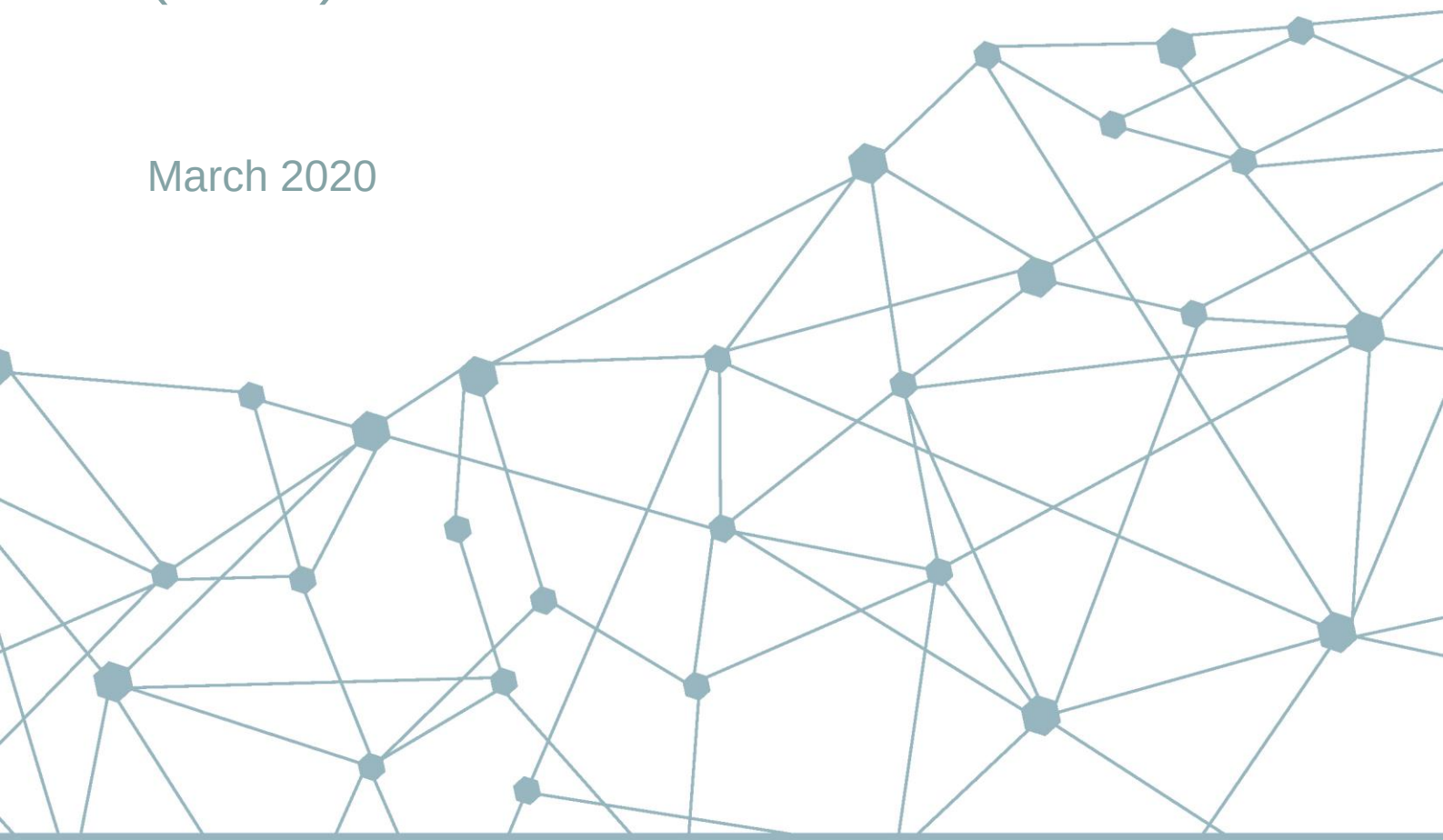
CONSTRUCTION INNOVATION HUB

INDUSTRIAL STRATEGY | UK Research and Innovation

BIM Interoperability Expert Group (BIEG)

March 2020



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1. Executive summary

Interoperability is pivotal to delivering the 'whole life' beneficial outcomes of Building Information Modelling (BIM) to all parties, by providing a means of information transfer between different proprietary technologies; beneficial outcomes not just for clients who own, operate and maintain assets, but the whole construction industry. It is therefore necessary to consider the difficulties reported by those trying to deliver the benefits of BIM due to problems encountered when trying to achieve interoperable information exchange as part of the information management and modelling process (please see the definition of interoperability in section 2 c).

In response to these reported problems and to inform future policy development, the Centre for Digital Built Britain (CDBB), part of the Construction Innovation Hub (CIH), with oversight from both The Department for Business, Energy and Industrial Strategy (BEIS), Infrastructure Projects Authority (IPA) and support from the UK BIM Alliance, has undertaken a comprehensive evidence gathering exercise to:

- facilitate 'real-world' understanding of the interoperability issues encountered by information management experts when implementing the UK BIM Framework; and
- understand what alternative interoperable processes/standards are available and their possible advantages and disadvantages.

CDBB has been requested to produce recommendations that enable UK Government to develop existing BIM policy (often referred to as the 'BIM Mandate'). The principal aims of this approach are:

- to greatly increase the benefits gained from improved interoperability, across all parties including Government and supplier organisations;
- to ensure that the momentum UK BIM adoption has achieved to date is maintained, so that UK productivity and global leadership ambitions can continue to be pursued.

This report provides a summary of the evidence received by the BIM Interoperability Expert Group's committee (BIEG) and their resultant recommendations.

Evidence for this report was gathered from 21 organisations, drawn from the broad stakeholder categories of practitioners (both client and supply sides), technology providers and supporting organisations, such as institutions, academia, standardisation bodies and BIM consultants. The topics mentioned most often and most strongly in the evidence gathered were:

- the importance of standardisation to open interoperability;
- the importance of Government department leadership through their projects and asset management;
- the importance of education and upskilling of all those involved (but particularly practitioners of all kinds); and
- the development of the Industry Foundation Classes schema to support all asset types, including the specific Model View Definition COBie.

