

Data Requirements for the Construction and Management of Buildings

A Guide for Clients



Oct 2017

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Purpose of this Document

This document should be used by clients and their supply chain in tandem with the UKBIM Alliance data requirements matrix tool. It has been developed to assist clients in setting their data requirements for the construction of buildings in accordance with BIM Level 2. A separate document and matrix will be developed in for infrastructure projects.

PAS 1192-3 states that an Asset Information Requirement (AIR) document should be produced. This should be undertaken by the client and should state the information (in the form of Data, Documents and Geometry) that is required in the Asset Information Model (AIM). The AIM should then be used by the Facility/Asset Management teams to operate and maintain the building. The reason this guidance is required is that many clients are asking for BIM Level 2 within contract documents, but not clearly setting out the data requirements within the AIR. This in turn can lead to the under supply or over supply of data that has little or no value.

Without clearly stating the data requirements and ensuring that they are collected, validated/verified and utilised in the operation of the building, many of the benefits of Level 2 BIM are lost. It is therefore important for the client to consider what data will be delivered from the outset of a project.

The guidance and matrix are not meant to be the definitive set of requirements for all systems and products and their associated attributes. It has been developed to provide a starting point for clients to establish meaningful and useful data requirements. As clients and their supply chain learn which data is useful, they will expand/make more bespoke data requirements for their needs. The matrix provides an indication of the level of data granularity that should be captured across assets as part of BIM level 2.

Information Management and Information Exchange

Building Information Modelling (BIM) Level 2 has been mandated by the UK Government to derive benefits such as; reduced cost and improved quality in briefing, design, construction and operation of built assets. The success of BIM is predicated on the managed exchange of information (Data, Documents, Geometry) throughout an asset's lifecycle, so that critical decisions can be made by the client and their supply chain, based on timely and accurate information.

The information required by the client and their supply chain should be determined by answering specific 'Plain Language Questions' (PLQs). For instance, if the question from the client is; Within the AIM, to what extent is the data correct and complete to anticipate operational cost? Then the information required to answer this question must be produced and validated by the main contractor. The Plain Language Questions should be stated by the client in their Employer's Information Requirements document (as stated with PAS 1192-2). Then within the BIM Execution Plan (BEP) the supply chain respond with a method capable of answering these questions.

Information Exchanges through the Project

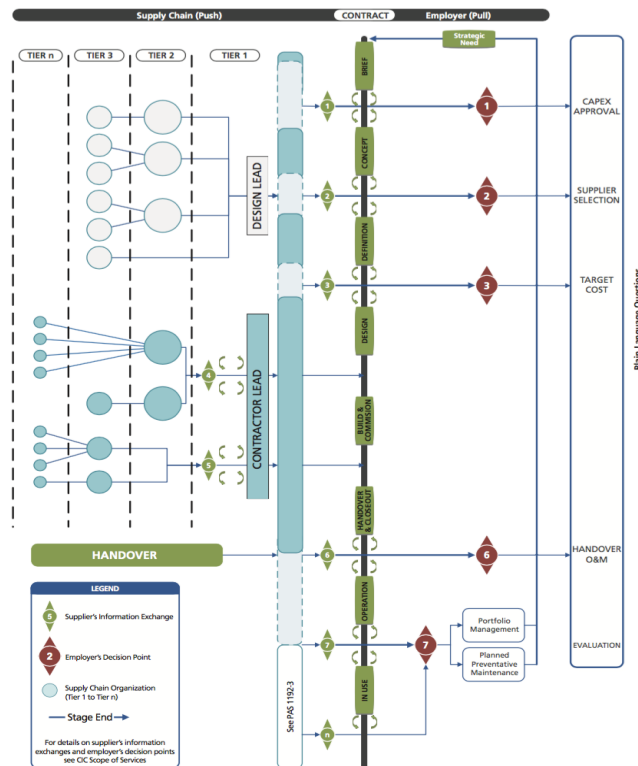


Figure 1 - Image from PAS 1192-2 showing information exchanges thorough the project

The PLQs might be answered using three types of Information:

- **Documentation** – Drawings and PDFs from manufacturers, such as safety Data Sheets, etc. that are usually handed over to clients and their facilities management teams via Operation and Maintenance Manuals
- **Non-Graphical Data** – For BIM Level 2 that is in line with the British Standard BS1192-4 which utilises the Data exchange format COBie.
- **Geometry, Graphical Models** – 3D models of the building and the systems and components within it.

