

Integration Challenges in Infrastructure

Dr. Graham Bleakley, Systems Engineering Technical Director, Costain
UK Ltd.

graham.bleakley@costain.com

Who are Costain?

Our heritage

COSTAIN



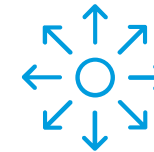
More than
155 year
Track record



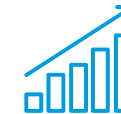
3,100
Employees across a
broad mix of disciplines



Top 50
Employers for
Women 2021



4 hubs
and many projects UK
wide including our state-
of-the-art technology hub



£1,070.5m
Adjusted Group revenue
in 2020



Top 20
UK Management
Consultant



Why Costain?

Who we work with

COSTAIN



Infrastructure owners and operators

Local authorities

Central government

Water and energy utilities

Regeneration agencies

Technology developers

Small medium enterprises

Universities and research institutes

Other consultants

Our digital services

Digital advisory

COSTAIN



We work with you to understand your challenges and then advise on a cost-effective solution that helps you meet your goals.



Systems thinking

Design, deliver and reduce the cost of infrastructure development and maximise benefits with our expert systems-based tools and techniques



Data architecture

Maximise the value of organisational data while reducing the costs of managing it



Digital twin

Design, build, operate and optimise assets and an entire asset portfolio using our digital twin expertise



Data capture, BIM, GIS mapping & analytics

Manifest deep understanding of your infrastructure and environment for seamless project delivery



Enterprise architecture

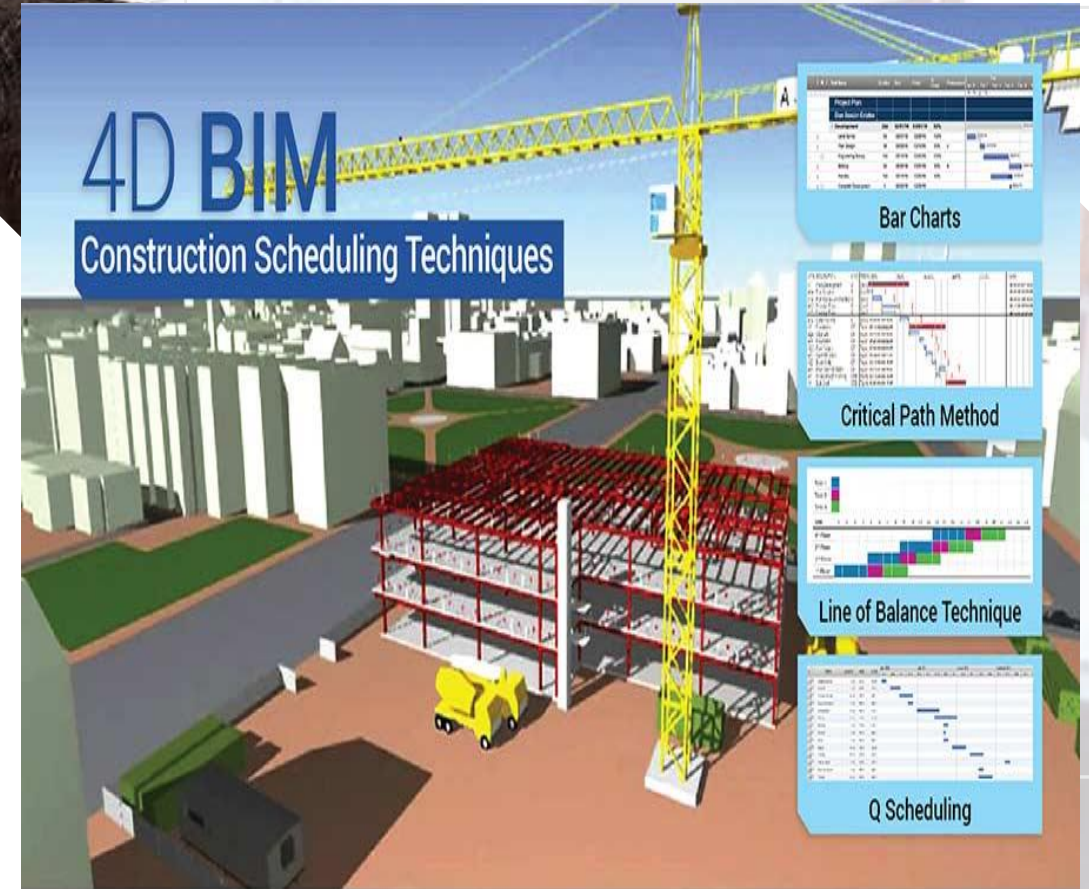
Align your business capabilities, information systems and processes with your strategic goals