In response to the evidence received, especially the clear need for ongoing Government leadership, the top level recommendations of the BIEG are that:

- the existing BIM Mandate is further developed in order to deliver open interoperable data;
- the BIM Mandate is supported by the formation of a new steering group; and

- the steering group instigates, engages, leads, manages, coordinates, promotes and communicates the recommendations / enablers, which were identified as part of the evidence gathering and which are detailed in sections 5 and 6 of this report.

The recommendations will help to support additional beneficial outcomes of interoperability, some of which are listed in section 3 of this report.

Although the work recommended by the BIEG responds directly to the current BIM interoperability requirements of UK clients and the wider construction industry and the benefits it delivers, including efficient maintenance, statutory record keeping, improved health and safety, amongst many other short to medium term improvements, it is envisaged that it will in turn inform CDBB's longer term National Digital Twin Programme. This was set up to deliver key recommendations of the National Infrastructure Commission 2017 'Data for the Public Good Report' and has the following objectives:

- to steer the successful development and adoption of the Information Management Framework for the built environment; and
- to create an ecosystem of connected digital twins, a national digital twin, which opens the opportunity to release value for society, the economy, business and the environment.

It will be important therefore to ensure that the work done to respond to current interoperability challenges, dovetails into and can be built upon by the work of the National Digital Twin Programme.

2. Introduction

a) Background

Building Information Modelling (BIM) is not a technology but a process which provides the ability to author, exchange, assure and subsequently use and re-use trusted information (data) to the benefit of all those involved in an asset's lifecycle, from inception, through capital phase procurement, post-occupancy asset management, maintenance, refurbishment, and ultimately through to the asset's disposal or re-use. In the UK BIM is defined by the UK BIM Framework, which is based on the emerging ISO 19650 series of standards, and the remaining BS/PAS 1192 suite of documents.

In order to achieve the benefits of BIM implementation and to support the 'Golden Thread of …*Asset* Information', as called for in 'Building a Safer Future' (Hackitt, 2018), the independent review of the Building Regulations and Fire Safety Final Report, an open and interoperable standard for information and data classification and exchange is needed. Interoperability provides the ability to exchange information between proprietary technologies, so that it can subsequently be made use of in which ever system it is located. Without interoperability IT systems have a limited ability to maintain and manage information across the whole asset lifecycle.

Interoperability supports the provision of a 'Golden Thread of Asset Information'

The UK has, for some years, been in the vanguard of developing BIM standards, protocols and guidance. Through its centrally led programme and focused '2016 BIM Mandate', which was first announced in 2011, significant BIM adoption has been encouraged within the construction industry, to what formerly was called BIM Level 2, and now replaced by the 'UK BIM Framework'. However, it has become apparent that significant further development work is required. The reason for this is that as BIM maturity grows, along with increased awareness of the need for assured information and the sophistication of data uses within the client-base, there is a need to consider solutions that are more fit for purpose than could reasonably have been anticipated when the Government BIM Mandate was first introduced. Also, as the market for information expands, with more companies involved in developing and using structured information, increased interoperability will be beneficial because it will help the market develop and diversify and, in turn, facilitate the economic benefits through network effects i.e. the value of information and networks increases as more information is linked and more participants become involved.

Not only is there a need to find better solutions for appropriate, timely information transfer between systems e.g. from delivery phase information models to asset management systems, but also to support changes to the way that information is being generated, processed and stored.

While BIM maturity differs across the industry, it has become increasingly necessary to look at the evolution from a reliance on information generated through files, to information associated with BIM objects. All this needs to be considered so that we do not hinder UK productivity ambitions and erode UK leadership standing and the export growth which the outreach programme hopes to achieve.

To date the ability to share data between technologies and systems has proved hard to accomplish and therefore needs to be addressed. It can be also strongly argued that

* Please note in the context of this report, information refers to both documents and data.

UK Government should have a clear vision of how openness and interoperability can be practicably achieved, in order to facilitate a market for technology solutions that are relevant to the built environment, competitive, innovative and able to contribute to the delivery of key policy objectives around economic growth, building safety and net zero carbon, all of which will require much higher levels of digitalisation.

The overall aim is that the benefits of BIM adoption are not lost and are instead enhanced, so that the goal of a digital built Britain can be achieved as efficiently and effectively as possible.

b) Evidence Gathering, the BIEG Committee and Methodology

Four 'select committee' style evidence gathering days were held during December 2019 and January 2020, with between four and five evidence providers individually presenting to the BIEG committee each day. Two separate pieces of written evidence were also submitted, resulting in information being received from 21 organisations in total.

Evidence to the BIEG came from industry practitioners, technology providers and support organisations.

The BIEG committee was made up of eight members, listed below, all of whom have sufficient BIM knowledge to understand the evidence and who were able, in large part, to adopt an impartial view. Where potential conflicts of interest might lie, these were clearly stated, and could be challenged by the other committee members if required.

BIEG committee membership:

- Alexandra Luck – Security Advisor
- Anne Kemp – UK BIM Alliance / ISO Convener
- Barry Blackwell – BEIS
- Fergus Harradence – BEIS
- Fiona Moore – CDBB UK BIM
- Mark Enzer – CDBB National Digital Twin
- Mathew Brett (TFL) – Public Sector ISO Transition Group
- Terry Stocks – CDBB UK BIM

Each evidence provider was given a maximum of 25 minutes to present followed by 25 minutes questioning by BIEG committee members. They were asked to respond to the high level statement and questions given below:

The ability to deliver interoperable data is key to the success of UK BIM implementation and is especially important to Government procurers and asset owners; it is for this reason you are invited to answer the following questions:

1. How are you [or the industry as a whole] currently achieving [or providing the means for] information/data openness and interoperability?