Information Requirements

- Information requirements at the design stage

As noted in figure 1 from PAS 1192-2, information exchange points 1- 3 (and depending on the contract 4 & 5), are derived from the designers. For further guidance on information requirements for design stages please see www.ribaplanofwork.com and the digital plan of work <https://www.thenbs.com/knowledge/what-is-the-digital-plan-of-work>

- Information Requirements for the Asset Information Model (AIM)

It is the AIM that is used by the client and the asset/facilities managers to operate their buildings and it is often referred to as a *digital O&M*.

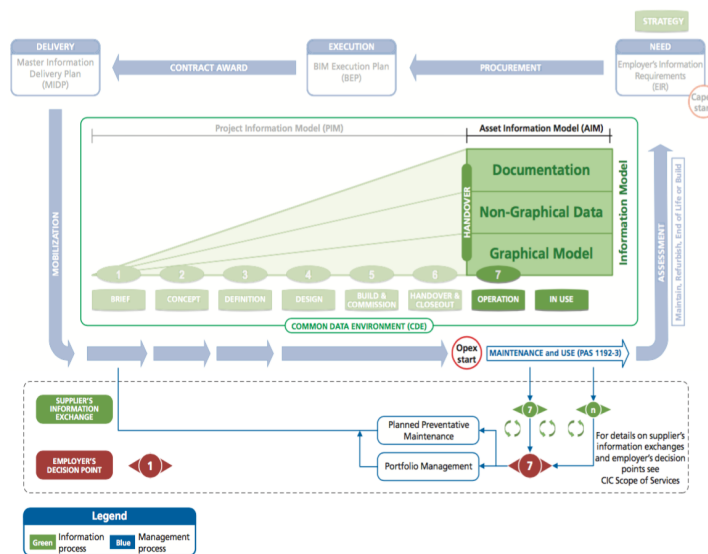


Figure 2 – AIM element of the Asset Delivery cycle PAS1192-2

The AIR is a crucial document authored by/on behalf of the client (in consultation with the asset/facility management team, where appropriate) detailing the information that is required for the management and operation of the building.

The guidance from this document and associated matrix should therefore help in setting the data element of the Asset Information Requirements for your projects N.B. When we refer to data, we mean non-graphical data.

The Data Collection and Exchange Format - COBie

The BIM Level 2 standard BS 1192-4 states that COBie should be the schema used for data procurement, collection and exchange into Asset Management Systems.

- **Recommendation 1 - Make sure that the Asset Management Software that your asset management team propose to use can utilise COBie.**

COBie is structured according to the spatial and physical hierarchy for a building. When a COBie spreadsheet is viewed, you'll see this hierarchy as you move through the tabs. Under the Facility (the building) are the Floors and Spaces and their grouping into Zones. There are also the (Product) Types and Components and their grouping into Systems. COBie also contains operational information such as Spares, Tasks and Resources associated to the Types. All these various types of assets can have associated attributes, documents and impacts.