Digital Twin Use Case

Digital Twin applies in many places in Infrastructure

- Design:- 3d CAD + BIM + GIS + SAP= Build rehearsal, Net Zero
- Delivery:-
 - Primavera + BIM + GIS = 4D BIM = Project Rehearsals,
 - 4D + Cost information (SAP)= 5D BIM
 - 5D BIM + Facilities and Operational information = 6D BIM
 - TAP :- Requirements Management and Verification/Validation
- Operations
 - Monitoring for net zero
 - Change management
 - NRT Modelling and simulation

COSTAIN



Technical Assurance use case

Technical assurance is the process of managing the evidence of that shows that what work has been carried out meets the requirements for each phase of development

- Design
- Construction
- Handback

Essential for compliance and governance

- Replacement for the box of paper test plans
- Uses referencing and linking

Progressive assurance plans what needs to be collected

- Plans the collection



Technical and progressive assurance

COSTAIN

Typical TAP Tooling:- DOORS Classic, Assetwise, eB

Requirements in infrastructure describe contracts for work

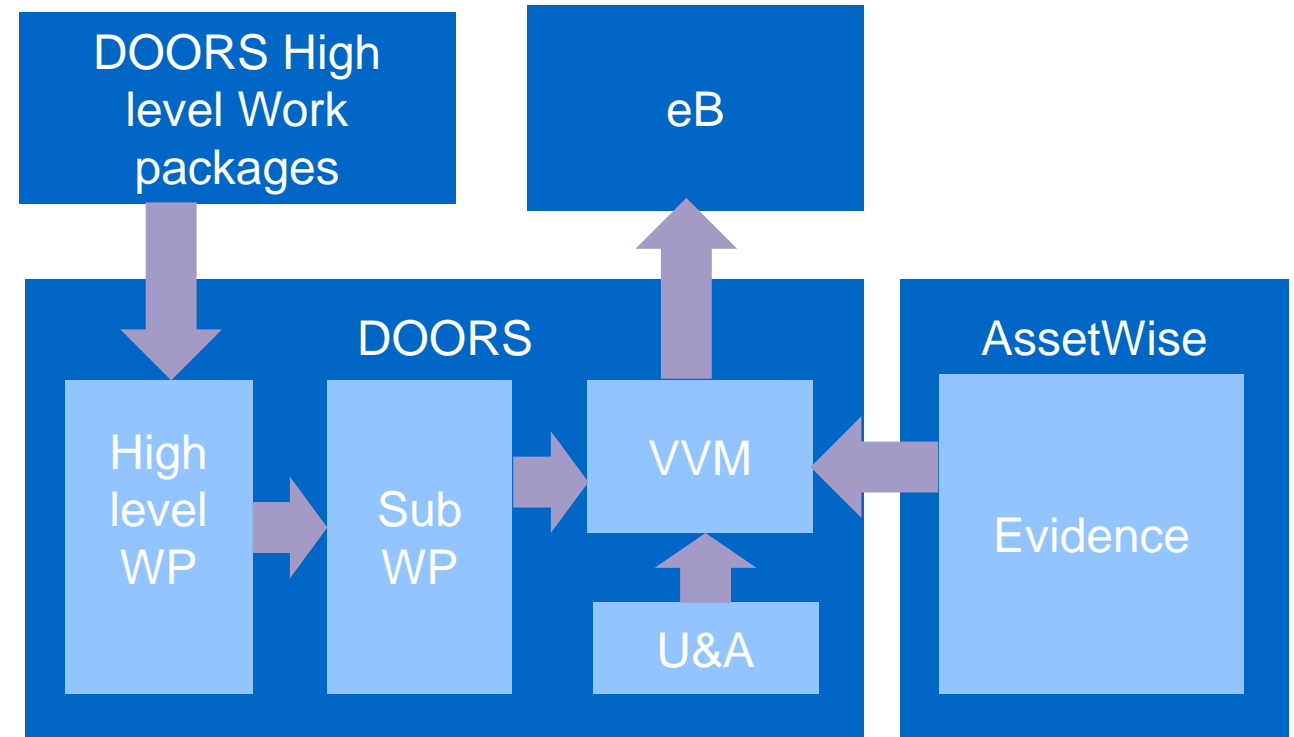
- Build bridge
- Create crossing for pipes
- Build section of road

