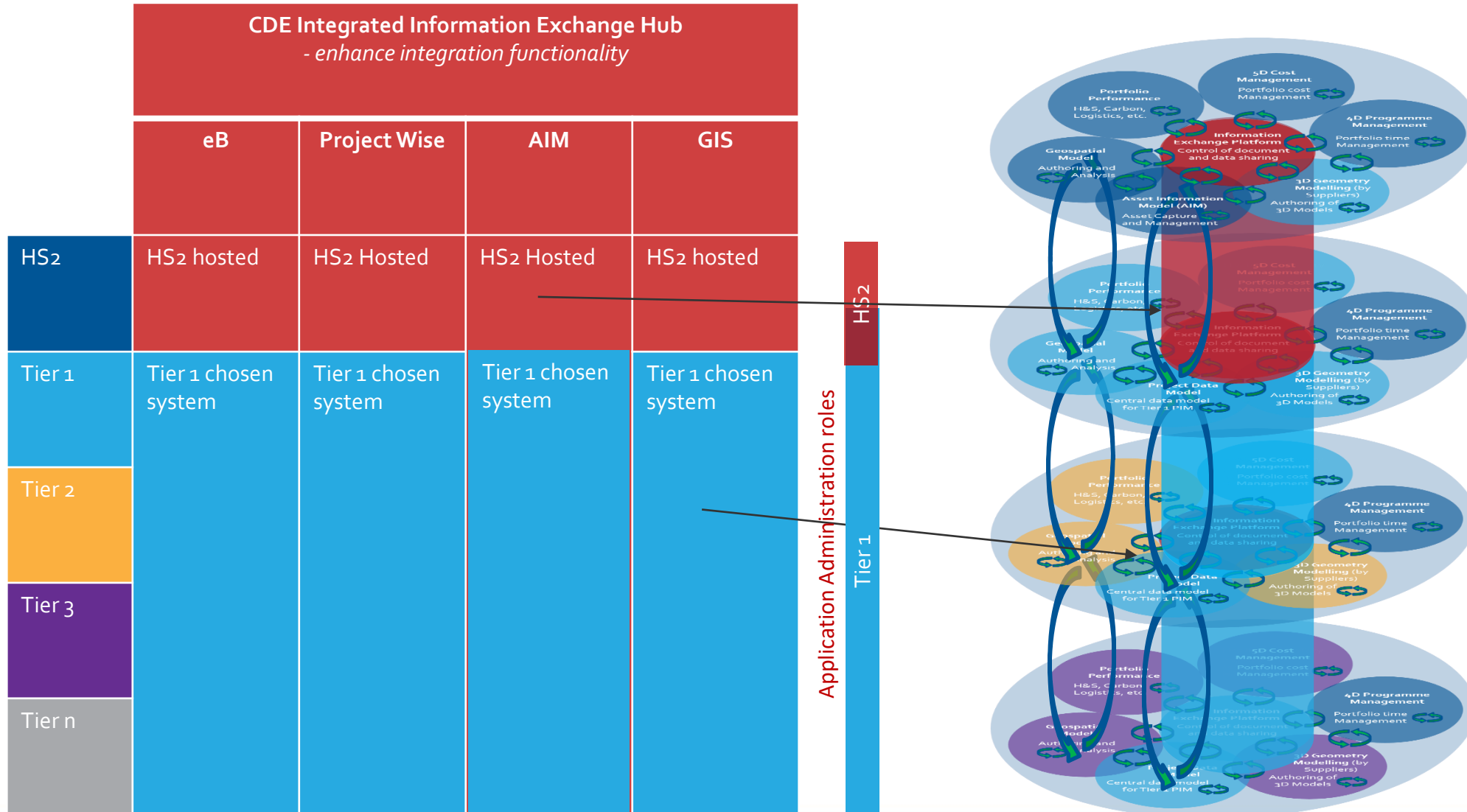
923,678

design/CAD models

25Tb

technical data

CDE – Client vs. Contractor

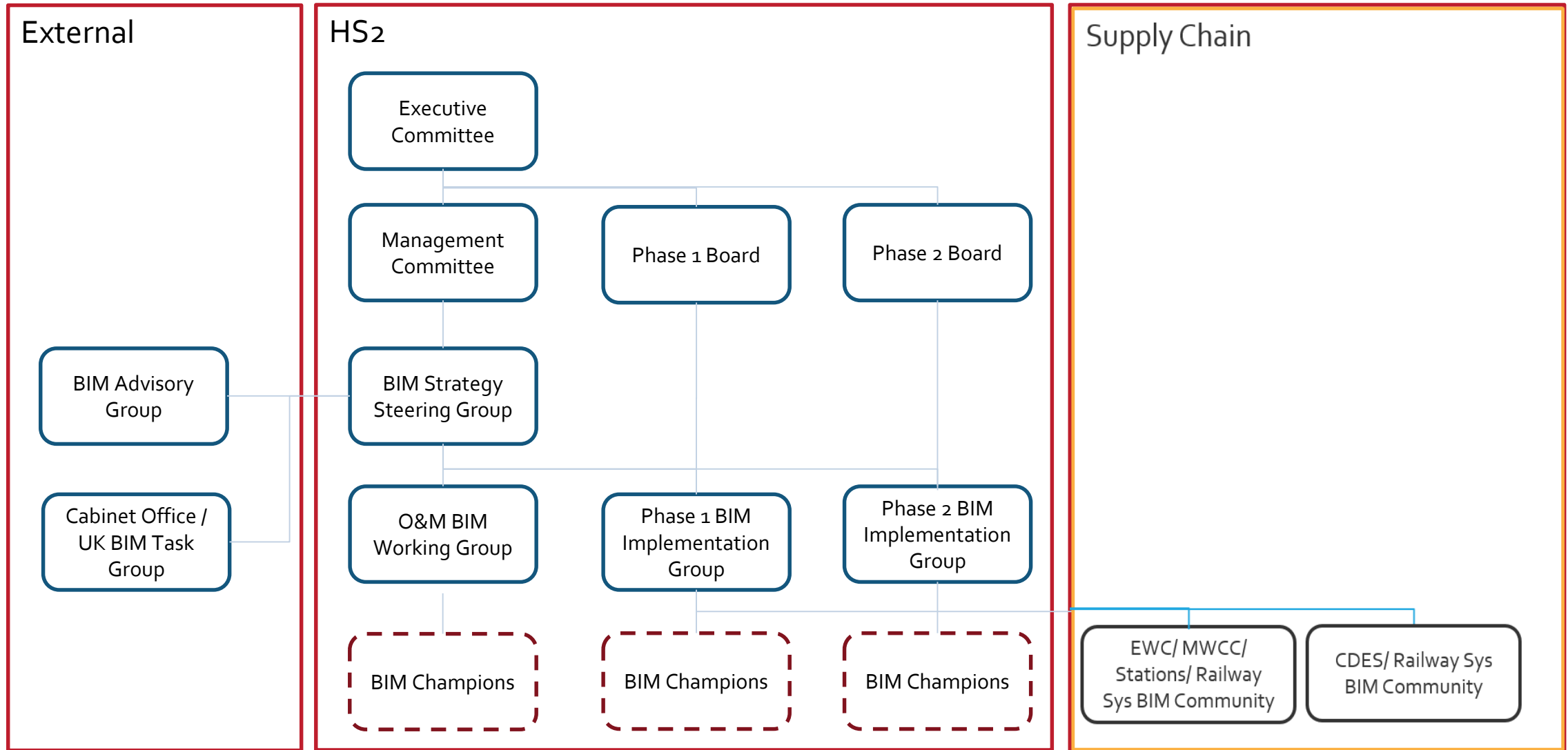