For more information on COBie see BS 1192-4

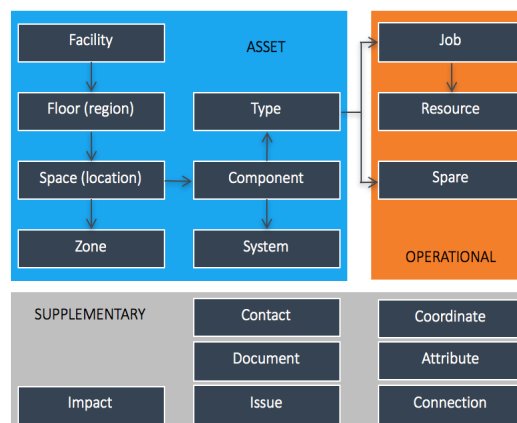


Figure 3 – The COBie hierarchy from www.wbgd.com

Whilst COBie is a data schema it also contains required and recommended attributes that should be collected at various information exchange points through the design, construction and handover of a building. The type of attributes it asks for are primarily operation and maintenance data.

The requirement to provide data is indicated through the COBie colour scheme as noted on Fig. 4.(next page)

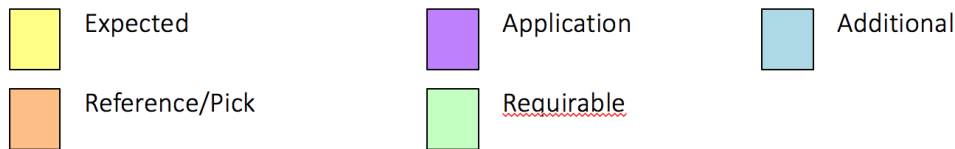
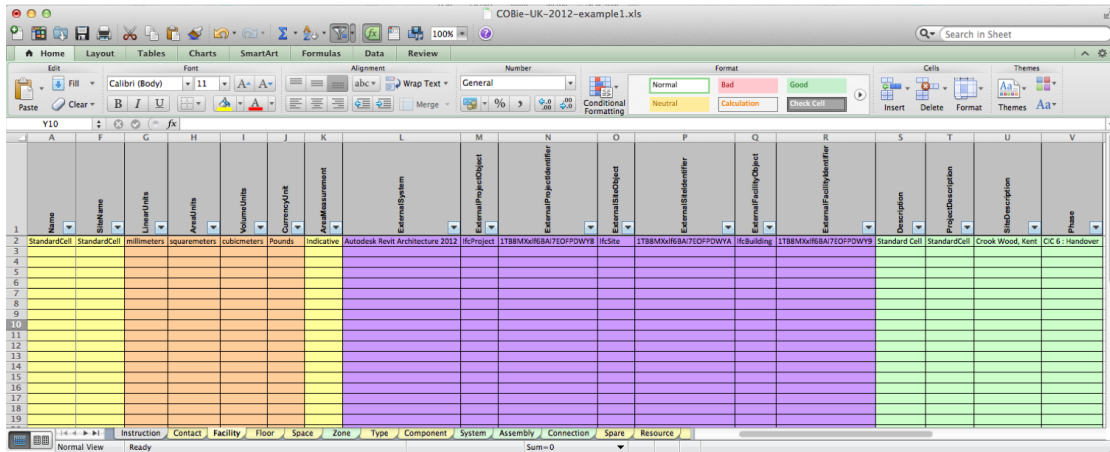


Figure 4 – COBie template with legend

Most of the data required for the Facility, including its Floor, Spaces, and Zones can easily be exported from the 3D model as it is related to location/geometry. It is the Type and Component data that requires the client to be very specific about the Systems/Products and the attributes they require, as this data is collected from the manufacturers and sub contractors.

The 'Type' tab in COBie requires/recommends the following attributes;