Verification and Validation Matrix is used

- Initially to plan
- Link evidence to “requirements”
 - Linking to files in other tools (urls)
 - Risk, assumptions, U&A, materials certificate

Infrastructure has issues of timescales and size

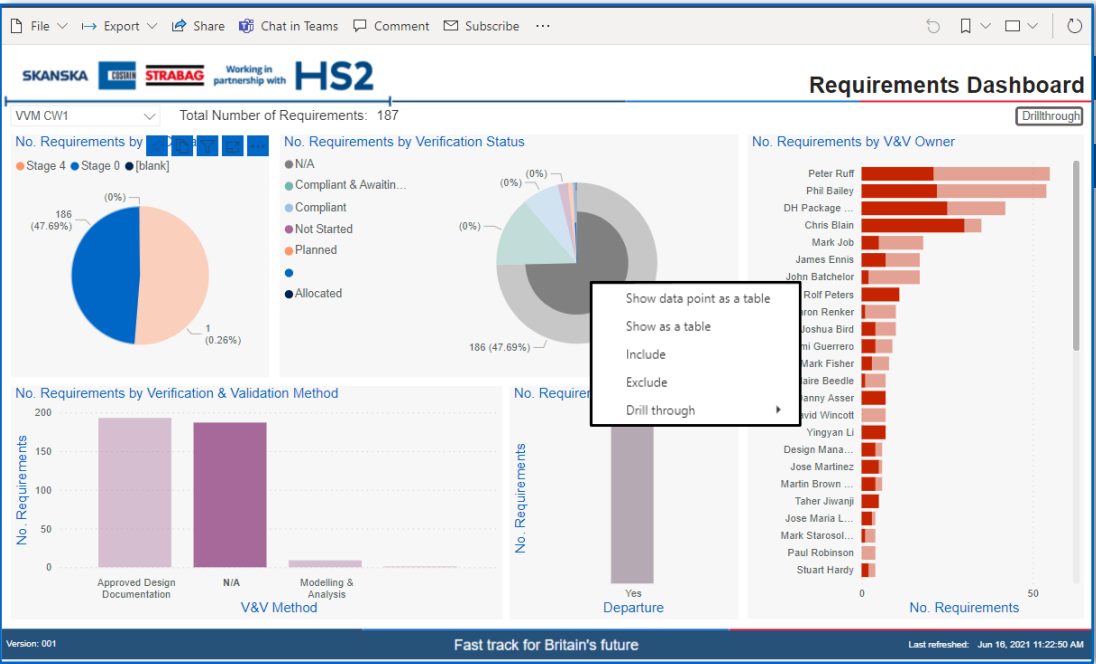
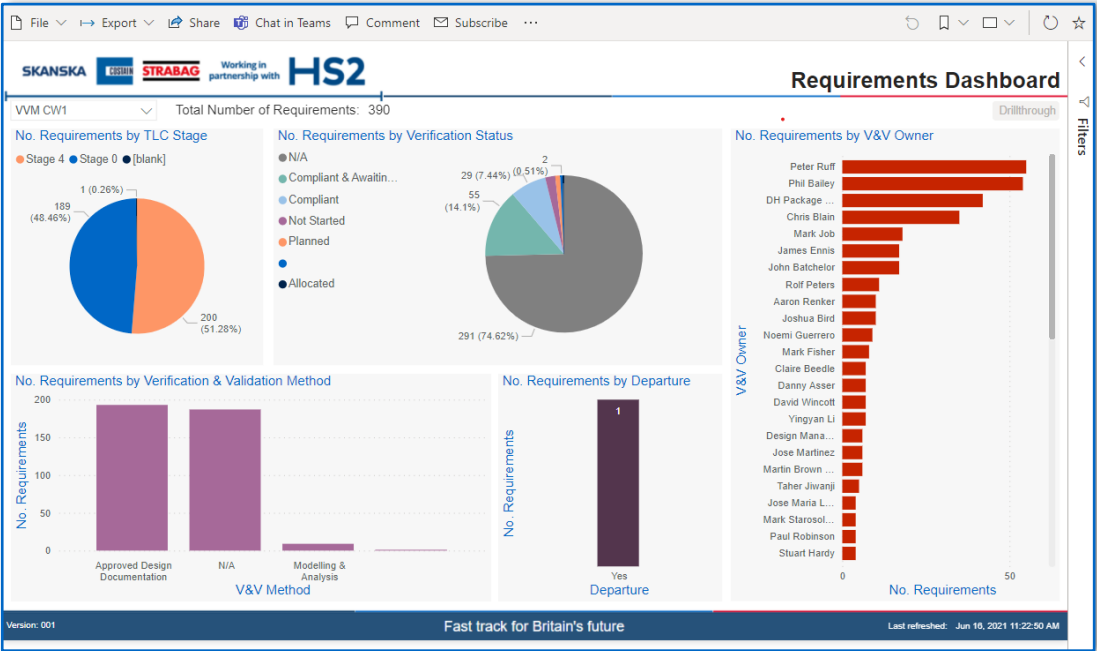
- Project C.10 years to design and build
- Operational lifespan C.100 years
- Volume is typically ONE
- Opportunities for reuse e.g bridges, crossings, pump houses, storage tanks
 - Product line engineering
 - Parametric modelling



VVM Reporting

Status Reporting

- Report on status supported by combination of export of data using DXL or DWA REST API to Power BI



