

Product Data Definition

A technical specification for defining and sharing structured digital construction product information

13 April 2016

Steve Thompson PCSG Ltd on behalf of the BIM Task Group

Guide

This technical specification does not constitute a standard that has been developed through a recognised and independent consensus-building process. It should therefore not be regarded as a formal British Standard or a BSI PAS.

Contents

| | |
|--|-----------|
| Foreword | 4 |
| Purpose of this technical specification | 4 |
| Copyright | 4 |
| 1.0 Introduction | 5 |
| 2.0 Scope | 7 |
| 3.0 Implementation | 8 |
| 4.0 Terms and definitions | 9 |
| 5.0 The concept: Product DNA | 11 |
| 6.0 Plain language dictionary | 13 |
| 6.1 Parameter and information set Source Priority Groups | 15 |
| 6.2 Information required to propose a new unique parameter | 16 |
| 6.3 Relevant Authorities | 17 |
| 6.4 Application requirements to become a Relevant Authority | 19 |
| 6.5 Information required to propose a new Source | 20 |
| 6.6 Information required to propose a new information set | 20 |
| 6.7 Unique parameter information requirements | 21 |
| 6.8 Removing parameters and approval process | 22 |
| 6.9 Source information requirements | 22 |
| 7.0 Product data templates | 24 |
| 7.1 Product identification | 24 |
| 8.0 Use Cases | 27 |
| Bibliography | 34 |

Publication History

This technical specification was first published as a draft for consultation on 18th March 2016.

This technical specification does not constitute a standard that has been developed through a recognised and independent consensus-building process. It should therefore not be regarded as a formal British Standard or a BSI PAS.

Acknowledgements

The following have been involved in the development of this technical specification.

| | |
|---------------------|--|
| Steve Thompson | PCSG - Author |
| Alan Baikie | BIM4M2 |
| Andy Green | Faithful + Gould |
| BIM4 Steering Group | |
| Chris Witte | BIM4M2 |
| Darren Lester | SpecifiedBy.com |
| Glen Worrall | Bentley Systems (UK) Ltd |
| Hywel Davies | Chartered Institute of Building Services Engineers (CIBSE) |
| Ian Chapman | RIBA Enterprises |
| Jaimie Johnston | HMG BIM Task Group |
| Jeff Stephens | Build UK BIM Group, buildingSMART UK & Ireland User Group, VINCI Construction UK |
| Mark Bew | HMG BIM Task Group |
| Matthew Teague | Tata Steel |
| Paul Marsland | NG Bailey Ltd |
| Paul Oakley | Building Research Establishment |
| Peter Caplehorn | Construction Products Association |
| Rob Warren | Saint-Gobain |

Foreword

The development and publication of this technical specification has been sponsored by The Department of Business, Innovation and Skills (BIS), and delivered through HMG UK BIM Task Group to provide a consistent approach to defining product information requirements and sharing of product information through the product life cycle, and the life cycle of an asset. It has been developed in association with the Construction Products Association, BIM4M2 and the Chartered Institute of Building Services Engineers (CIBSE) in consultation with a wider stakeholder group.

Purpose of this technical specification

This technical specification is intended to provide a consistent methodology for the definition, creation, management and sharing of product information through the life cycle of an asset based on the purpose of that information, and who the information is to be used by. It does not constitute a standard that has been developed through a recognised and independent consensus-building process. It should therefore not be regarded as a formal British Standard or a BSI PAS. Please provide any feedback on the technical specification to productdata@bim4m2.co.uk.

The technical specification and the methodology it describes provide a framework for defining specific information requirements irrespective of the level of BIM maturity and exchange standards. It is designed to support delivery against defined information requirements such as those set out in BS 1192-4, PAS 1192-2 for capital works and PAS 1192-3 for the operation phase, but also requirements familiar to both supplier and requester of information. This is achieved through the use of plain language terminology that is mapped and exchanged through open standards.

This technical specification is intended to work alongside the BS 8541 suite of standards which define the requirements for library objects for architecture, engineering and construction.

Copyright

Copyright is claimed on Figure 1 and the Product DNA images of Figures 2, 3, 4, 18, 20, 22 and 24. Copyright holder is Steve Thompson. Original Product DNA concept developed by Steve Thompson and Matthew Teague.

1.0 Introduction

Product data is essential for the delivery, maintenance and operation of any physical built asset. It is important to share consistent, accurate information to enable specification, assembly and ongoing maintenance and replacement through an asset's life cycle and the purpose of this technical specification is to provide a framework to support the flow of information using plain language terms with a focus on the purpose of information.

