CDBB
Capability Framework and Research Landscape Scoping Workshop

Workshop: Capability to acquire, create and manage the DATA in forms that allow secure interoperability and integration

Centre for Digital Built Britain

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UNIVERSITY OF CAMBRIDGE

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Centre for Digital Built Britain

This document captures the working notes from the workshop "Workshop: Capability to acquire, create and manage the DATA in forms that allow secure interoperability and integration", held at Churchill College Cambridge on 10-11 April 2018

The summary sheets are assembled from the separate working groups from each of two streams; Research and Applications.

The details of the outputs from the individual working groups are captured in turn.

This material was used as a starting point for the creation and development of the Capability Framework and the Research Landscape. It is provided as source material for the interested reader.

Acquire, create and manage DATA - Research Summary		
Rank order	Topic title	
1	Data integration system	- How to build federated DB/integrate - Meta data frameworks around quality - Integration of real time w/static - Breaking down boundaries around data - Applicability
2	How to manage Risk and Accountability over lifetime	
3	Data DNA (7) +	- Provenance - mixing of data - Accuracy (true reflection)
4	Understanding data requirements	- Applicability to other contexts - AIR -> PIR (public info requirement)
5	Develop ontologies for DBB	- Static and real-time, quant and qual - Standards and protocols
6	How to manage/incorporate new forms of data w/existing structures	
7	Handing legacy data	- Capturing as-is, tacit info

Research Topic: …	
Acquire, create and manage the Data	

Scope:

Scope - In		Scope out	What sub-topics might overlap with other topics?
- Cyber security for provenance - Big data management - Sensor optimisation location - Metadata frameworks -->Bias - Federated Data Architecture - Data fusion - Integrating real time with geometry + topology of the data flows --> temporal dynamics - Targeted sensing: When, where and how often?	- Performance metrics of data quality --> provenance - Ontology for DBB: Quantitative, Qualitative and Subjective - Flexible platform for data management for different sourced types of data - Physical extents of built environment - Second order effects - Comparative capability relationships - Understand cycle + verify source data sets - Data and organisation change		- Non-linear systems feedback - Analytics /information modelling + Governance + Complex systems - NB archaeological data or data of past environments as a special case

Step 2. Scope change by thinking about stakeholders

Step 3. Scope change by thinking about spatial differences

e.g. National/Regional	e.g. City/local	e.g. Asset specific
- Infrastructure	Planning Communication visualization trust Mapping between scales: Room --> building --> Neighbourhood -->City -->Region -->National	- Access to knowledge of state of place to aid decision to act - (Archology) Pre-construction information for new design - Trade-off between data detail / complexity and its purpose of use

Step 4. Scope change by thinking about the lifecycle of assets and services

Articulate user needs and requirements	Conceive, plan and design (including optimisation and integration)	Build and commission (including optimisation and integration)	Manage and Operate (refine and enhance, optimise and integrate)	Provide valued services to users (and minimise downsides for non-users)	Retrofit / Renew / Decommission (with attention to the whole cycle)	…Assess, feedback and optimisation
			- Protocols - Process	- Feedback verification		

Research Topic: ...		
Acquire, create and manage the Data		

Scope:

Scope - In								Scope out	What sub-topics might overlap with other topics?
- Data schemas/Ontology e.g. Uniclass for linear assets? - Deliver vs. operate vs. integrate - Data organisation and interoperable potential	- Secure distributed data stores - Block chain - Sharing data between agencies: > Data protections legislation and permissions > Reluctant sharers - ownership	- Cost of capture, manage, usage and preservation of data - ££ for data collection + updating data / data will become dated	- Excessive data (Oscar Wilde) - Accumulated but unused - Understanding data requirements - less creativeness - Selecting from huge quantities of data - what is useful / required? - Value--> information-->Sensor data - Ethics of storing data for so long?	- Data obsolescence over life-cycle (identification and management) - Currency (i.e. up-to-datedness) of data - What is the life cycle of BE in question? How long do you collect data for? - Contextualization time sensitive - Digital data preservation of longer life-cycle	- Data uncertainties (identification, quantification, visualization management) - Trust - Multiple sources of "truth" - Hierarchies of data - what is considered more important than other data	- Ensuring we consider quantitative data and the - more detailed (often more time consuming + costly to collect) qualitative data - Data validation and verification	- Handling legacy data - (H) BIM > Sensed - to - BIM > As-Is modelling > Sensing the invisible	- Crowd sourcing in tagging (ranking) data (usability, quantity)		