SCS ID	CRT ID	Requirement	TLC Stage	V&V Owner	V&V Method	V&V Method Summary	V&V Justification	V&V
SCS-248	CRT-S2-1418	Viaducts, underbridges, overbridges, underpasses and culverts (where span > 0.9 m) shall be designed in accordance with the Technical Standard, Bridge Design Basis (HS2-HS2-BR-STD-000-000001).	Stage 0	Yingyan Li	N/A	N/A	Not Applicable to Victoria Road Ancillary Shaft, as this asset does not have any bridge structures.	
SCS-249	CRT-S2-1419	Viaducts, underbridges, overbridges, underpasses and culverts (where span > 0.9 m) shall be designed in accordance with the Technical Standard, Bridge Design Requirements (HS2-HS2-BR-STD-000-000004).	Stage 0	Yingyan Li	N/A	N/A	Not Applicable to Victoria Road Ancillary Shaft, as this asset does not have any bridge structures.	
SCS-251	CRT-S2-1423	Viaducts and Underbridges shall be designed in accordance with the Technical Standard, Viaducts and Underbridges (HS2-HS2-BR-STD-000-000002).	Stage 0	Yingyan Li	N/A	N/A	Not Applicable to Victoria Road Ancillary Shaft, as this CRT is only applicable to Viaducts & Underbridges.	
SCS-252	CRT-S2-1424	Overbridges shall be designed in accordance with the Technical Standard, Overbridges (HS2-HS2-BR-STD-000-000003).	Stage 0	Yingyan Li	N/A	N/A	Not Applicable to Victoria Road Crossover Box, as this CRT is only applicable to overbridges.	
SCS-254	CRT-S2-1426	HS2 viaducts shall include an emergency walkway.	Stage 0	Yingyan Li	N/A	N/A	There are no viaducts in the current design. Not applicable to assets in Lot S2.	
SCS-255	CRT-S2-1427	Emergency walkways on HS2 viaducts shall have a non-slip surface.	Stage 0	Yingyan Li	N/A	N/A	There are no viaducts in the current design. Not applicable to assets in Lot S2.	
SCS-256	CRT-S2-1428	Emergency walkways on HS2 viaducts shall be traversable by wheelchair.	Stage 0	Yingyan Li	N/A	N/A	There are no viaducts in the current design. Not applicable to assets in Lot S2.	
SCS-1864		Civil engineering works shall be designed and constructed in accordance with SCEWSERIES 4400 - Conveyors (HS2-HS2-CV-SPE-000-014400).	Stage 4	TBC	N/A	N/A		
SCS-13	CRT-S2-1051	High speed infrastructure systems and its processes that overlap onto infrastructure for which NR is the Infrastructure Manager shall apply relevant current standards at the design stage that are applicable to the NR	Stage 0	Taher Jiwani	N/A	N/A	Not Applicable to Victoria Road Ancillary Shaft, as this asset does not overlap onto NR infrastructure.	

Fast track for Britain's future

Last refreshed: Jun 10, 2021 11:22:50 AM

Linked Data from Power BI



DOORS - AssetWise Validation

Requirement ID: Search

Work package: All

Filters

Validation Table

Requirement ID	Number	Title	Work package	Revision	Approval Status	Date Effective	Review and Acceptance
SCS-1	1MC04-SCI-AU-PLN-SS04-000002		Civils Package 2	C03	Approved		Code 2 - Accepted with
SCS-100	1MC04-SCI-CR-PLN-SS02-000003		Civils Package 1	P04	Approved		Code 1 - Accepted
SCS-100	1MC04-SCI-EV-PLN-SS02-000003		Package 3	C03	Approved		Code 2 - Accepted with
SCS-101	1MC04-SCI-EV-PLN-SS02-000003		Package 3	P04	Approved		Code 2 - Accepted with
SCS-102	1MC04-SCI-EV-PLN-SS02-000003		Package 3	C01	Approved		Code 1 - Accepted
SCS-102	1MC04-SCI-EV-PLN-SS02-000003		Package 3	C03	Approved		Code 1 - Accepted
SCS-102	1MC04-SCI-EV-PLN-SS02-000003		Package 2	C02	Approved	08/10/2019	Code 1 - Accepted
SCS-103	1MC04-SCI-EV-RIA-SS04-000006		Civils Package 1	C01	Approved		Code 2 - Accepted with
SCS-104	1MC04-SCI-EV-RIA-SS04-000006		Civils Package 1	C02	Approved		Code 2 - Accepted with
SCS-104	1MC04-SCI-EV-RIA-SS04-000002		Civils Package 1	C01	Approved		Code 2 - Accepted with
SCS-108	1MC03-SCI-EV-REP-S001-000020		Civils Package 2	C08	Approved		Code 1 - Accepted
Total							

Count of Requirements: 384

Count of evidence in AssetWise: 128

Count of evidence not in AssetWise: (Blank)