Leadership

Upskilling

Future-Proofing





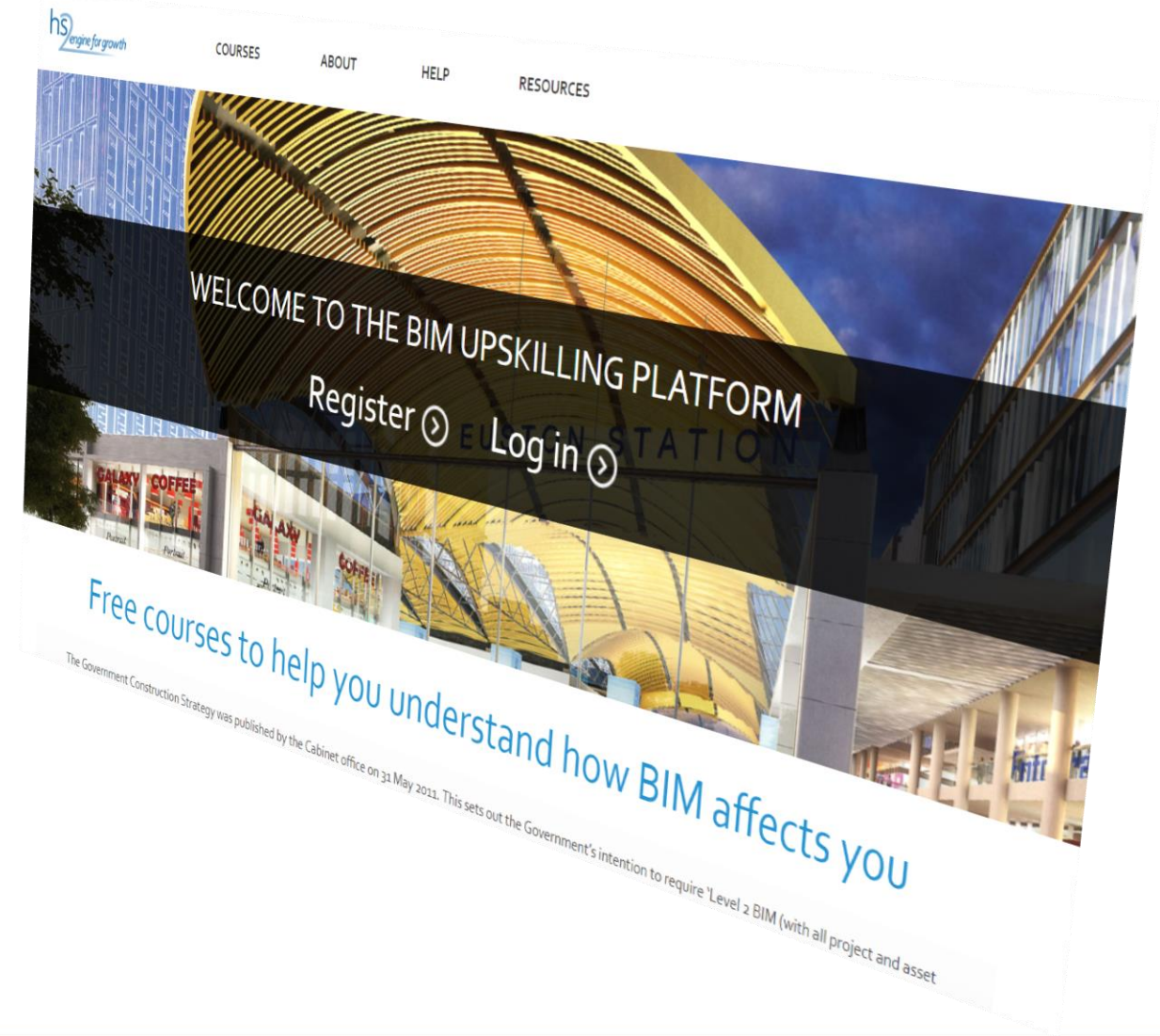
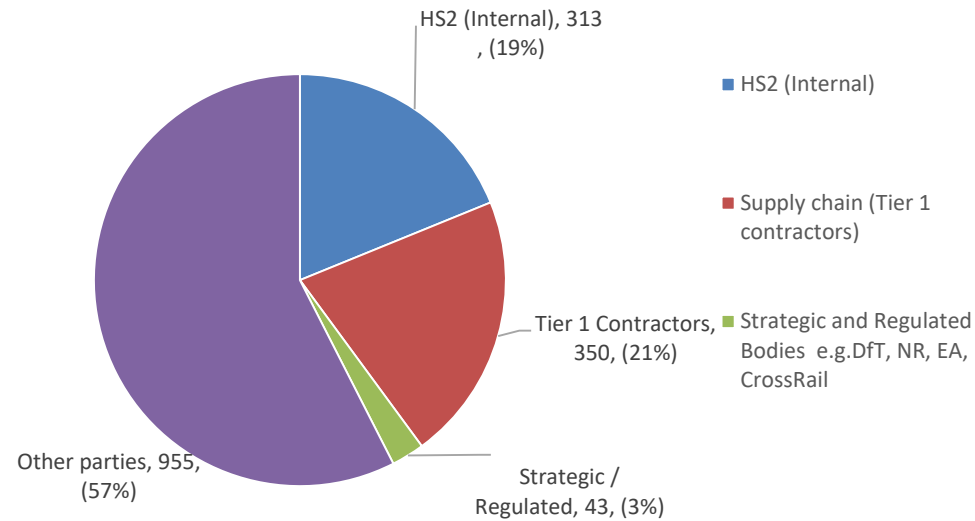
www.bimupskilling.com What does BIM mean to HS2?