2. What problems do you encounter [or does the industry encounter] when currently delivering [or providing the means to deliver] interoperable data?

3. What do you think could be used to deliver interoperable BIM data in future? Please consider a timeframe of up to 5 years only.

4. What needs to change/happen to achieve interoperability going forward?

A summary of the evidence received is included in Appendix B of this report.

The BIEG committee then met twice to review and examine the evidence received to formulate its recommendations and then a final time to reach a consensus on the recommendations contained within this report.

c) Definitions of Interoperability and Openness

The interoperability and openness of information are the two concepts that have been at the centre of the BIEG's work. It is therefore helpful for these terms to be explained in the context of this report.

The BIEG has adopted the following definition of interoperability:

> 'the ability of two or more systems* to exchange information and to use the information that has been exchanged.'

This definition is adapted from the one contained in 'ISO/TS 27790:2009, Health informatics— Document registry framework'. There are many other definitions of interoperability and some of those that were considered by the BIEG are contained in Appendix A.

Openness, in relation to data and information, means that it is provided or made available in a format that can be accessed and used without recourse to the software that generated it. Openness is the opposite of proprietary, where information and data are in the generating software's native format and may or may not be able to be opened by other software.

Evidence supporting the importance of openness, in relation to information, came from a few evidence providers who highlighted the need to sustain information over the lifetime of an asset, which might be many decades. Reliance on proprietary information for exchange in these circumstances is seen as a significant risk (for example, due to vendor lock-in, or from, vendor insolvency).

There is a distinction between interoperability and specifying or producing open information. Openness can support interoperability, but is not a requirement for it. It is possible to achieve interoperability through the use of inherently compatible proprietary systems (which might be achieved by using software products from the same vendor). However, it should be noted that a proprietary approach cannot be taken by those Government procurers who are required to take a non-proprietary approach.

It should be noted that for public sector clients it is necessary to be able to specify, and achieve, open interoperability in relation to project and asset information, and this phrase has been used in the recommendations related to information schemas.

Please note in the context of this report, interoperability is referenced in terms of systems that are employed to implement the UK BIM Framework.

3. The benefits of interoperability

Open interoperability delivers positive benefits, therefore it is a Government policy objective. The question is how to deliver interoperability and the extent of the intervention required to do so. Existing approaches are likely to be insufficient and would have the negative consequences listed below. Therefore, there is a need for Government BIM policy to focus on and drive interoperability.

Doing nothing in relation to open interoperability, means continuing to use the existing approaches to exchanging information within and between project delivery and asset operation. These existing approaches come with significant costs. While these costs are extremely difficult to quantify, one piece of evidence heard from a practitioner put the cost of dealing with interoperability problems on a moderate sized project at 2% of their design team fee.

The committee heard from one evidence provider, that if just this one consequence of lack of interoperability was replicated across the construction industry, then the level of unnecessary cost attributable to poor interoperability would be of the order of £200m per year.

There are many more consequences of doing nothing, with just some of them:

- the inability of client organisations to use information procured at capital stage throughout the asset's lifecycle;
- the inability to maintain and access a 'Golden Thread' of information during all stages of an asset's lifecycle;
- the inability to share asset information between Government organisations;
- the inability to derive the wider benefits of improved information management across construction as a whole, including collaboration, quality, cost and programme improvements; and
- the erosion of the UK's leadership position BIM development and implementation.

Doing nothing would erode the UK's leadership in BIM development and implementation.

Some of the benefits of increased open interoperability include:

- single procurement of information that can be relied upon over time, removing the need for it to be repeatedly re-procured;
- a 'Golden Thread' of information to provide statutory information in order to improve compliance, health and safety and zero carbon targets;
- faster, more efficient and reliable decision making using reliable information;
- efficient collaboration throughout an asset's full lifecycle, allowing procurers to improve their performance specification and compare it to performance in use, helping to deliver 'Soft Landings'; and
- the ability to efficiently share appropriate reliable information across Government, across industry and also with the public.

The recommendations contained in this report either relate directly to achieving interoperability or they are key enablers which help interoperability to be achieved.

4. Promotion by Government and leadership

It is very clear that in order to build on the UK's BIM adoption momentum to date and to ensure benefit is delivered now and in the future, there is a need for Government to lead the way. The BIEG repeatedly heard that the Government's April 2016 BIM Mandate, and the work of UK BIM Task Group, greatly helped message, positively engage and energise the construction industry as a whole, including public sector clients.

Central Government intervention is required

There is a clear view that central government intervention and public sector client leadership is required in order to achieve the desired outcome.

The BIM Mandate is, and will continue to be, official Government policy, but it is clear that it has to adapt over time to ensure it takes account of developments in technology and the market. Therefore, it is proposed that the existing mandate is further developed to reflect the technology, standards and process developments that have taken place since it was first drafted as part of the 2011 Government Construction Strategy. It will also be important to continue to support the promotion of BIM through Government projects, and to work with key industry bodies, such as Construction Leadership Council (CLC), Infrastructure Projects Authority (IPA) and UK BIM Alliance, to encourage the wider industry to follow suit.

A coordination group is required to ensure continued adoption.

A coordination group is required to ensure adoption is carried through the entire supply chain, drawing from experience gained from the success of the BIM Task Group.

The recommendations are:

- To create a new BIM Interoperability Steering Group, herein referred to as the Steering Group, to instigate, engage, lead, manage, coordinate, promote and communicate recommendations across Government and externally, as appropriate.
- That the Steering Group is made up of members of the BIEG committee in the first instance, but pulling in others from across the industry as and when appropriate. It is proposed this Group would meet once a month and at other times if/when required.
- That technical resource is used to carry out specific assigned tasks within an agreed programme of work. It is envisaged that these tasks would cover the recommendations given in sections 5 and 6 of this report.

It is currently envisaged that the Steering Group would need to be in place for between 2 ½ years and 5 years, in order to establish continuous, considered, incremental strategy, engagement and outputs. The duration of the group would need to be reviewed once the extent of the work required is fully determined, following the first full year's engagement.