Type	Example	Notes
Name	White Board	expected
CreatedBy	name@email.com	reference
CreatedOn	2013-04-15T00:00:00	expected
Category	L76134:Presentation systems	pick
Description	Short Throw Projector	expected
AssetType	Fixed	pick
Manufacturer	company@email.com	reference
ModelNumber	587	expected
WarrantyGuarantorParts	company@email.com	reference
WarrantyDurationParts	5	expected
WarrantyGuarantorLabor	company@email.com	reference
WarrantyDurationLabor	5	expected
WarrantyDurationUnit	Year	pick
ExtSystem	Authoring Application	application
ExtObject	IfcFurnitureType	application
ExtIdentifier	11T57iOoDD\$830Kgut03mv	application
ReplacementCost	2760	requirable
ExpectedLife	15	requirable
DurationUnit	year	pick
WarrantyDescription	Onsite warranty and advanced replacement warranty	requirable
NominalLength	2105	expected
NominalWidth	50	expected
NominalHeight	1329	expected
ModelReference	Short Throw Projector	requirable
Shape	rectangular	requirable
Size	2105mm x 1329mm	requirable
Color	white	requirable
Finish	matt	requirable
Grade	tough	requirable
Material	various	requirable
Constituents	remote controller	requirable
Features	auto-shutdown	requirable
AccessibilityPerformance	visual impairment adapted	requirable
CodePerformance	fully earthed	requirable
SustainabilityPerformance	low-energy	requirable

Figure 5 - Type required attributes in COBie BS1192-4

As stated previously these attributes are primarily based on operation and maintenance requirements.

However, as noted within the COBie legend you should collect the yellow (this is 'expected') and salmon reference/pick attributes are mandatory because they tend to provide context to the data. The green (Requirable) and blue (Additional) are in effect optional and up to the client/user to decide and may be determined by PLQs. Here in lies our second bit of key advice.

- **Key Recommendation 2 - Don't ask for all Type attributes unless you are sure you will use them.** For instance, there is no point in collecting data on the colour or finish of a pump, but it may be very useful to know the colour and finish of wall cladding. Therefore, careful consideration must be given to what Type data you request and what and why you require it.

Regarding Component attributes i.e. instance data, you may require the name of the product, its description, serial number, Identifier and installation date.

Component	Example	Notes
Name	White Board:247849	expected
CreatedBy	name@email.com	reference
CreatedOn	2012-12-12T13:29:49	expected
TypeName	White Board	reference
Space	101	reference
Description	WhiteBoard in room 101	expected
ExtSystem	Authoring Application	application
ExtObject	IfcFurnishingElement	application
ExtIdentifier	0ITs7iOoDD\$830Kgut03mv	application
SerialNumber	54567901	requirable
InstallationDate	2012-12-12T13:29:49	requirable
WarrantyStartDate	2012-12-12T13:29:49	requirable
TagNumber	247849	requirable
BarCode	4567901	requirable
AssetIdentifier	2f7761ec-6323-4dfc-80c0-52ae3703f410	requirable

Figure 6 – COBie Component attributes BS 1192-4

COBie does not suggest any system or product performance attributes, such as the fire rating for a fire door, or the U Value of a window, but this may be vital data required for the construction and operation/maintenance of your building.

COBie can, however, accommodate any data over and above the recommended attributes. This data should be entered within the 'Attribute' tab.

- **Key recommendation 3 – Determine which system/product performance attribute data you require.** The accompanying Data Requirements Matrix can help with this. However, if further properties are required then you should use a Product Data Template (PDT) to select them.

A PDT is machine readable list of a products/systems attributes. It should be based on standards such as European hEN, National Standards such as BS, and openBIM such as IFC and COBie. A Product Data Sheet (PDS) is a completed PDT. For more information on PDTs see LEXiCON by the Construction Products Association (CPA)

www.constructionproducts.org.uk and the CEN 442 committee Working Group

https://standards.cen.eu/dyn/www/f?p=204:7:0:::FSP_ORG_ID:1991542&cs=16AAC0F2C377A541DCA571910561FC17F

The Purpose of the Data

As previously noted, data should only be collected if it adds value. It is therefore important to note the purpose of the data within the AIRs; this process will act as a check that the data is being collected for valid and logical reasons. For example, will the data assist in determining the asset type, location and condition, to ensure intervention visits are well informed.

Data Purposes

BS 1192-4 requires that the Employer states:

- The aspects of the facility that are intended to be managed
- Their purposes for requiring data and information deliverables
- The purposes for which data/information is not required or excluded
- Any additional purposes for data and information use

(see Figure 7 on next page).