Delivering High Speed Two With BIM | Professor Andrew McNaughton

"We've decided to bet the shop on building information modelling (BIM)". Join Professor Andrew McNaughton, Technical Director of High Speed Two, for a look at how BIM is shaping the design, delivery, operation and maintenance of Britain's latest high speed railway.



BIM Upskilling Platform: Total Numbers of Registered Users Oct 17- (1661)





“BIM is our **lifeblood**.... Our
central nervous system”

Professor Andrew McNaughton
Technical Director, HS2 Ltd



Reputation /
Regulation



Cost



Time




Environmental

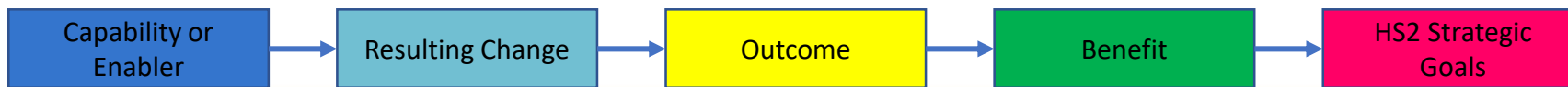
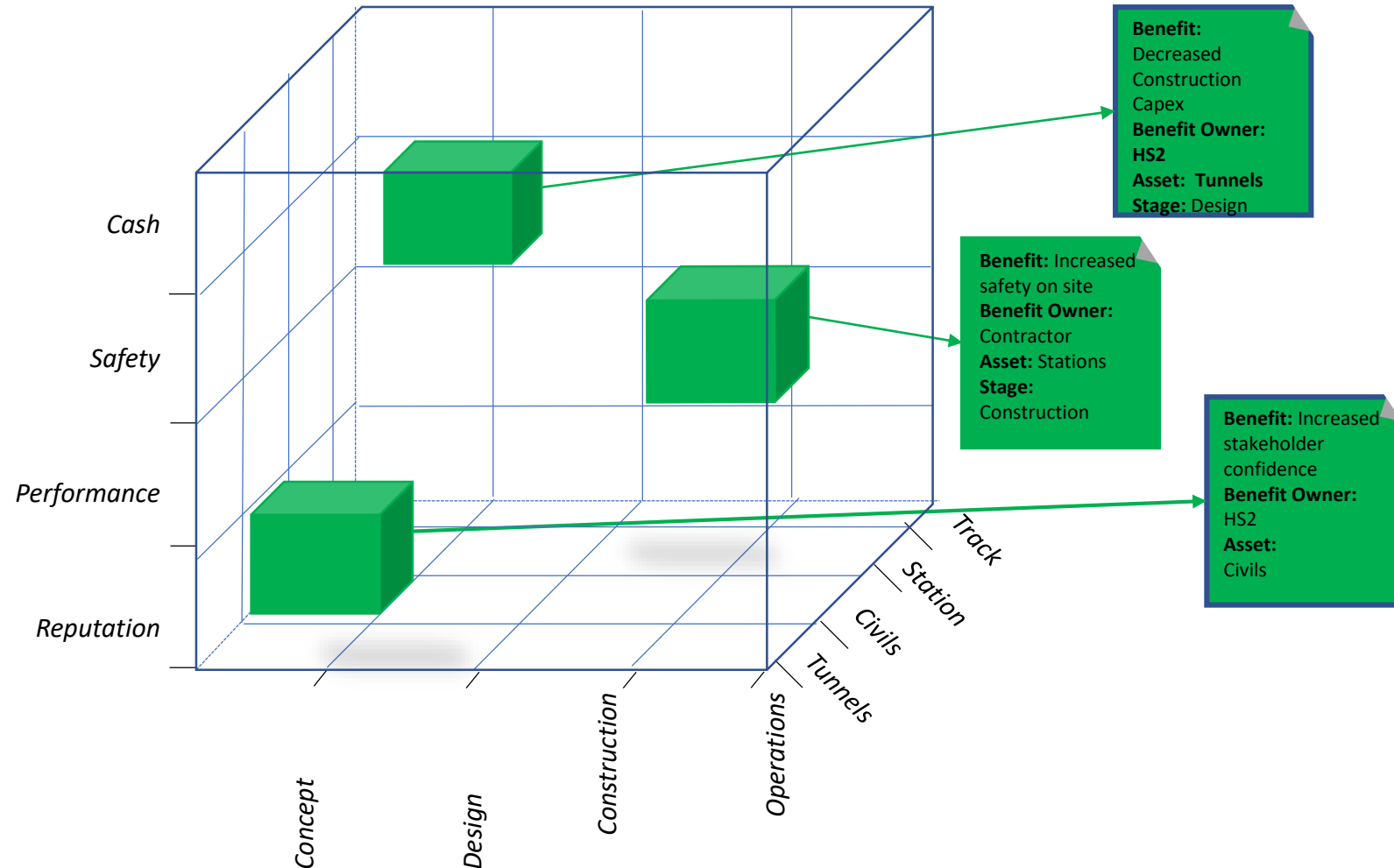