The global construction & asset management sector is changing rapidly to become a more efficient, collaborative and digitised industry, driven by new and more accessible technologies and national or international initiatives and mandates including the UK Government's BIM Level 2 mandate in 2016.

The change to a digital environment leads to a change in the information required and exchanged between actors in the construction and operation of an asset, but also a change in the timing, actors and format of information. Figure 1 compares the typical flow of information through an analogue and digital delivery and operation of an asset, where the information required at Strategic Definition or Preparation & Briefs phases are typically focussed on what is required at an asset or Facilities level such as what the purpose of the Facility is, and what it needs to deliver. System, Product and Material information is not usually considered until the Concept or Developed Design phases, where the requirements of individual elements of an asset are more clearly defined. Finally, in a traditional construction delivery model, the flow of information often stops at the Handover stage with operations & maintenance information being passed to the asset owner, whereas in a digital environment the information continues to flow through the operation and maintenance of the asset.

To support the efficient flow of information through the life cycle we need structured data. We need to consider the purpose of information, who is best placed to provide it, what format it should be provided in and how it can be shared or developed through the life cycle.

The focus of this technical specification is to provide a framework for structuring and organising product information using a plain language dictionary and product data templates which provide accessible terminology that can be clearly understood by those requesting or providing that information. Information can then be exchanged through open standards and presented back in plain language terminology. A key part of the methodology is the agreement and approval of appropriate terminology and templates by recognised industry authorities and clarity on the source of an information requirement.

The purpose of the methodology defined in this technical specification is to:

- Provide manufacturers open access to share product information using familiar terminology, in the confidence that they are providing it in a format that meets user's requirements
- Enable a designer or specifier to provide or request information in a consistent format, to compare similar products that meet identified criteria and be clear on the information requirements that can be addressed by using such a dictionary
- Enable a contractor to define their specific information requirements on product performance, availability and logistics
- Enable a chartered surveyor to request information to support cost planning and life cycle costing
- Enable facilities managers or employers to consistently receive information for future operation and maintenance that meets their specific needs
- Enable restricted data on sensitive assets to be requested using a common language, which can be clearly separated from non-restricted data in a client-specific template.