Defining data and information purposes at the outset is important as it provides the data/supplier with the use context. Data purposes should be contained in the Employer's Information Requirements or the Asset Information Requirements (where this is a separate document).

The standard BS 1192-4 suggests the following data purposes.

Recommended Purposes from BS 1192-4

Clause	Purpose	
5.2.2	Register	A register of assets to support auditing and reporting
5.2.3	Business questions/case	To support the evaluation of the business case for facility ownership and operation
5.2.4	Compliance and regulation	To support the maintenance of the health and safety of facility users
5.3.2	Capacity and utilisation	To enable comparison of actual use and utilisation with constructed for use and utilisation
5.3.3	Security and surveillance	To support the management of security and surveillance of the facility and/or adjacent sites
5.3.4	Repurposing	To support repurposing of the facility/its spaces
5.4.2	Impacts	To support evaluation of the impacts (cost, carbon, energy, waste, water etc.) of the facility
5.4.3	Operations	To enable the anticipation of operational cost
5.4.4	Maintenance and repair	To enable the anticipation and planning of costs associated with planned preventative maintenance
5.4.5	Replacement	To enable the anticipation of service life and replacement costs
5.4.6	Decommissioning and disposal	To support anticipation and planning of end-of-life costs

Figure 7 – Recommended Purposes from BS 1192-4

Plain Language Questions

A plain language question (PLQ) is a 'request (or a check) for information' that is expressed in simple, easy-to-understand terms (BS 8536-1: 2015). A PLQ is therefore a means of communicating an information requirement.

The Employer's Information Requirements (EIRs) and companion contract/appointment documents set out the information to be delivered and the standards and processes to be adopted by the design and construction team as part of the project delivery process.

The EIR should include a schedule of PLQs to support the programme of structured data/information exchange. PLQs should be drafted for each planned information exchange and the purpose for which the information is required through the PLQ should be stated.

PLQs should enable data/information to be obtained in a timely and effective manner to support the employer's decision making. PLQs can also operate as a check against the complete, comprehensive contents of EIRs.

A PLQ can be supported by a prompt and/or an example to ensure that the requirements are understood by receiver/responder

The success of PLQs depends upon the:

- Clarity and appropriateness of the PLQs
- Provision of correct, complete and relevant data/information in answering the PLQs
- Effective implementation of the decisions resulting from the PLQ responses

Suggested PLQs

Assessment of Requirements

The purposes behind each of these PLQs is to ensure that the design and construction team receives and understands the project brief including the information requirements. They also act as a check for the Employer that the content of their appointment/project documents is comprehensive and correct.

To what extent (or: 'How') does the Employer's project brief set out:

1. The business related activities and processes that are to take place in the facility
2. The security issues that are applicable to the owner's business, assets/facilities and personnel
3. The owner's requirements
4. The operator's requirements
5. The end users' and other key stakeholders' requirements
6. Project outcomes and targets for the operational performance of the facility
7. Project outcomes and targets for the durability of the facility
8. Required performance targets
9. Existing policies and standards that are relevant to the design, construction and operation of the facility
10. A design standardisation policy
11. Requirements for whole-life cost assessment
12. Requirements for delivery of project information and asset information
13. The approach to be taken to post occupancy evaluation
14. The existing facilities management strategy
15. Security arrangements for the facility in operation

The PLQs could be broken down further by separating out questions to refer to individual, explicit requirements, see BS 8536-1 for issues that PQLs should cover.