Safety



Performance

Phase 1 & 2 –
£0.5 Billion 



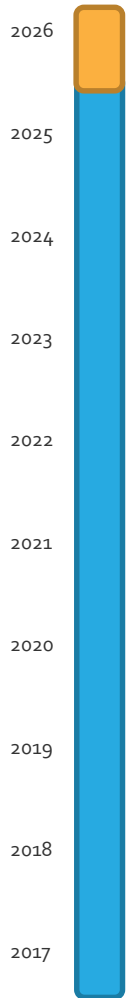
BIM Performance Indicators & Reporting



BIM Performance Indicators	Benefits Ref:	Objective	Indicator	Measurement	Description of activity/measurement	Activity stage	Measurement Owner	Measurement Type	Supply Chain Collection method	HS2 Assurance method

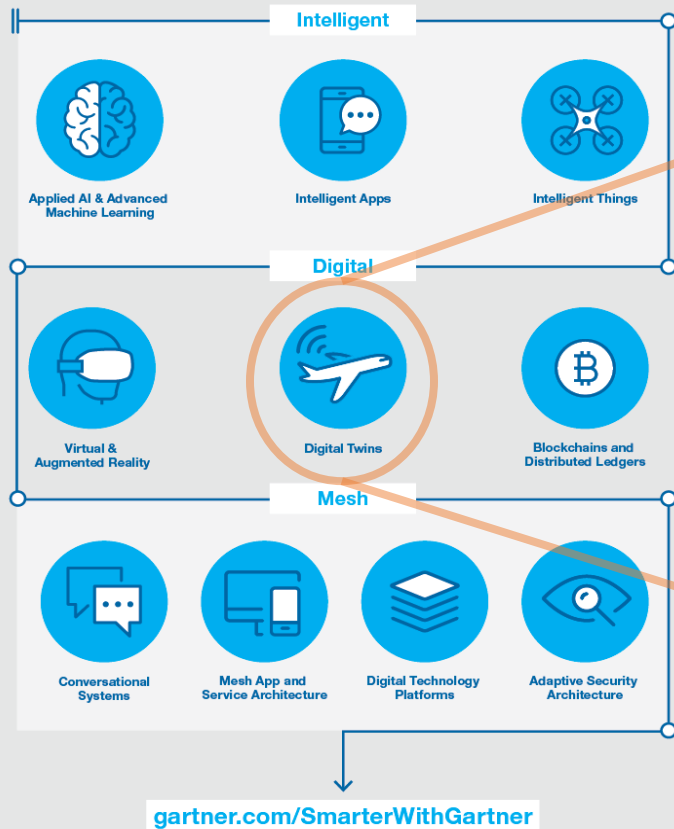


- Seamless handover of a precise, verified, representation of assets from Construction to Operations & Maintenance
- Fully functional and integrated Asset Management System
- Transition from reactive to predictive maintenance supported by a 'Virtual Railway'