The main focus of the group will be Design, Build & Operate, but not Integrate, addressing the problems of the here and now, and what needs to occur within a five year horizon. However, the work will help to inform the longer term National Digital Twin programme (Integrate) and to this end it is proposed that the

Steering Group chair works closely with the leads for the UK BIM Framework and National Digital Twin Programme. In particular, with the development of the Information Management Framework, which may introduce greater semantic precision, and therefore this BIM interoperability initiative needs to be cognisant of the possible future emergence of an overarching ontological framework.

The full scope for this Steering Group and its Terms of Reference (ToR) are to be written and worked up with Government once this report has been agreed.

BIM interoperability expert group evidence gathering established a convincing consensus from experts that the UK should increase its support for the development and adoption of a set of enablers as part of the evolving BIM mandate.

The enablers to interoperability identified during the evidence sessions are presented in two groups: the first being the primary enablers (section 5) which the BIEG recommends are prioritised as the focus for the newly formed Steering Group, and the second (section 6) being the enablers which need attention, but may need addressing in a later programme of work, or elsewhere by other groups.

5. Primary recommendations / enablers

i. Classification Schema Alignment

Firstly, it is proposed that the Steering Group work with NBS to examine how Uniclass 2015 can be improved, supported and maintained going forward.

Once this initial engagement has been undertaken, other matters can be considered, including:

- How Uniclass 2015 aligns / maps to other conventions, such as CoClass.
- Alignment or mapping of appropriate aspects of Uniclass 2015 with other breakdown structures, such as NRM and SFG20.
- Support to help NBS to improve and then maintain Uniclass 2015 – including helping NBS to liaise with key construction industry sector stakeholders.

It should be noted that the BIEG also considered other schemas such as CoClass and OmniClass. It concluded that the most efficient way forward was to continue to support Uniclass 2015, whilst at the same time supporting its mapping to other schemas.

ii. COBie - Practical Application and Development

Liaise with the UK BIM Alliance and buildingSMART UKI, with support from buildingSMART International as appropriate, to explore the development of multiple Model View Definitions (MVDs). This work will start with COBie, for the reason that it continues to be a very important part of UK Government information procurement.

More specific work is likely to be identified once the initial liaison has taken place.

iii. Education and Skills

There is clear direction from those providing evidence that there is a lack of digital skills within the sector which needs to be urgently addressed.

This is an area which will involve wider engagement, and may need to be addressed by, and coordinated across, a number of different organisations.

iv. Industry Foundation Classes (IFC)

Liaise with buildingSMART International, and its UK/Ireland Chapter, to support the further development of IFC, with the aim of helping to voice the concerns of key construction industry stakeholders, as expressed by a number of the evidence providers (see Appendix B).

More specific work is likely to be identified once the initial liaison has taken place.

v. Standards

It is clear that work is required to clarify and communicate the Standards landscape and then to make sure appropriate training is available to help improve its application. Further discovery work will be required to correctly scope this work.

6. Secondary recommendations / enablers

During the course of the work a number of other facets of the interoperability agenda were raised. However, the BIEG agreed that these enablers required further evaluation, prior to issuing specific recommendations for a variety of reasons, including:

- lack of consensus on direction;
- requirement for further development and/or unlikely to enter the mainstream within the timeframe of this report;
- insufficient evidence to produce an acceptable level of recommendation; and
- some form of proprietary content

These secondary enablers are listed below in alphabetical order and NOT in order of priority. Each is explained Appendix B.

i. **Asset Information Model (AIM) Common Data Environments (CDE)**

ii. **Drivers and Enablers**

iii. **Global Unique Identifiers (GUID)**

iv. **Operational Focus**

v. **Product Data Templates (PDT)**

vi. **Proprietary software and the use of Application Program Interfaces (API)**

vii. **Standard Data Approach**

viii. **Procurement and Contracts**

In assessing each of the enablers and potential activities, it will be important for the Steering Group to take account of the work of others in the field, who may be working on other related projects within the CIH, the UK BIM Alliance and wider industry. The Steering Group should actively seek to share knowledge, avoid duplication and improve outcomes.

7. Next steps / roadmap

An initial roadmap for the proposed work is as follows. Note that it will be subject to change during the consultation and sign off period:

April 2020

- Assign resource to liaise with identified initial key interested parties and carry out engagement:
  - British Standards Institution (BSI).
  - buildingSMART International and UK/Ireland Chapter.
  - Digital National Asset Register (DNAR).
  - Public Sector ISO Transition Working Group (PSITWG).
  - NBS.
  - UK BIM Alliance.
- Publish this report to industry and put in place a formal process for submitting comments.
- Funding/budget sign off.
- Gain full sign off.
- Further develop programme and deliverables.
- Carry out landscape / stakeholder mapping.

May 2020

- Respond to industry comments received and make amendments accordingly.
- Draft ToR.
- Technical Resource Interviews.
- General mobilisation.
- Comms Planning.

June 2020

- Commence work.

Appendix A – Definitions of interoperability

Some alternative definitions of interoperability are given in the table.

Definition	Source
ability of systems to provide services to and accept services from other systems and to use the services so exchanged to enable them to operate effectively together	ISO 37100:2016 Sustainable cities and communities — Vocabulary
the capability of devices of different types and from different manufacturers to exchange information and commands via the communications network	ISO 16484-2:2004 Building automation and control systems (BACS) — Part 2: Hardware
a characteristic of a product or system, whose interfaces are completely understood, to work with other products or systems, at present or in the future, in either implementation or access, without any restrictions	AFUL.org Interoperability Working Group
the ability of computer systems or programs to exchange information	Oxford Dictionary
the capability of two or more functional units to process data cooperatively	ISO/IEC 2382-18:1999 Information technology — Vocabulary — Part 18: Distributed data processing

Appendix B – Evidence

a) Evidence Providers

The BIEG would like to thank all those who generously gave up their time to provide evidence. Evidence providers were as follows:

Organisation	Name	Second Person	Field of Expertise
ActivePlan	George Stevenson		Data Expert
Atkins	Nick Tune		Data Expert
Autodesk	Marek Suchocki		Technology Provider
Bentley	Mark Coates	Marc Thomas	Technology Provider
Bond Bryan Digital	Emma Hooper	Rob Jackson	Practitioner
BSI	Dan Rossiter		BIM Expert
buildingSMART	Nick Nisbet		Data Expert
CIBSE	Hywel Davies	Carl Collins	Data Expert
Clearbox	Graeme Forbes		Technology Provider
Environment Agency	Graeme Tappenden	Alan Proctor	BIM Expert
Faithful & Gould	Andy Green	Shahida Rajabdeen	Data Expert
Galliford Try	John Ford		Practitioner
Glider Technology	John Hall	John Adams	Technology Provider
IBM	Paul Surin		Technology Provider
Intra TeamIT Consultant	Phil Jackson		Data Expert
Majenta Solutions	James Smith		BIM Expert
NBS	Sarah Delany		Classification Expert
Northumbrian Water	Mike Overy		Client
Scottish Futures Trust	Ryan Tennyson		Client
Universities of Cambridge and Auckland	Prof. Rafael Sacks	Prof. Robert Amor	Academia
Viewpoint / Trimble	Duncan Reed	Ben Wallbank	Technology Provider

b) Review of Evidence Received

The evidence received by the BIEG extended to over 600 pages of transcript representing 19 hours of presentation and discussion and 12 pages of separate written submissions. What follows draws out the principal messages from this body of evidence, but it has not been possible to include every single view put forward by the evidence providers.

Primary Recommendations and Enablers Evidence

Promotion by Government and Leadership

From the evidence heard, Government promotion and leadership in relation to interoperability was expressed from three different perspectives:

1. Government leadership through its own projects.
2. Government commitment through an evolution of the BIM Mandate.
3. Government leadership through sponsorship of an evolved Task Group.

About two thirds of the evidence providers were of the view that Government needs to lead the adoption of interoperability through its own project and asset management programmes. A central Government pull was implemented for the BIM Level 2 programme through the Mandate contained in the 2011 Construction Strategy. The BIM Level 2 pull was seen as one of the fundamental successes of the programme as it gave the commercial imperative to a sufficient proportion of the supply-market to engage. There was no particular pattern in the type of evidence providers who were either in favour of Government project/asset leadership or neutral on it.

There was a less emphatic view, from about one third of evidence providers, that Government project and asset leadership needed to be supported by a formal Mandate.

The view that an evolved BIM Task Group (or similar) should be overseeing and assisting central Government interoperability leadership was also put forward by just over a third of the evidence providers. Only practitioner evidence providers (including client and supply chain organisations) gave strong views for an evolved Task Group, but weaker views in favour of this came from all stakeholder categories (technology providers, practitioners, support organisations). There were strong views that this task group must have dedicated, paid-for resources and be charged with maintaining (and developing where necessary) the various schemas for structuring and classifying interoperable information.

i. Classification Schemas Alignment

Classification and Uniclass 2015:

Standardized classification of asset information should provide a complete and consistent approach to its identification. This is fundamental where information needs to be exchanged between different parties, projects, departments and organisations. It also supports use of the information for different purposes/activities occurring throughout an asset's life (such as programme, cost and asset management).

A requirement of ISO 19650-2 clause 5.1.7 is that an information container is assigned with a classification attribute in accordance with ISO 12006-2 (which Uniclass 2015 and other systems can provide). The National Annex to ISO 19650-2:2018, clause NA.4.4 states that classification of information within information containers should be in accordance with Uniclass 2015.

Uniclass 2015 is a classification system owned and maintained by the NBS. It was developed by NBS for government as one of the tools to support the adoption of BIM Level 2 and is free to use.

Just under half of the evidence providers referenced classification making the link between the ability to exchange information and ability to use it for different purposes (i.e.

interoperability). However, some evidence providers considered that classification is confusing, complex and that the availability of multiple classification systems does not support industry adoption.

The majority (80%) of the evidence providers referencing classification did this in terms of Uniclass 2015 and most of them supported its use. Where its use was supported there was a strong view that Uniclass 2015 would benefit from review and a robust maintenance programme that industry could anticipate and accommodate.

Further factors that appear to have influenced the direction and adoption of Uniclass 2015 to date are:

1. Poor engagement with government departments. This has shaped the way in which Uniclass 2015 has developed which has been more supply chain led than client-led.

2. Client competency to request Uniclass 2015 as a supply chain deliverable in a clear and concise way.

3. Informal nomenclature making it challenging for NBS to determine classification and difficult for practitioners to apply it easily and appropriately.

4. Regularity of updates.

Alignment of Uniclass 2015 with other conventions:

Half of the evidence providers who talked about classification also spoke about the alignment or mapping of appropriate aspects of Uniclass 2015 with the:

- new measurement rules (NRM) developed by the Royal Institution of Chartered Surveyors; and
- library of building maintenance specifications, SFG20 developed by the Building Engineering Services Association.

It was stated that these mappings would improve the speed, ease and accuracy of translating systems and products identified through Uniclass 2015 classification into information that can be used for cost and maintenance purposes throughout the whole life of an asset.

The evidence providers gave examples of mapping being successfully developed and implemented through private endeavour. However, the progressive growth of both Uniclass 2015 and SFG20 requires that individuals maintain their own mappings. Furthermore, there are instances where a one-to-many relationship requires that mapping from Uniclass 2015 to NRM to SFG20 requires user interpretation and may be inconsistent depending on the application.

Summary thoughts:

Some of the evidence providers considered that classification is over-used in ways that are not required or helpful. There was also a view that classification will become redundant because technology will overcome information identification and translation issues through background content indexing similar to the way that commonly-used computer operating systems work.