PLQs for COBie Information Deliverables

PLQs to test that complete/correct COBie is provided in accordance with the Employer's Information Requirements:

1. To what extent is the COBie Facility, Floors, Spaces, Zones, Components, Types and Attributes [*note, this list of COBie sheets may need extending to include Systems, Assemblies, Connections and Documents*] data correct and complete, providing a register of spatial and physical assets
2. To what extent is the COBie data correct and complete to enable evaluation of the business case for facility ownership and operation
3. To what extent is the COBie [Issues, Jobs, Resources and Documents] data correct and complete to support the maintenance of the health and safety of facility users
4. To what extent is the COBie [Facility, Floors, Spaces, Zones and Attributes] data correct and complete in providing a record of the facility's spaces, their capacity (see Note 1) and utilisation (see Note 2) according to the Employer's Information Requirements
5. To what extent is the COBie data correct and complete to support management of security and surveillance of the facility in accordance with the Employer's Information Requirements
6. To what extent is the COBie data correct and complete to support management of security and surveillance of the site in accordance with the Employer's Information Requirements
7. To what extent is the COBie data correct and complete to support management of security and surveillance of the neighbouring site(s) in accordance the Employer's Information Requirements
8. To what extent is the COBie [Facility, Floors, Spaces, Zone and Attributes] data correct and complete, providing a comprehensive record to support repurposing of the facility and/or its constituent spaces
9. To what extent is the COBie [Impact] data correct and complete providing an as constructed record of Employer defined Project Impacts (see Note 3)
10. To what extent is the COBie [Impact] data correct and complete providing a forecast of Employer defined In-use Impacts (see Note 4)

11. To what extent is the COBie [Component, Types, Systems, Resources, Jobs and Impact] data correct and complete to enable the Employer to understand facility operational requirements and to anticipate operational cost
12. To what extent is the COBie [Component, Types, Systems, Spares, Resources, Jobs, and Impact] data correct and complete setting out recommended maintenance tasks and to support the Employer to anticipate and plan for the costs of maintenance
13. To what extent is the COBie [Component, Types, Systems, Spares, Job and Impact] data correct and complete detailing expected/service life and constituent materials for the purposes of understanding replacement costs
14. To what extent is the COBie [Job and Impact] data correct and complete to assist the Employer is planning for end-of-life costs (purpose: 5.4.6 Decommissioning and Disposal)

Notes about the COBie PLQs:

- The purpose of each PLQ above is connected to the BS 1192-4 purpose. For clarity this could be noted in the PLQ as provided in Q14 by way of example
- The PLQ should, in each case, be responded to with a COBie data output
- Detailing the COBie sheets might make the PLQ too complicated – this needs review. The referred to COBie sheets have therefore been contained in [] so that they can be deleted, altered or extended by the user

Notes

Note 1: if space capacity is to be collected, the AIRs/EIRs should be clear that capacity should be added to the required COBie fields. This could be collected as an Attribute of each Space

Note 2: if space utilisation is required BS 1192-4 indicates that this should be provided based on hours of intended use, expressed as a fraction where $24/7/52 = 100\%$. This data could also be collected as an Attribute of each Space

Note 3: that Project Impacts and in-use Impacts should be documented separately

Criticality and Vulnerability

When selecting which Products and Systems you require data for, it is important to consider their criticality and vulnerability within the building.

Not all products and systems are equally critical to the operations of a building, and not all products and systems are equally prone to deterioration and dis-function.

By taking these two factors together, clearer prioritisation should emerge for inspection and maintenance. Overall system capacity and/or performance can also be used along with the measures of the served occupancy to support benchmarking. For example, Concrete Frame Structure: Criticality – High, but Vulnerability – Low, whilst a Fire Sprinkler System is: Criticality - High and Vulnerability – High. Therefore, it is more important to capture data for the Sprinkler System.

Collection of the Data and Documents for the Asset Information Model

Once the AIR has been defined, the project team should detail how they will collect the data and documents within the BIM Execution Plan.

It is vital that the main contractor (in partnership with their supply chain) collects and validates the data (as stated within the AIR) as construction progresses, so that the AIM is systematically created.

Traditional Operation and Maintenance Manuals (O&M) are often collated towards the end of a project, by asking the sub-contractors that have installed the products and systems to send the documents that are required to an administrator within the main contractor, or an assigned consultant. This practice is not recommended.

- Key Recommendation 4 - The person/body responsible for delivering the Asset Information Model (usually the main contractor), should collect the data and documents as the products/systems are purchased and installed.