Step 2. Scope change by thinking about stakeholders

Step 3. Scope change by thinking about spatial differences

e.g. National/Regional	e.g. City/local	e.g. Asset specific
	Translation between scales	Indoor localization Understand the ECOSYSTEM e.g. between Assets and systems (integration) Linear + Non-Linear Assets

Step 4. Scope change by thinking about the lifecycle of assets and services

Articulate user needs and requirements	Conceive, plan and design (including optimisation and integration)	Build and commission (including optimisation and integration)	Manage and Operate (refine and enhance, optimise and integrate)	Provide valued services to users (and minimise downsides for non-users)	Retrofit / Renew / Decommission (with attention to the whole cycle)	...Assess, feedback and optimisation

Research Topic: …	
Acquire, create and manage the Data	

Scope:

Scope - In		Scope out	What sub-topics might overlap with other topics?
- How to use data, not just store/manage? - How to support data interoperability by distributing computation not data - Hierarchical data acquisition and modelling - Focus on data use	- Decentralized data sets - Capture data once and use it many times over - Access to data: Who and how much, controlling and access - Privacy - Future proofing of data required as knowledge develops - How to provide for accountability e.g. Provenance, instrumentation etc..?	Block chain "myth"	- Contractual liability and contracts - Permission and access level - Information provenance (authenticity and quality) - Ownership of information IP and copyright

Step 2. Scope change by thinking about stakeholders

- How to handle the many stakeholders over 10-50 year lifespan of Assets --> Complexity
- How to construct contracts to resolve tension in use f digital Asset analogous to CAPEX vs. OPEX vs. TOTEX considerations
- Stakeholders change along the project life-cycle
- Data lifespan: Building lifecycle vs. Information lifecycle
- Different stakeholder priorities
- Legacy of the data

Step 3. Scope change by thinking about spatial differences

e.g. National/Regional	e.g. City/local	e.g. Asset specific
	Cost of getting each dataset vs. Cost of handling data at volume	Consider dataset as an 'asset'

Step 4. Scope change by thinking about the lifecycle of assets and services

Articulate user needs and requirements	Conceive, plan and design (including optimisation and integration)	Build and commission (including optimisation and integration)	Manage and Operate (refine and enhance, optimise and integrate)	Provide valued services to users (and minimise downsides for non-users)	Retrofit / Renew / Decommission (with attention to the whole cycle)	…Assess, feedback and optimisation
	Developers and operators together: stakeholders forum		Informed end user to an informed client	Speculative developments and guesswork in end user requirements		
		"DEVOPS" for DBB? (Procurement vs. Operation)				

Research Topic: ...	
Acquire, create and manage the Data	

Scope:

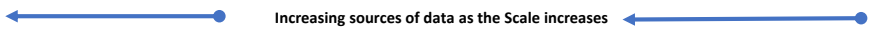
Scope - In	Scope out	What sub-topics might overlap with other topics?
- Minimal + appropriate data collection to refine/add confidence in model of building - International data schema - Effective data collection and storage methods: CQR code, RFiD - Data from building users e.g. wearables. Different implications to 'building generated' data - How people use physical / digital space - IP and data ownership: > who owns the data? > why is this a limitation? - Identify new data sources for digital technologies (twins) - New standards for data exchange - Automation and accountability - Move from file-based systems to data-repositories - Sematic data and ontologies (relationship between entities networking)	Crowdsourced data	Context dependency:- `Implications for data storage in hospitals and transport hub

Step 2. Scope change by thinking about stakeholders

- Policy makers incentivize stakeholders to share data
- Business model to support 'activities'
- Risk management in open data responsibility / data role

Step 3. Scope change by thinking about spatial differences

e.g. National/Regional	e.g. City/local	e.g. Asset specific
- Loss of data provenance along processing chain - Increased likelihood of 'poor' data quality / completeness at scale --> inconsistent - Amount of data to be recorded«- Policy handbook - Data security - Standards	- Integration of different data sources	- Cost benefit of raw data storage management? --> Data 'flood' of storing sensor data even at a local level - Multiple users of same data points --> Sharing : Purpose / Benefits



Step 4. Scope change by thinking about the lifecycle of assets and services

Articulate user needs and requirements	Conceive, plan and design (including optimisation and integration)	Build and commission (including optimisation and integration)	Manage and Operate (refine and enhance, optimise and integrate)	Provide valued services to users (and minimise downsides for non-users)	Retrofit / Renew / Decommission (with attention to the whole cycle)	...Assess, feedback and optimisation
			Identify what data is required for predictive maintenance			