However, based on all the evidence provided it is considered that government-led initiatives should be progressed to support:

- the development and maintenance of Uniclass 2015 so that it can be applied consistently, easily and correctly across all asset types; and
- the alignment of Uniclass 2015 and other industry conventions so that information generated through construction can support activities throughout the whole life of the asset.

ii. COBie - Practical Application and Development

COBie is the existing schema for structured data, within the UK BIM Framework. In the UK it is defined in BS 1192-4. COBie was a topic that

almost evenly divided the evidence providers who expressed a view in relation to it.

Some saw COBie development and implementation so far as a good start, with statements that COBie needed to be developed to rectify its shortcomings. These were particularly in relation to infrastructure projects. Most of the positive views on the development of COBie came from practitioner evidence providers.

Others saw COBie as an approach that has run its course, so had negative views on its further development. These evidence providers, who came from across the stakeholder categories, tended to propose that the focus going forward should be on IFC as the mechanism for interoperability. Only one of these evidence providers also gave strong views that development of a wider set of Model View Definitions (MVDs) was necessary – see below.

The opposing views can be seen to emerge from the evidence that at present COBie is widely misunderstood, and has been ascribed uses beyond its purpose of data transfer. For example there was evidence that some had tried to use COBie as an asset register or asset management data set. This is well outside the intended purpose of COBie.

Within the discussions on COBie, there were statements that development of the existing schema, within the UK, might run into difficulties because of lack of clarity around the intellectual ownership of COBie.

In addition to the above views there was other evidence supporting an alternative approach to interoperability. This view builds on COBie's status as a MVD of the IFC schema (i.e. one particular defined sub-set of IFC created for a specific purpose, in this case the handover of data from a project team to an asset operation and management team). The evidence was that a range of MVDs needs to be created, to respond to a range of different project and asset information purposes. This would include COBie but would expand the use of MVDs to other frequently occurring interoperability scenarios.

The evidence about development of more MVDs was stronger than the positive views on development of the existing COBie schema, and it came from across the different evidence provider categories.

iii. Education and skills

Education and skills featured prominently in discussion with two thirds of the evidence providers identifying or alluding to the need for better education and development of skills for industry (including clients/asset owners) to achieve interoperability. This was a particularly strong theme for the technology providers.

There appears to be an underlying need for education about the information management processes (as set out in BS EN ISO 19650-2) to understand why they are important and relevant and what good practice entails. This is across the board (industry, client and FM communities).

The evidence providers discussed the limited availability of skills and their views are summarised below:

- Owner operators and clients, including government, are unable to require information in the first place (i.e. to identify what information is needed and to articulate this need effectively) and then to receive and use it to support asset operation. A contributing factor to this, as highlighted by one evidence provider, may be the disconnect between the people and organisations procuring asset delivery and those operating and managing the delivered asset. This increases the complexity of generating useful and useable information and can result in it being discarded during the operational phase on an asset.
- There is limited understanding amongst practitioners about the IFC data schema and MVDs. Furthermore there is limited capability to use MVDs to extract only the information needed and then to validate it. Two evidence providers observed that this has led to a market failure because there is no commercial incentive for software providers

to develop software to support export demands of MVDs.

- Whilst some practitioners are digitally competent there is a requirement for a basic attainment of digital literacy for all practitioners and support organisations. This covers the fundamentals such as how to work with information within a CDE solution.

There was a strong view amongst the practitioners and support organisations that some programs are too complex to operate and require practitioners to have a high degree of digital literacy (i.e. beyond that reasonably expected to do their core job). It was considered that software should address this complexity so that it supports practitioners instead of challenging their capabilities.

iv. IFC

IFC is the existing schema for structured information models (combinations of geometrical information and non-geometrical data concerning design and construction projects and built assets). It is defined in BS EN ISO 16739-1:2018.

Most evidence providers, across all categories, supported the continued use of IFC for open interoperability in the UK, on the basis that it is the best available interoperability schema. Where shortcomings have been identified, for example in the support it offers for various types of infrastructure project, the evidence providers acknowledged that there was work underway to cover some of these applications. This included a range of infrastructure applications which were being addressed through the development of IFC Road, IFC Bridge, IFC Tunnel and IFC Rail.

One key point made by the evidence providers in support of IFC is that there is already an established development resource to move the schema forward. This is largely provided by buildingSMART International and its various national Chapters, but as IFC is expressed as an ISO standard the official review of IFC is overseen to ISO Technical Committee 59/Sub-committee 13 'Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM)'. The UK has representation on this sub-committee and participates in much of the work done on its behalf.

In addition to the comments about the technical scope of the IFC schema, there were various views from evidence providers that more and/or better support is needed to help practitioners (both client and supply side) to understand the schema and use it properly. This reinforces the evidence for a funded Task Group to oversee and, where appropriate, develop interoperability schemas.

When considered in parallel with the concept of MVDs (see iii. COBie), the view of most evidence providers was that IFC provides a powerful and flexible platform through which to make the best practical journey towards interoperability.

v. Standards

Standards also featured prominently in the discussion with just under two thirds of the evidence providers referring to their impact on interoperability.

The implementation of standards generates consistency and predictability of requirements and methodologies and some of the evidence providers acknowledged that there has been a lot of good work in the development of the standards to date.

However, there was concern that there are too many standards and they are not accompanied with clear messages about why they should be adopted (e.g. to generate value and efficiency).

A number of technology providers had a strong view that there is a need for more training around standards, with the current lack of training undermining their impact. This is illustrated through conflicting views about data standards – some evidence providers considered that standards need to be developed to support classification, and shareable information, whilst others considered that there are already good standards in place.

There were some firm opinions that there are sufficient technical standards already published or in development (e.g. IFC 5), and other opinions that some moderate revisions are needed to correct known shortcomings (e.g. extending COBie to better cover infrastructure).

This suggests a limited understanding of the standards landscape/horizon as it applies to information management, modelling and interoperability.

Summary thought:

It is recommended that work to review the standards landscape is prioritised so that any gaps or overlaps can be identified and addressed.