The reason for this, is that if the AIR document has stated the requirement for data as well as documents then the responsible Information Manager needs to validate and verify the accuracy of the information throughout the project. Also, if the Type and Component data required for COBie is not collected during the purchase and installation stages, then a large amount of unnecessary work is required to collect the data later in the project. For example, if the project requires Type and Component data but at the end of the project the main contractor has only received PDFs, then they will have to manually extract the information from the PDFs and enter it into the COBie sheet or model as machine readable data. This is very time consuming and prone to error.

All the required Type data that is required comes from the manufacturer, so it is important that contractors and their sub-contractors receive this data in the form of a machine-readable Product Data Sheets directly from the manufacturers. They can then easily pass this onto the main contractors' Information Manager.

The Component data is based on the instance of a product and is therefore related to a specific product e.g. a specific window located on floor 2 room X and can therefore only be collected by the contractor installing the product.

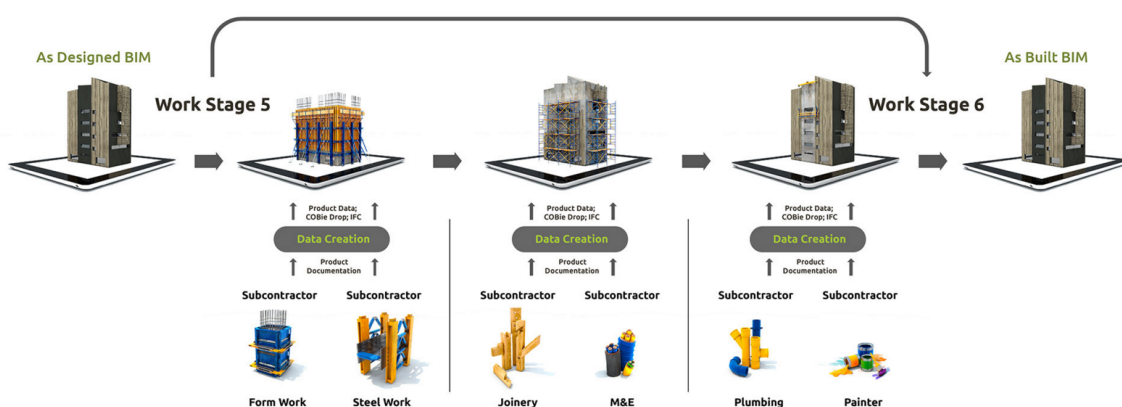


Figure 8 Collection of data during construction phase (N Tume 2017)

Key Recommendations

- **Key Recommendation 1** - Make sure that the Asset Management Software that your asset management team propose to use can utilise COBie.
- **Key Recommendation 2** - Don't ask for all Type attributes unless you are sure you will use them. For instance, there is no point in collecting data on the colour or finish of a pump, but it may be very useful to know the colour and finish of wall cladding. Therefore, careful consideration must be given to what type data you request and what and why you require it.
- **Key recommendation 3** – Determine which system/product performance attributes you require. The accompanying Data Requirements Matrix can help with this. However, if further properties are required then you should use a Product Data Template (PDT) to select them.
- **Key Recommendation 4** - The person/body responsible for delivering the Asset Information Model i.e. a digital O&M with data as well as documents (usually the main contractor), should collect the data and documents as the products/systems are purchased and installed.
- **Recommendation 5** – Products/Systems should be added to/edited by the client and their project teams to meet their own needs.

Referenced Standards

- BS 1192:2007+A2:2016 Collaborative production of architectural, engineering and construction information.
- PAS 1192-2:2013 Specification for information management for the capital/delivery phase of construction projects using building information modelling
- PAS 1192-3:2014 Specification for information management for the operational phase of assets using building information modelling
- BS 1192-4:2014 Collaborative production of information. Fulfilling employer's information exchange requirements using COBie.
- BS 8536-1:2015 Briefing for design and construction. Code of practice for facilities management (Buildings)

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Appendix A

● Guidance to the Data Requirement Matrix

The Data Requirements Matrix has been developed to support clients in establishing their Asset Information Requirements. It should be used in tandem with the guidance paper; Data Requirements for the construction and management of buildings; A guide for clients from the UKBIM Alliance.