Count of Evidence not provided: 306

Validation Table

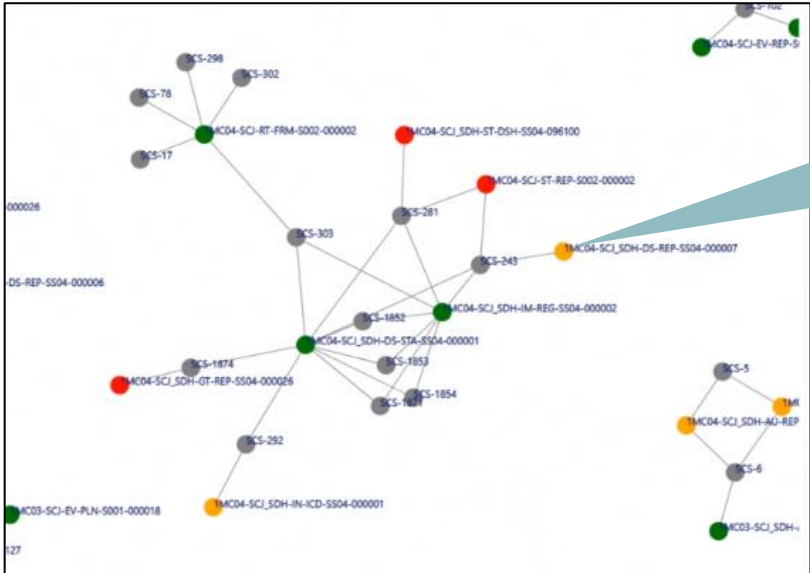
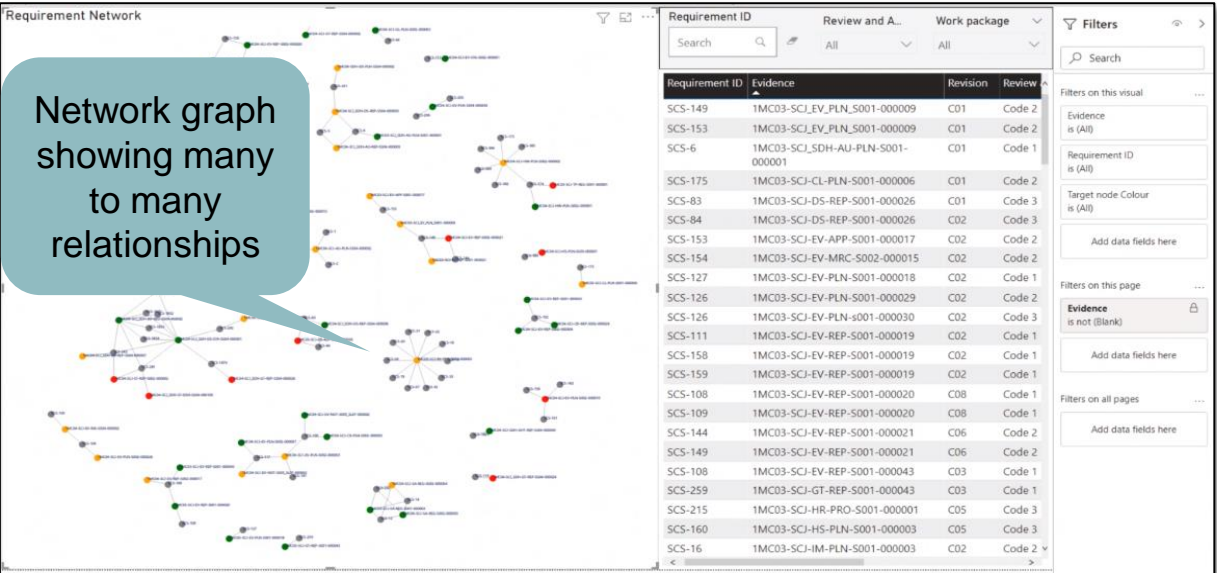
Acceptance Status	Document Status	Discipline	EMT Code	Is Latest Revision	URL
ted with Comments (Revise and Resubmit)					https://scs-aw.bentley.com/aimweb/Search/QuickLink.aspx?n=1MC04-SCI-AU-PLN-SS04-000002&t=3&d=Main%5CSCS_Prod&sc=Global&r=C03&i=view
ted					https://scs-aw.bentley.com/aimweb/Search/QuickLink.aspx?n=1MC04-SCI-CR-PLN-SS02-000003&t=3&d=Main%5CSCS_Prod&sc=Global&r=P04&i=view
ted					https://scs-aw.bentley.com/aimweb/Search/QuickLink.aspx?n=1MC04-SCI-EV-NOT-S005_S107-000002&t=3&d=Main%5CSCS_Prod&sc=Global&r=C03&i=view
ted with Comments (Revise and Resubmit)					https://scs-aw.bentley.com/aimweb/Search/QuickLink.aspx?n=1MC04-SCI-EV-PLN-SS02-000003&t=3&d=Main%5CSCS_Prod&sc=Global&r=P04&i=view
ted with Comments (Revise and Resubmit)					https://scs-aw.bentley.com/aimweb/Search/QuickLink.aspx?n=1MC04-SCI-EV-PLN-SS02-000003&t=3&d=Main%5CSCS_Prod&sc=Global&r=C03&i=view
ted					https://scs-aw.bentley.com/aimweb/Search/QuickLink.aspx?n=1MC04-SCI-EV-REP-S001-000004&t=3&d=Main%5CSCS_Prod&sc=Global&r=C03&i=view
ted					https://scs-aw.bentley.com/aimweb/Search/QuickLink.aspx?n=1MC04-SCI-EV-REP-S002-000004&t=3&d=Main%5CSCS_Prod&sc=Global&r=C03&i=view
ted					https://scs-aw.bentley.com/aimweb/Search/QuickLink.aspx?n=1MC04-SCI-EV-REP-S002-000026&t=3&d=Main%5CSCS_Prod&sc=Global&r=C02&i=view
ted					https://scs-aw.bentley.com/aimweb/Search/QuickLink.aspx?n=1MC04-SCI-EV-RIA-SS04-000002&t=3&d=Main%5CSCS_Prod&sc=Global&r=C01&i=view