Secondary Recommendations and Enablers Evidence

i. AIM CDE

The AIM CDE was raised by a small minority of the evidence providers. There was one strong view (from a practitioner client organisation) that the AIM CDE was one of the ultimate objectives of interoperability, enabling the long-term asset owner/occupier to develop their asset information model from multiple sources over time.

The relationship between interoperability and the AIM CDE revolves around the handover of information from project delivery teams to the asset operation teams. The asset operation teams need to curate the information over the operational life of the asset and see that it is updated as the asset ages and changes. The long-term nature of this commitment supports the need for open interoperability to eliminate the risks from proprietary data formats and specific software products.

ii. Benefits and risks – Drivers, enablers and Hackitt

Some evidence providers were explicit about interoperability being a key enabler to the 'Golden Thread' of information envisaged by both the Independent Review of Building Regulations and Fire Safety (the Building a Safer Future Report) and the BS 8536 series. Most alluded to the need to generate this golden thread through interoperability and the benefits this would bring. One evidence provider considered that the recommendations of the Building a Safer Future Report would in themselves, generate significant data and information exchange requirements.

A number of evidence providers referred to current ways of working which generates various challenges as noted elsewhere in this report. One evidence provider explained that their organisation is spending significant time, effort and cost (circa £200,000) trying to make information work to support different information uses. This means generating information using certain software then adapting it to suit use by other software, sometime moving from software to software to software and so on. There are also concerns about loss of information integrity throughout this process.

iii. GUIDs

There were a few mentions from the evidence providers regarding global unique IDs (GUIDs). These are pseudo-random codes generated automatically within software. One practitioner evidence provider strongly supported their use as data keys to link different parts of the overall information model, such as linking object documentation to geometrical information. Other evidence providers highlighted the possibility of GUIDs being lost or links broken either when objects were deleted in the source software or because the source software did not handle GUIDs correctly.

The use of GUIDs was seen by one supporting evidence provider as part of making information machine readable in preference to human readable, and in this view GUIDs and semantic web ontologies (vocabularies to help web applications understand language) were preferable to classification systems and data dictionaries.

An extension to the idea of GUIDs, raised by a few evidence providers, was the naming convention for information containers. This

convention is currently described in the UK National Annex to BS EN ISO 19650-2. There were comments about aspects of how the convention is defined, however these are being considered in a parallel piece of work at BSI to revise the National Annex.

iv. Operational focus

Just under half of the evidence providers talked about the need for effective engagement with the facilities management / maintenance community. There was a strong message that these stakeholders have demonstrated limited interest and understanding about how to access and use asset information generated through construction activities. It came through clearly, that understanding operational and maintenance requirements and systems is fundamental to ensuring beneficial interoperability for the lifetime of an asset.

It was also clear that there are technology issues to overcome, with two evidence providers noting that computer-aided facility management (CAFM) software does not read IFC and most software does not support the straightforward import of the COBie structure as a spreadsheet.

A further evidence provider explained that there is limited consistency in how different CAFM software identify different information attributes, indicating the need for expertise/effort to move information into the right place in the software. The same evidence provider considered that people in design and construction typically do not understand the complexity of the FM market. Due to the lack of FM integration, poorly informed decisions about model contents are being made, focussing primarily on geometry, not on information relevant for asset operation.

At present, even if there is clarity in FM and operational requirements it is not straightforward to transfer information generated through construction into CAFM software.

One evidence provider also noted that CAFM systems (or similar) support maintenance activities, not asset optimisation activities. They tend to operate as systems to alert people to activities and to record information about those activities. They do not support the intelligence driven operation of an asset.

Two examples were provided to indicate that with engagement, appropriate support and a clear understanding of CAFM software an integrated approach, but not an interoperable one, can be successfully applied

v. PDT

PDTs was a topic that was only raised by one third of evidence providers. Those who did have a view were fairly evenly split between practitioners, including clients, and technology providers. PDTs provide an open format for pre-defined data content, such as the characteristics of a particular product type, rather than just a data structure. In this way they can support interoperability across the many-to-many relationship between product manufacturers and product consumers (project delivery teams and asset operation teams). There were comments from various evidence providers that a lot of work has been done around PDTs, initiated by different industry bodies and groupings. But at present there does not seem to be an industry-wide consensus around a single set of PDT definitions. There was a strong view from one evidence provider that PDTs could replace the need for COBie, but this would only be a practical proposition if a single set of PDT definitions emerges as the industry standard.

vi. Proprietary software / APIs

Just less than a quarter of the evidence providers expressed a view on the role of proprietary software in respect of interoperability. With the exception of one technology provider, there was a strong view that interoperability is not a problem to be solved by the software market; concerns were expressed about access to data and data ownership driven by licensing arrangements and availability and development of the software.

Furthermore, without mentioning proprietary software, additional evidence providers were explicit that information must be able to reside outside of the software tools used to create it.

Just less than half of the evidence providers expressed their views about the role that APIs bring to the interoperability solution. There were more positive views than there were negative ones but there was some concern that the increasing adoption of a proprietary approach will result in greater reliance upon APIs. This in turn will further complicate the activity of exchanging and using information, not assist it.

Four evidence providers held strong views that the solution to interoperability is to move towards cloud-hosted model servers to negate the requirement for model federation. They consider that this approach could allow for genuine cooperation and collaboration across project teams.

vii. Standard Data approach

Standardised data deliverables through standardised information requirements was an approach supported by a small number of evidence providers, primarily from the practitioner category. The benefit seen by these evidence providers was in streamlining a particular client's information processes. This was particularly around the specification of what information and data they expected to receive from their project teams, in terms of corporate standardised documents for exchange information requirements and for asset information requirements.

This standardisation is most applicable to clients who have project and/or asset portfolios that contain large degrees of similarity within them (i.e. many projects for similar types of buildings or infrastructure assets).

The consequence of this for open interoperability is that for a particular client, the range of project and/or asset types then forms a relatively small subset of all possible requirements for information exchange, and thus limits the extent of interoperability needed between the client and their project/asset suppliers.

viii. Contracts / procurement

The majority of the evidence providers talked about procurement and contracts, although synonymously in many instances.