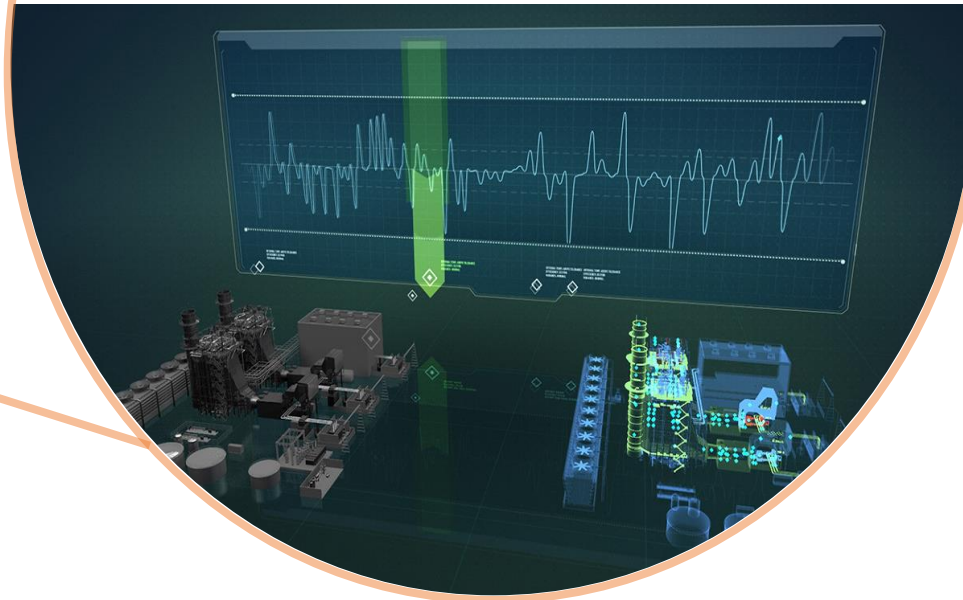
Top 10 Strategic Technology Trends 2017

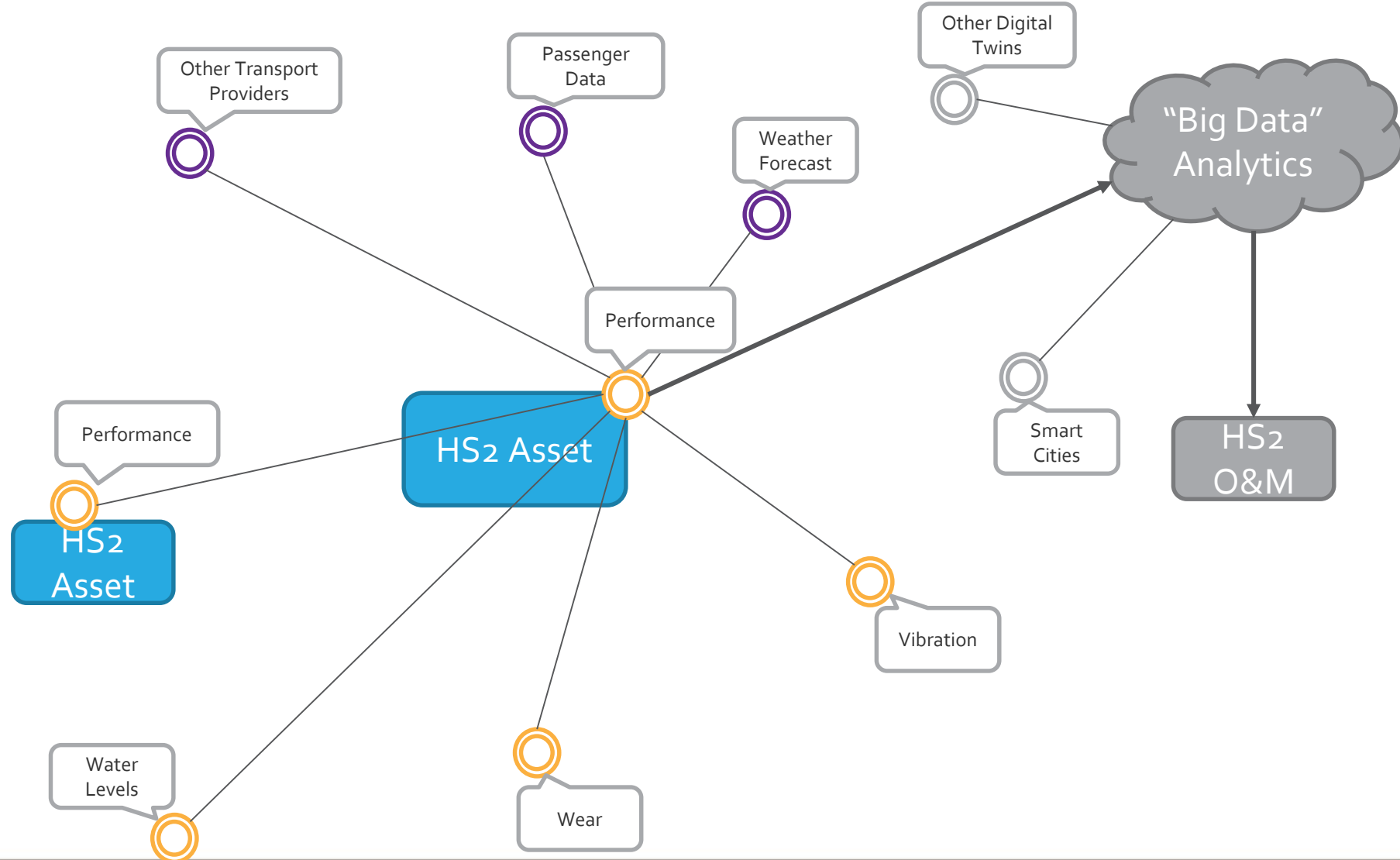


Gartner.

Source: Gartner
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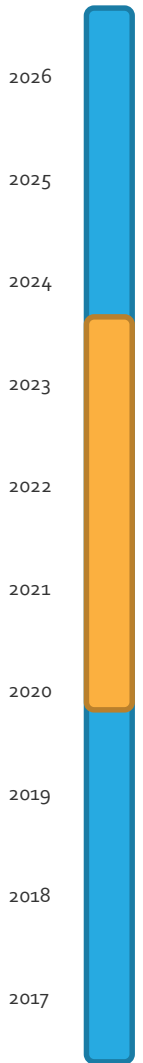
“A digital representation of the physical and operational railway to provide the link between the virtual and real world, potentially in real time”