Identify what data is needed at every stage

Research Topic	
Acquire, create and manage the Data	

Step 1. What are the major research clusters/themes?	What are capabilities and research that will be needed as DBB matures from 'deliver' to 'operate' to 'integrate'?					
	Deliver *(create the built asset)*		***Operate*** *(manage asset through life and deliver the services that derive from and depend on the asset)*		***Integrate*** *(deliver services and benefits based on integrated systems and organisations)*	
	What capabilities and enabling research?	***Which people / institutions are working on this?***	***What extra capabilities and enabling research?***	***Which people / institutions are working on this?***	***What extra capabilities and enabling research?***	***Which people / institutions are working on this?***
- Ontology of DBB + Operationalise		ANAN (UCL) ETH Zurich OS IDBE			National working group CDBB + IDBE (Standards and Protocols)	
How to develop platforms for data integration						
Data Fusion **How to extract information knowledge for big data**		ITRC / Mistral ↓ DAFNI UKCRIC Observatories			- Federation DB - Real time integration with static Geometry / Topology - Metadata frameworks: provenance, linage, uncertainty, quality,	DAFNI
Security						
Intra scale / inter scale capability (spatial and temporal) **Organisation 'buy in'**		Data evidenced infrastructure Bryden Wood				CHSA IDBE Newcastle SAM

Research Topic	
Acquire, create and manage the Data	

Step 1. What are the major research clusters/themes?	**What are capabilities and research that will be needed as DBB matures from 'deliver' to 'operate' to 'integrate'?**					
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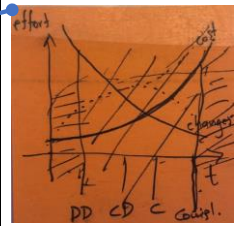
Developing / designing appropriate Schemas	Linear assets (Cross rail, HS2 etc..)	NBS Building Smart	Linear assets (Cross rail, HS2 etc..) →	COBie people		
Understanding data requirements + cost of ownership	Develop meaningful E.I.R.s (employment Information requirements)		Developing A.I.R.s (Asset Information Requirements)		Develop "Public information Requirements"	
Data certainty and obsolescence	- What are the factors (uncertainties) - Can we visualise them? →					
Handling legacy data	As-Is modelling --> invisible elements / aspects		Tacit Information --> Making explicit			
Governance, Security and Access	Unman factors (security)	- Lots of Block Chain for contracting - "secured communications" + other encrypted platforms	Block Chain		Data sharing: > Voluntary/ involuntary > Reluctant sharers > Ethics	

Research Topic	Delegate names
2A Acquire, create and manage the Data	**[Not stated]**

Step 1. What are the major research clusters/themes?	What are capabilities and research that will be needed as DBB matures from 'deliver' to 'operate' to 'integrate'?					
	Deliver *(create the built asset)*		***Operate*** *(manage asset through life and deliver the services that derive from and depend on the asset)*		***Integrate*** *(deliver services and benefits based on integrated systems and organisations)*	
	What capabilities and enabling research?	***Which people / institutions are working on this?***	***What extra capabilities and enabling research?***	***Which people / institutions are working on this?***	***What extra capabilities and enabling research?***	***Which people / institutions are working on this?***
- Measures of data quality + use of such in contract + liability **- Capture + provision of Metadata** **- Data accuracy: is this a true reflection of what's happening/ happened?**					Digital virtual observatory: LIGO	
Liability, Contract, Legislation needs + implementation						
- Provenance in / use of data / mixing of data **- Search engine for data / information**	Capturing user data e.g. Highways - people not just traffic		Developing data detail: > levels of information > levels of structure			
How to marry the structured, rigid, well defined construction world with fuzzy, uncontracted ICT/CS world?					- Open architectures for integrity sensor data to BIM models - Linking / assessing structured e.g. BIM data and e.g. sensor data	