ted					https://scs-aw.bentley.com/aimweb/Search/QuickLink.aspx?n=1MC04-SCI-EV-PLN-SS02-000026&t=3&d=Main%5CSCS_Prod&sc=Global&r=C02&i=view
ted					https://scs-aw.bentley.com/aimweb/Search/QuickLink.aspx?n=1MC04-SCI-EV-RIA-SS04-000002&t=3&d=Main%5CSCS_Prod&sc=Global&r=C01&i=view
ted					https://scs-aw.bentley.com/aimweb/Search/QuickLink.aspx?n=1MC03-SCI-EV-REP-S001-000020&t=3&d=Main%5CSCS_Prod&sc=Global&r=C08&i=view

Count of Requirements: 384

Count of evidence in AssetWise: 128

Count of evidence not in AssetWise: (Blank)

Count of Evidence not provided: 306



Benefits of OSLC in Infrastructure



Save money



Improving consistency



Change impact analysis



Shining light on problems



Easy to find information



Removing frustration

COSTAIN



Summary



- **Lack of standardised tool integrations**
 - Common approach is to export as CSV and use Power BI Analytics

Or

- Export via ETL tools like FME and Power BI
- **OSLC is unknown**
 - Most of the tools have some form of REST API
- Infrastructure uses many of the same concepts as used in OSLC domains but not named as such.
 - Requirements Management and Test = Technical or Quality assurance
 - Change management and Impact analysis is hard to do as traceability is by reference
 - Increasingly problematic as more software needs to be delivered to support Operational Digital Twin
 - Configuration management is primitive
 - Increasingly problematic as agile approaches are being asked for

Lots of opportunity for OSLC providers

Thank you



[LinkedIn.com/company/costain](https://www.linkedin.com/company/costain)



[Twitter.com/costaingroup](https://twitter.com/costaingroup)



[Costain.com](https://www.costain.com)