Procurement is the overall act of obtaining a service/asset and determining the strategy on how the service/asset is to be acquired, whereas a contract provides the terms under which the appointing party and service/asset provider agree to operate.

Evidence providers from the client group identified two blockers to interoperability, generated by procurement:

1. The cycle of tendering for framework partners. The time and effort involved in getting a new framework partner on board with the appointing party's information requirements is prohibitive and expensive.

2. Clients become tied into long-term software contracts that provide bespoke functionality and tailored solutions but offer limited flexibility to evolve or interoperate across other platforms. As with (1) the time and effort of moving to a new software provider is prohibitive and, almost by default, contracts are renewed.

One of the evidence providers also noted that procurement does not encourage innovation or create the pull needed to encourage adoption of interoperability.

A further point noted by the BIEG is that PAS 91, used by government to pre-qualify service providers, is out of date in respect of information management and modelling, and does not promote collaborative working, open-source working or interoperability.

It was also highlighted by one evidence provider that the process of procurement coupled with timescales set to deliver assets, often do not factor in sufficient time for robust tender and contract preparation activities.

In respect of contracts, there was a strong view that commonly used forms of contract:

- do not promote collaborative working; and
- drive the delivery of documents, not the delivery of usable, accessible, sufficient quality information.

In addition to this, the BIEG observed that where a contract is in place to deliver an asset, priority tends to be given to the handover of the physical asset, not handover of complete and validated information about the asset. Furthermore, the evidence providers noted that although contracts often do stipulate the requirement to work in accordance with specific information management and modelling standards, mechanisms to ensure that the standards are implemented as intended must be positively pursued. This echoes views of some of the evidence providers who considered that where a project is up against a deadline, delivery of the physical asset with be prioritised over the digital asset.

One of the client members of the evidence panel appears to have overcome this problem by setting information delivery based key performance indicators (KPIs). This creates a 'win-win' because there is motivation and support for all service/asset providers to generate useful and useable information and the client gets the information they require when they require it, in a useable format.

ix. Those items not to be recommended and why

The evidence also included some specific negative views on certain topics. These were only raised by a handful of evidence providers but were done so clearly and emphatically.

Negative view 1: Not to move from Uniclass 2015 to CoClass

Uniclass 2015 is the UK's preferred classification system for construction work and built assets. It is owned and managed by NBS and is the classification system required in the UK BIM Framework.

CoClass is a classification system developed in Sweden. Like Uniclass 2015 it aligns with ISO 12006-2 and therefore satisfies the classification requirement for information container metadata in ISO 19650-2. The view expressed was that CoClass is too low-level (product oriented) and not sufficiently able to deal with higher level concepts (systems, entities, complexes). A move to CoClass was therefore seen as a backward step.

It should be noted at this point that there was also a strong view from one evidence provider that a move to align Uniclass 2015 to CoClass was a good idea as CoClass is also aligned with BS EN 81346 'Industrial systems, installations and equipment and industrial product – Structuring principles and reference designations – Basic rules'.

Negative view 2: Not to move from IFC to Geography Markup Language (GML)

GML is an Extensible Markup Language (XML) grammar defined by the Open Geospatial Consortium for use on geographical objects and features.

GML is defined through ISO 19136, one of a family of standards maintained by ISO Technical Committee 211 Geographic information. While it has the capabilities to define geographical features and objects, the view expressed was that this does not cover the definition of objects in the sense of modelling for design, construction or management of small scale assets.

c) Evidence Frequency

The evidence received was assessed for its strength of support across a range of topics associated with information interoperability and openness. Although aspects of this assessment were subjective, the strength and frequency with which these topics were raised by the evidence providers gives support to the BIEG's recommendations.

Topic	Ratio of evidence (positive : negative : not cited)	Weighted strength of support from evidence providers	Banded strength of support from evidence providers
Standards	13 : 0: 8	31	High
Government leadership (through departmental implementation)	14 : 0 : 7	26	High
Education and upskilling	12 : 1: 8	23	High
Alignment of classification and breakdown structures	9 : 0 : 12	21	High
Procurement does not aid BIM/interoperability	8 : 0 : 13	20	High
Engagement of FM/maintenance community	9 : 0 : 12	19	High
Development of IFC to support all asset types	11 : 1 : 9	18	High
Contracts do not aid interoperability	9 : 1 : 11	18	High
Golden thread of information (Building a Safer Future)	9 : 0 : 12	15	Medium
Engagement with technology providers	7 : 0 : 14	15	Medium
Development of MVDs beyond COBie but for exchange	7 : 0 : 14	15	Medium
Government leadership (such as a new task group or other leadership)	8 : 0 : 13	14	Medium
Mandate (evolution of, not new)	7 : 0 : 14	13	Medium
Product data templates	7 : 0 : 14	13	Medium
Beneficial use of APIs	6 : 0 : 15	12	Medium
Digital plan of work (bringing in the prof inst's)	5 : 0 : 16	11	Medium
Machine readable	5 : 0 : 16	11	Medium
Call for regulation	4 : 0 : 17	8	Low
Sustainability of information	4 : 0 : 17	8	Low
Understanding of benefits	3 : 0 : 18	7	Low
Detachment of information from system	3 : 0 : 18	7	Low
AIM CDE	5 : 0 : 16	7	Low
Limitations of APIs	4 : 0 : 17	6	Low
GUID can aid interoperability/data/model use	4 : 1 : 16	5	Low
Certification	4 : 0 : 17	4	Low
Wider stakeholders	4 : 0 : 17	4	Low
Use of classifications other than Uniclass 2015	4 : 1 : 16	3	Low
Understanding of risks	3 : 0 : 18	3	Low
Development of COBie is required	6 : 5 : 10	3	Mixed
Proprietary software will suffice	1 : 4 : 16	-9	Negative

Reference

Hackitt, J. (2018). Building a Safer Future.

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