Research Topic						
2A Acquire, create and manage the Data			Challenge to differentiate given the complexity of the future system			
Step 1. What are the major research clusters/themes?	**What are capabilities and research that will be needed as DBB matures from 'deliver' to 'operate' to 'integrate'?**					
	Deliver *(create the built asset)*		***Operate*** *(manage asset through life and deliver the services that derive from and depend on the asset)*		***Integrate*** *(deliver services and benefits based on integrated systems and organisations)*	
	What capabilities and enabling research?	***Which people / institutions are working on this?***	***What extra capabilities and enabling research?***	***Which people / institutions are working on this?***	***What extra capabilities and enabling research?***	***Which people / institutions are working on this?***
- Risk management - IP and data ownership - Accountability (liability, ownership, regulation) - How to manage risk and accountability across the lifecycle of data and assets	- Smart contracts and legal Frameworks - Awareness and ethical training - Block chain - Skills and knowledge		ATI			
- Digital / Physical data sources - How to manage and incorporate new forms of data aligned with existing assets? - Automation / Digital Twin: how to manage new data? (including digital assets)	- Best practice of data management - Integration of different new assets and aligned with new assets		BSI Building Smart - BRE Big Data - Cambridge Service Alliance			
How to manage Quality + Quantity	- New methodologies and tools - Digital infrastructure standard		BDAL - UWE			
- Business models to support data activities - What are the capabilities to build new data driven business models from new data sources?	- Identify the ECOSYSTEM players to create data driven business models - Institution knowledge - Make the case of data as an asset		Cambridge Service Alliance		Horizon Digital Economy	Nottingham University

Acquire, create and manage DATA - Application/Demonstrators Summary		
Rank order	Topic title	
1	Data retrofit	Finding out what we need to know about existing assets - meaningfully/good enough…
2	Asset stock performance classification	- Peer comparison - Dynamic - e.g. can I charge my Tesla or will it be powering the office?
3	Identification and management of assets across different portfolios of ownership and responsibility	- ID - Classification - Discovery - Breaking silos
4	Citizen as a Sensor (e.g.. for asset condition)	Technical aspects: Data creation and acquisition Governance: Privacy, "he who shouts loudest" etc
5	Managing Borders post Brexit: oil, gas, power, people, goods, shipping, smuggling	- National integrated model of Access points and flows
6	"Campus" or "District" level data store with Graphical Prog Language - Citizen generated Apps	

Application Topic: …	
Acquire, create and manage the Data	

Step 1. Scope: What topics should we include in this part of the framework – and what demonstrators would illustrate / stretch the boundaries?

Scope - In		Scope out	What sub-topics might overlap with other topics?
- Data quality assessment	- Sharability and security	- Commercial models for information exploitation - Unintended uses of data…? e.g. ->security implications of 'merging' data sets to gain access to gain new insights -> does this place any onus on the supplier?	
- Data models (for legislation) across broad scope	- Data requirements --> how do you take a Broadview		
- Data collection - structured	- Measure value of the data to the end users --> cost allocation to fund capture?		
- Sensitive information	- Ontologies		
- Ensuring data quality in challenging environments	- Intentional as well as sensor data		
- Interoperability	- Funding model for data acquisition		
- Master reference data	- Data 'authority' ---> an accepted 'truth'		
- Automatic data collection (using drones)	- Data granularity --> measure the individual		
- Integrated data stream	- M2M applications --> data for a 'new audience'		
- Data quality --> frequency, management	- Temporal agent --> now/real-time		

Step 2. Scope change by thinking about stakeholders (Are there new / different aspects of the topic and its demonstrators?)

Government funders / user/ arbiter / legislator	- Financiers
Citizen (user)	- Data acquirers
- Asset owners	- Insurers
- Asset operators	- Regulators

Step 3. Scope change by thinking about spatial differences (e.g. to consider how can scale make a difference to the demonstrators we would propose)

e.g. National/Regional	e.g. City/local	e.g. Asset specific
- Ladder of control across geographic scale - Data accessibility - Level of granularity of data		

Step 4. Scope change by thinking about the lifecycle of assets and services: Are there new / different aspects of the topic and its demonstrators if we think through the lifecycle of the assets and the services?

Articulate user needs and requirements	Conceive, plan and design (including optimisation and integration)	Build and commission (including optimisation and integration)	Manage and Operate (refine and enhance, optimise and integrate)	Provide valued services to users (and minimise downsides for non-users)	Retrofit / Renew / Decommission (with attention to the whole cycle)	…Assess, feedback and optimisation
				Service feedback from the users --> feedback to the design		

Application Topic: …	
Acquire, create and manage the Data	

Step 1. Scope: What topics should we include in this part of the framework – and what demonstrators would illustrate / stretch the boundaries?