This Matrix has recommended Systems and Products (based on IFC and mapped to Uniclass *N.B. At the time of this documents release, most 'BIM' software does not support IFC 4, so care is required when selecting products, see columns F&G in Product tab*) that can be selected for a building project in order to collect data for attribution in the Asset Information Model. It also contains suggested product performance attributes, that you may wish to choose for those Systems and Products (For BIM L2 compliance, all yellow tab attributes must be selected).

- When using the Matrix you should put an X against the attributes you require for each System or Product. We have included examples, but please select based on your information needs.

PLEASE NOTE it is NOT a definitive list of all the systems/products and their associated attributes. It is meant as a guide/starting point for clients to set their data requirements. The attributes are indicative of the detail to be captured across all fabric and MEP assets within a building. The attributes required will depend on the specific needs of the client and its FM Supply chain and should be edited accordingly (see the associated guidance paper **Data Requirements for the construction and management of buildings; A guide for clients** from the UKBIM Alliance).

● Systems and Products

There are two tabs; Systems and Products. The Systems and Products in the list have been compiled based on the most commonly selected Systems and Products by clients in a study of many building projects. *N.B. This is therefore NOT a definitive list.*

- **Recommendation – Products/Systems should be added to/edited by the client and their project teams to meet their own needs.**

As noted, when selecting which Products and Systems you would like to select to collect data for, it should be done within the context of the Plain Language Questions as stated within the Employer's Information Requirements (see PAS 1192-2) and consideration should be also given to the Criticality and Vulnerability of the System or Product. e.g. Concrete Frame Structure, Criticality – High, but Vulnerability – Low, whilst a Fire Sprinkler System is Criticality High and Vulnerability – High. Therefore, it is more important to capture data for the Sprinkler System.

The Products that are in **red text** are those that are not suggested within the *National BIM Standard (NBIMS) United states Version 3* https://www.nationalbimstandard.org/files/NBIMS-US_V3_4.2_COBie.pdf but have been requested on many projects by clients.

The Systems and Products have been classified according to IFC Entities and have also been mapped to Uniclass 2015. Recommended IFC Enumerations have also been added based on those commonly selected on projects. However extra Enumerations can be selected from IFC 4, see BuildingSMART <http://www.buildingsmart-tech.org/specifications/ifc-releases/ifc4-release>

● Attributes

The attributes have been broken down into the following categories - COBie Type, Component, and performance (based on IFC/European Standards).

The attributes in the Matrix have been selected from research into the most commonly required and utilised attributes within regulations, standards, and client specification on projects. N.B. This is a recommendation to get clients started with selecting attributes for projects.

- **Recommendation – Attributes should be selected from the Matrix and extra attributes can be added to meet the clients and their project team's needs.** The selection of extra attributes should be done based on European, UK and openBIM standards via Product Data Templates, see CEN 442 WG4 https://standards.cen.eu/dyn/www/f?p=204:7:0:::FSP_ORG_ID:1991542&cs=16AAC0F2C377A541DCA571910561FC17F

Within the matrix each of the attributes have been given their recommended purposes, based on the BS 1192-4 standard. These state the purpose that the data is meant to be used for.

As with the Systems and Products columns, not all the attributes are meant to be required for every project as this is down to your organisational and project needs. Therefore, you can use the Matrix to select which attributes you require for which System and Product you would like to capture data for. N.B. We recommend that the selection of Product Systems and Attributes is done in conjunction with the Asset/Facilities Manager where possible as they will be the people who consume and utilise the data for operation and maintenance of the buildings.

Once the Matrix has been completed it should be issued within your Asset Information Requirements documents and issued to supply chain.