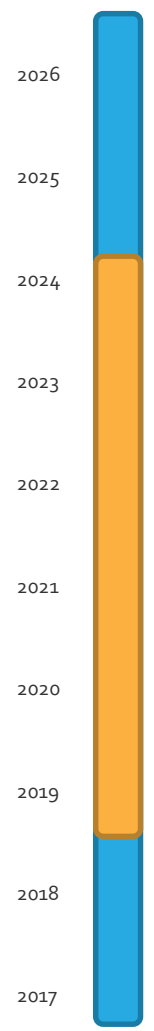
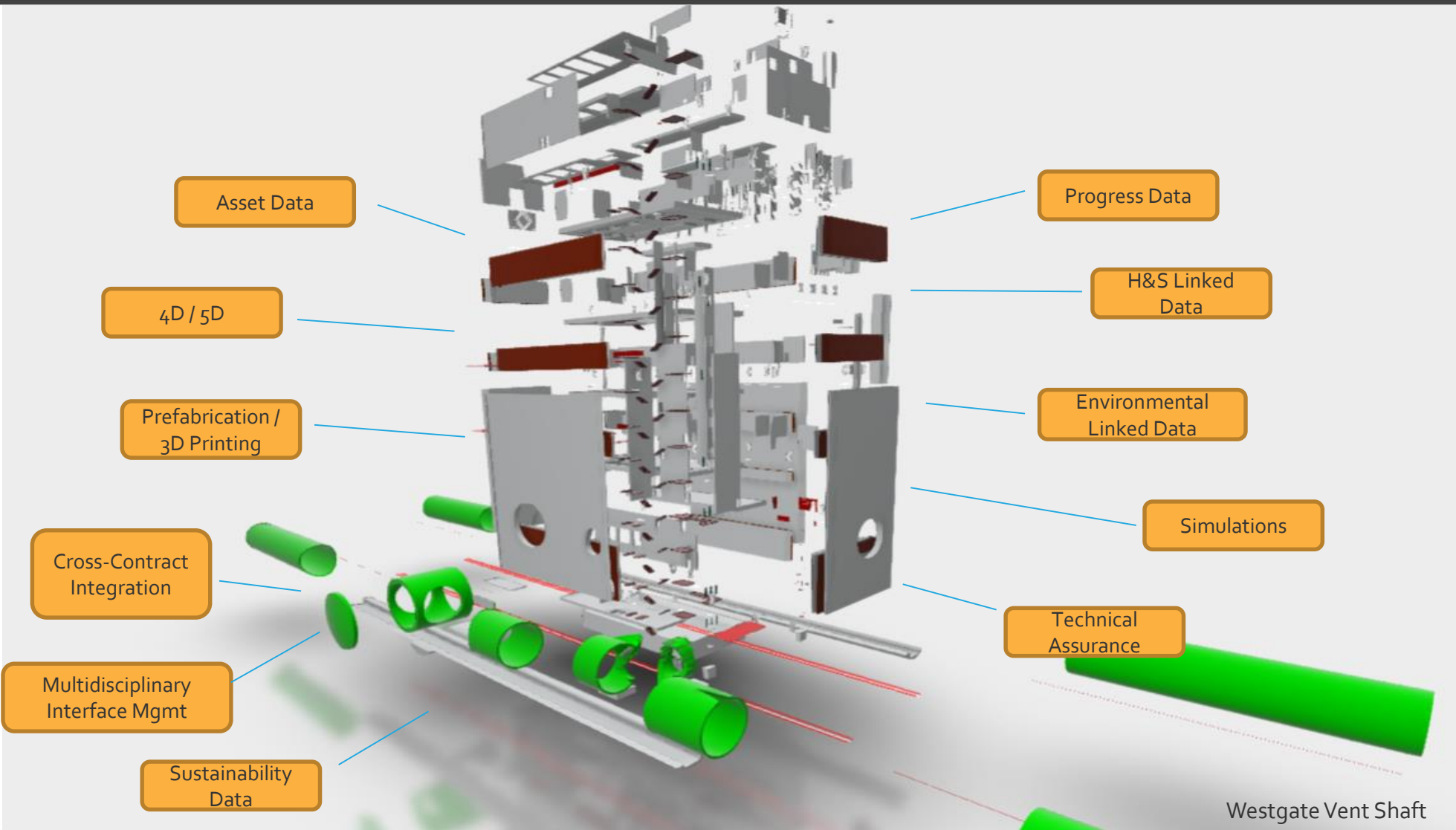






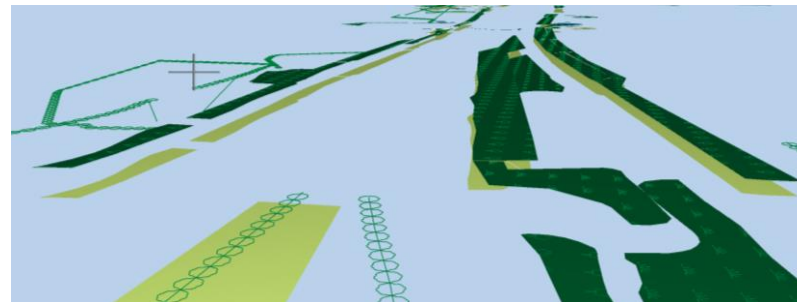
- Laser scanning to validate as-built asset
- Comparison to 3D design model
- Process could be used to assess progress against construction schedule







- Support engineering and environmental activities (including prototyping a 'digital Environmental Statements')
- Undertaking improvements to data processes and assurance
- Improving how we use information and technology to engage with stakeholders





Recommendations

- Treat data as a valuable resource (owned by the Client)
- Establish your data requirements (at business and project level)
- Structure data consistently and with the end-use in mind – from the start
- Use relational databases – from the start
- Become data-centric

Beware (or mindful of)

- Data interoperability (be prescriptive)
- Being led by IT
- Change control and change management

CASE STUDY



Crossrail, UK

Framework / Performance Criteria: Performance Criteria

Topic: Common Data Environment

Recommendation: Apply the CDE principle as a means of allowing quality assured information to be managed and shared efficiently and accurately between all members of the project team – whether that information is geo-spatial, design, textual or numeric

CONTEXT

Crossrail, currently Europe's biggest civil engineering project, is being built under central London to link existing Network Rail lines to the east and west of the capital. When it opens in 2018 it will provide rail services from Maidenhead and Heathrow in the west to Sheffield and Abbey Wood in the east of London.