Scope - In		Scope out	What sub-topics might overlap with other topics?
- Units of measure should be part of data definitions - Standards NOT PAS's - Crowdsource of data: low quality, very accessible, cheap - What is data quality? - Granularity of information - Acquisition of data vs. data transactions - Common language for constructed assets	- Specific view points for each user type - same data - Proxies for data in existing buildings - Define asset / services / performance - Static data vs. Dynamic data -->How do we trust it? - Differentiate: data / info / knowledge / vision - Look at data standards from parallel industries - Common language of data exchange IFC	Is very old data out of scope? and if so how old?	Social media data and temporal info

Step 2. Scope change by thinking about stakeholders (Are there new / different aspects of the topic and its demonstrators?)

- Different people - different needs
- Different data uses have different quality criteria
- Release data on user-based granularity
- How do different data base types communicate e.g. CityXML and IFC

Step 3. Scope change by thinking about spatial differences (e.g. to consider how can scale make a difference to the demonstrators we would propose)

e.g. National/Regional	e.g. City/local	e.g. Asset specific	
-Better regulation and policy for decade long instructions - Benefits --> TOTEX	- Better operational decisions - Optimisation	- Cost - Data gives performance - Asset = where cost comes to get data city/regional where benefit is realised	<u>e.g. NON - ASSET related (data)</u> unit-less measure that includes: > Latent heat > Gravity

Step 4. Scope change by thinking about the lifecycle of assets and services: Are there new / different aspects of the topic and its demonstrators if we think through the lifecycle of the assets and the services?

Articulate user needs and requirements	Conceive, plan and design (including optimisation and integration)	Build and commission (including optimisation and integration)	Manage and Operate (refine and enhance, optimise and integrate)	Provide valued services to users (and minimise downsides for non-users)	Retrofit / Renew / Decommission (with attention to the whole cycle)	…Assess, feedback and optimisation
- Structured digital brief - Operational performance data requirements	Structure the involvement of O&M teams to influence the design early on i.e. GSL policy	Model & asset verification of Built (data)	How much cost to keep data updated?	Provide views / extracts for user needs & level of detail	- Design life: > fault history > costs history > performance analysis - Deterioration modelling	

Application Topic	
Acquire, create and manage the Data	

Step 1. What are major demonstrators that are required?	**What capabilities / functionalities of the demonstrators illustrate the maturing of DBB from 'deliver' to 'operate' to 'integrate'?**					
	Deliver *(create the built asset)*		***Operate*** *(manage asset through life and deliver the services that derive from and depend on the asset)*		***Integrate*** *(deliver services and benefits based on integrated systems and organisations)*	
	What would be the big challenges?	***How?***	***What would be the big challenges?***	***How?***	***What would be the big challenges?***	***How?***
Citizen as a monitor / sensor e.g. pot hole identification	How to engage the citizen with the process e.g. openstreetmap		Privacy issues: > data sharing > data granularity > secondary data use (e.g. speeding!)		Different 'app' developers Different down-stream users--> consistent user requirement	
HMG as an asset owner/operator in different portfolio's management regimes impact each other, but in an unknown manner	Data integration	- Integration data model - Data integration and sharing environment - Common master + reference data - Data mapping into integration model / REF data	Optimise running of asset classes against widest set of objectives	Feedback gaps between asset management teams --> upwards and downwards		Feedback loop to 'design'
Managing post Brexit	- Construct National Infrastructure Model e.g. Oil, Gas, Power, People, Energy, Onshore, Offshore, Shipping, Smuggling - Model that integrates domains: > on / off shore > above / below ground > indoor / outdoor		Data compilation process: > sensed / captured > aggregated / informed		Level of granularity need to be defined for users	
Rejuvenate the high street - using real-time data to model + understand how space is used						

Application Topic	
Acquire, create and manage the Data	

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	What would be the big challenges?	***How?***	***What would be the big challenges?***	***How?***	***What would be the big challenges?***	***How?***
Data retrofit (migration / mapping)	- Granularity required for meaningful output - Access to asset to gain data	- Classify & grading of sensor detail required - is it worth it? - Advanced auto survey techniques	Quality of data / cost to retrofit	Standardised high level outputs as open re-useable info	How to encourage take-up? (What's in it for me?)	Open 'App" culture - sell access to API on data
Operational Asset stock performance classification	Asset classifications across organisations	Data standards	Performance capability vs. Actual performance (behaviours driven?)			
Open sources data on campus project with API to write apps	Value & cost of data? Security of data sharing IP	Proxies for non-available data		Feedback loop for continuous improvement		