The large and increasing number of contractors and stakeholders on the project meant that an increased amount of information was being produced on the project. An information and data management strategy had been put in place to ensure best practice in 'Whole Lifecycle Information Management', a combination of standards, methods and procedures, but also software, tools and hardware.

The role of lifecycle information management on the project was designed to:

- Reduce risk resulting from unmanaged or poorly controlled data
- Improve efficiency in workflows and data access through the implementation of spatial technology

Crossrail was already well underway when the Government-driven 'BIM Revolution' started in the UK in 2010/2011. However, elements of the Level 2 BIM criteria had been written into Crossrail's 'Data and Information Strategy', the 'Data Management Guide' and the 'Requirements Strategy'. The BS1192-based workflow was fully implemented through the use of an engineering content management system (ECMS) for all design drawings and models, complemented by a document management system and a web-based Geographic Information System to name a few components of the entire CDE. With the deployment of the asset management database another step towards Whole Lifecycle Data Management was done.

The collaboration tool used as the ECMS formed the basis for a centralised management of design standards. It managed synchronisation of edits from multiple users. The BS1192-based workflow was implemented through the software. All parties involved were required to work within the CDE to ensure they meet the required standards, the BS1192-based workflow and file naming conventions.

Other places for storing data, such as USB drives or local C drives were disabled by IT. Automatic data quality check non-conformities to the CAD support team. Lic system were provided by the client to all parties.

WHY WAS IT DONE AS DESCRIBED?

The Crossrail project aims for maximum integration of spatial data irrespective of its native format. The array of engineering disciplines involved in the project include structures, geotechnics, tunnelling, noise and vibration, commitments, interfaces, and heritage. These all generate and demand a huge amount of information every day on a project of this size. In addition to this there is a vast amount of historical information, surveys, reports and drawings from previous stages of the project, generated or collated by other consultants. Other disciplines within Crossrail that require or generate information in relation to the design are for example the property and legal team, health and safety, help desk, estates management and many more. It is vital to the success of the project that data and information is readily available to all staff working on the project, and that it is reviewed and updated where new or more accurate information is found. The number of people on the project and the risks of badly managed data made the business case for the comprehensive implementation of a CDE.

WHAT LESSONS CAN BE LEARNED?

The key principles can be summarised as:

- Treat data as a valuable resource (owned by the Client)
- Establish your requirements (at business and project level)
- Structure data with the end-use in mind – from the start
- Good asset breakdown structure & classification – from the start
- Use relational databases – from the start
- Become data-centric (create a CDE)

Beware (or mindful of):

- Data interoperability (be prescriptive)
- Being led by IT
- People don't like change!

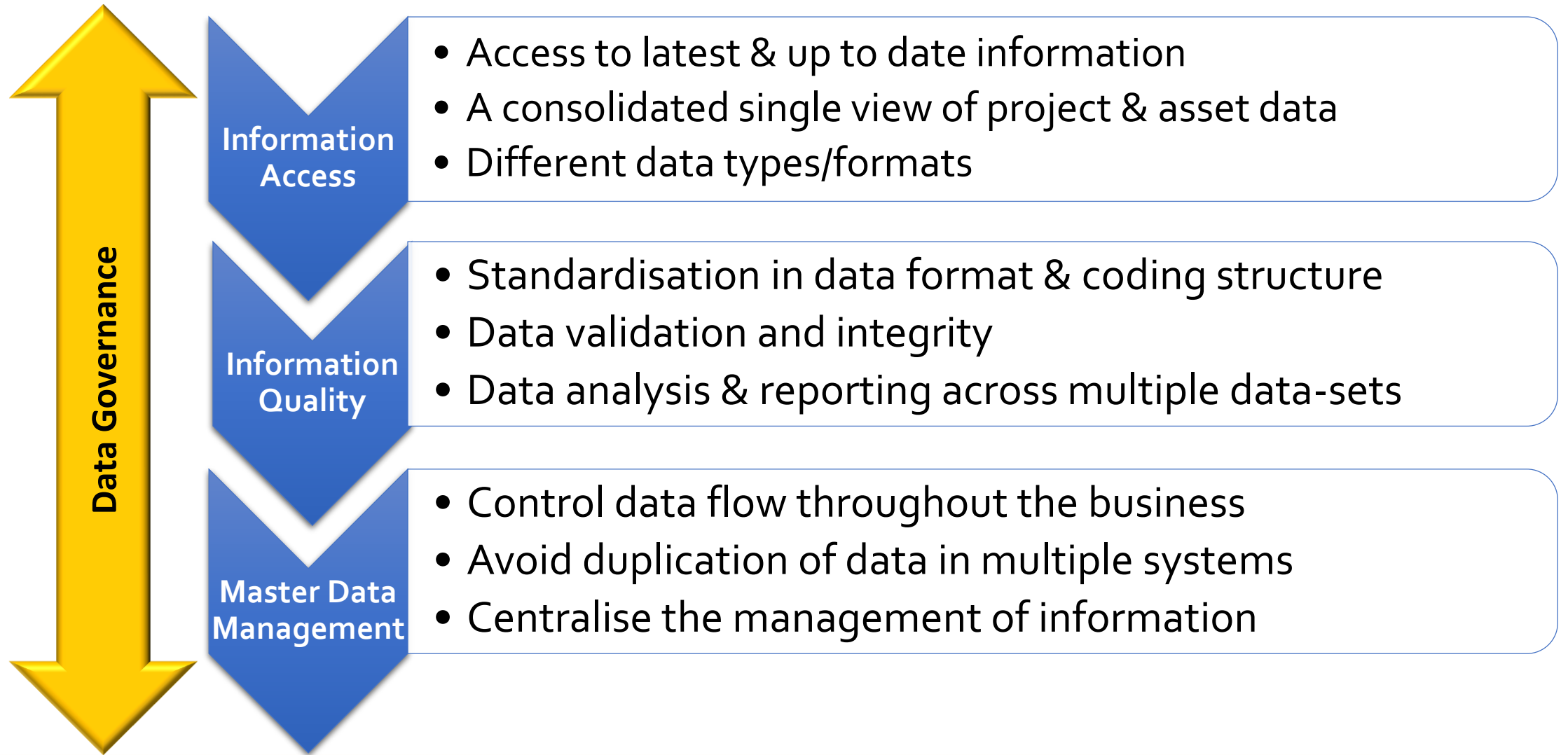
FURTHER INFORMATION

- <http://www.atkinsglobal.com/~media/Files/ATkins-Global/Attachments/sectors/rail/library/docs/technical-papers/>





- Cost the UK public sector some £21 billion in missed opportunities – *Capgemini 2008*
- Poor information quality costs organizations 10-20% of operating revenue - *Association for Information and Image Management 2010*
- In Rail & Construction specifically, waste at 10-20% due to information that is invariably inaccurate, ambiguous and incomplete - *Construction Project Information Committee 2015*
- Gartner (2010) estimates that data quality effects overall labour productivity by 20%, in contrary 40% of all business initiatives failing to achieve their targeted benefits

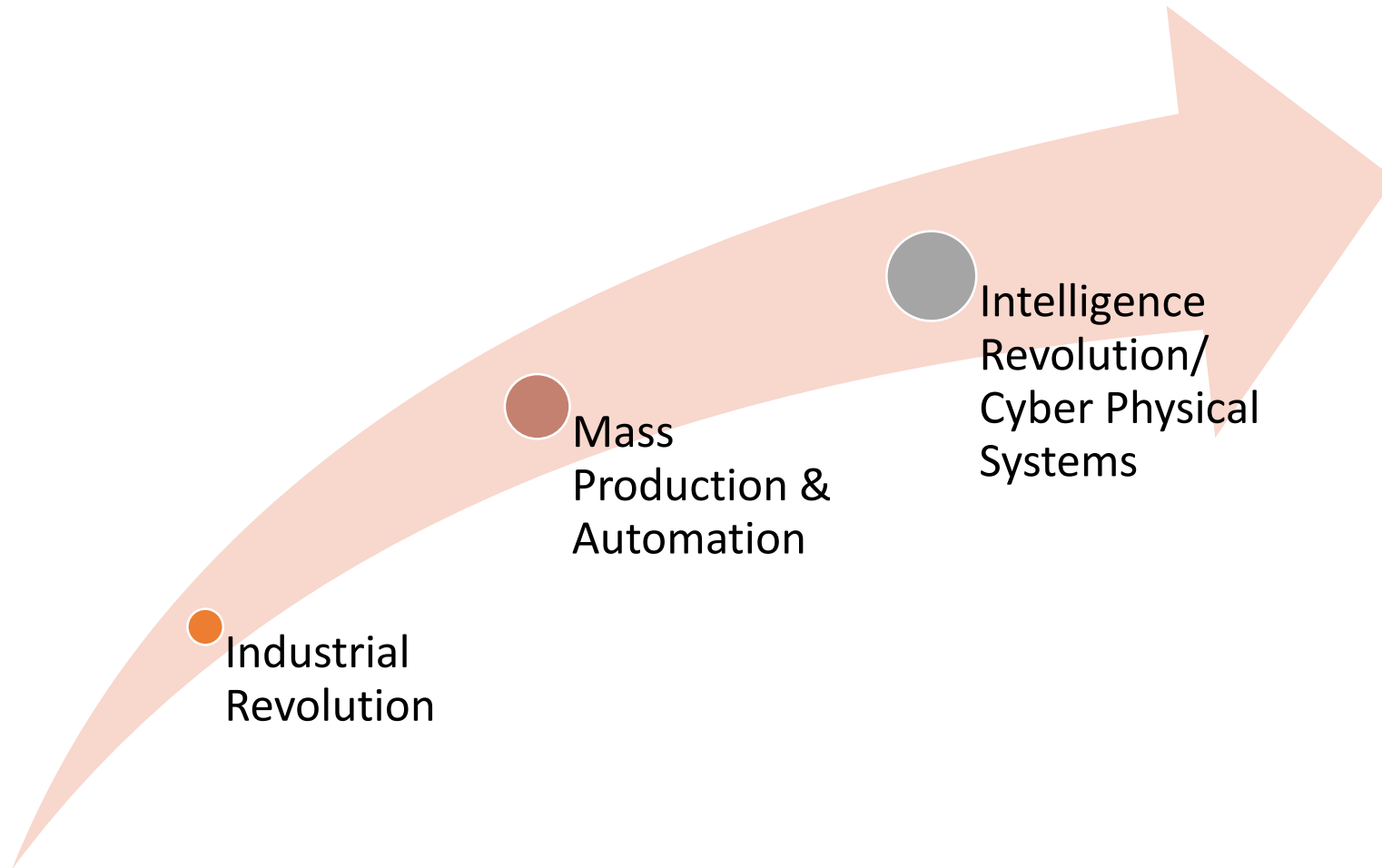




- Digital transformation in a very traditional industry
- Data exchange and interoperability in a multi-vendor environment
- Coordination and integration of such complex interfaces
- Object-oriented approach... modelling the data
- Capability and competency of the supply chain
- Data integration, exploitation, analysis & visualisation
- Focus on data to deal with technology obsolescence



We have entered the age of data... But more information doesn't mean more informed!



Smart companies:

- Treat data as a business asset
- Take a strategic stance on data management
- Identify data asset owners
- Use technology to leverage data
- Prioritise Master Data Management
- Catalogue data
- Establish data Governance
- Apply data mining to drive business efficiency

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Thank you

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