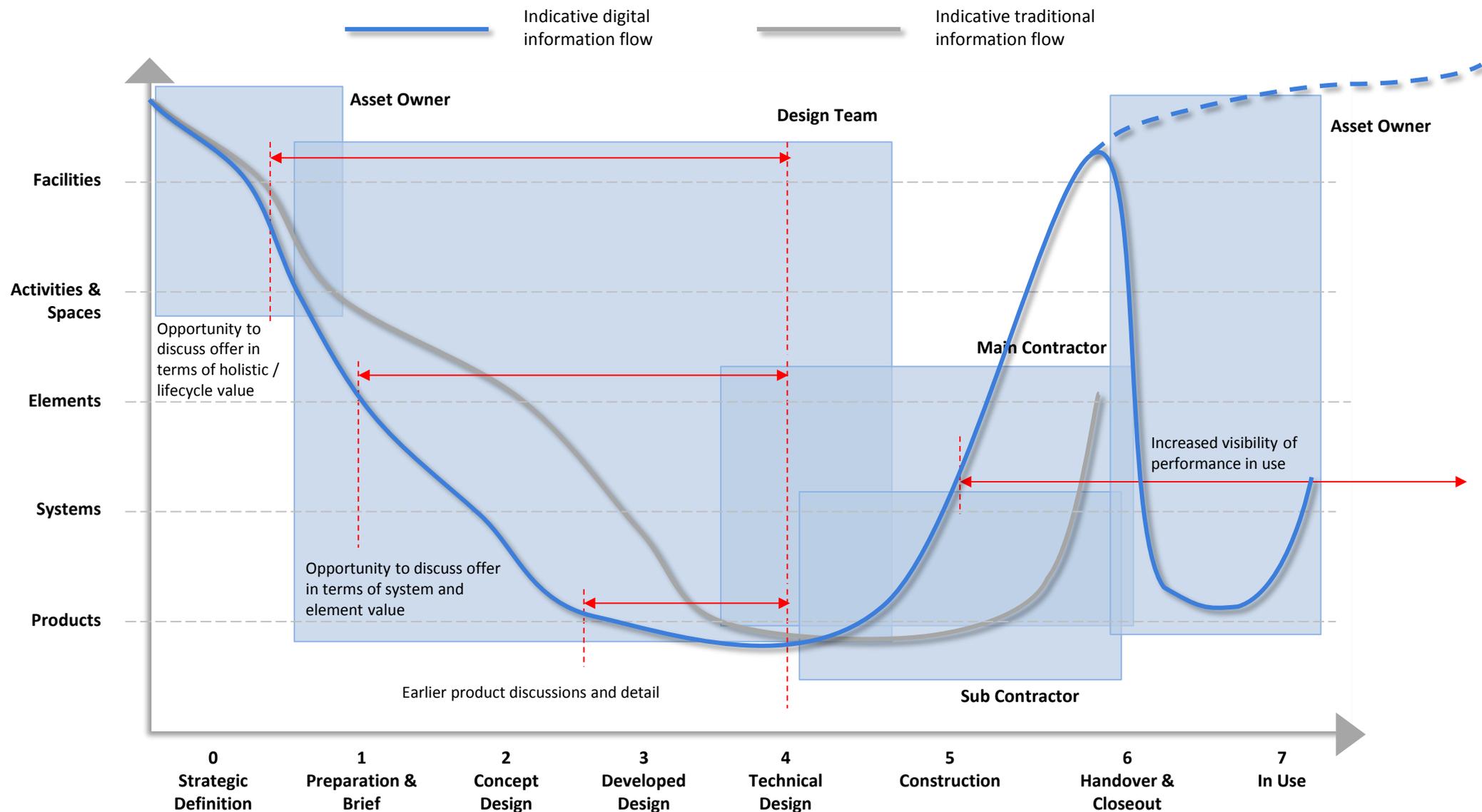


Figure 1: Information flow, granularity and changing points of interaction using digital processes

2.0 Scope

This technical specification sets out to provide a mechanism to enable convergence across the manufacturing sector to a common method of providing product information, to enable the consistent flow of information from a manufacturer on an application-agnostic product through to an installed, operational and maintainable product or system.

The scope includes defining and documenting a transparent development, approval and management process for flexible industry consensus and peer reviewed product information sets and a consistent plain language dictionary for product parameters, which must remain open to achieve industry adoption and widespread use.

In addition to the information requirements of parameters, information sets and sources this technical specification provides a methodology for industry approval of information requirements in a timely manner, based on existing industry expertise and recognised organisations.

The technical specification provides the structure to enable plain language parameters to be exchanged through open standards including ISO 16739 IFC 4 and BS 1192-4, whilst ensuring that all necessary product information requirements are met to comply with relevant standards through the life cycle of an asset.

The structure and categorisation of information request sources and a flexible approach to product data templates enable individual users and clients to create their own information sets and templates. This process provides the opportunity to separate restricted data on secure assets (for example data held within the CPNI secure extranet), with other, more public information requirements.

The scope of this technical specification does not include the definition of specific data templates for products or systems, but the process with which they should be defined and shared consistently based on the purpose of the information.

3.0 Implementation

In the short term this technical specification will be implemented through a joint initiative between the Construction Products Association, HMG BIM Task Group and BIM4M2. A free-to-all plain language dictionary and template tool will be provided that enables users to access, create and download data templates combining information requirements from a number of industry sources. In addition a number of industry groups and organisations will act as relevant authorities to approve terminology and information requirements for defined applications, led by the BIM4 Steering Group as the Executive Relevant Authority and the Construction Products Association as the Lead Authority - Product.

The plain language dictionary and template tool will include product data templates, not product data itself.

Whilst this technical specification should not be seen as a formal standard, it is provided as the basis for future adoption as a formal standard, and the approach developed will provide input into the standards development at a European and ISO.

4.0 Terms and definitions

For the purposes of this technical specification the following terms and definitions apply.

4.1 Actor

Person, an organization or an organizational unit (such as a department, team, etc.) involved in a construction process

4.2 Building Information Modelling (BIM)

Process of designing, constructing or operating a building or infrastructure asset using electronic object oriented information

4.3 Classification

Systematic arrangement of headings and sub-headings for aspects of construction work including the nature of assets, construction elements, systems and products

4.4 Client

Individual or organization commissioning a built asset

4.5 COBie

Construction Operations Building Information Exchange, a mandated requirement to comply with the UK Government's BIM Level 2.

4.6 Core property

A property which should be an IFC 4 property where one exists (or clearly defined parameter to another open standard where an IFC property is not available), which relevant unique parameters are mapped to and from to support the exchange of information.

4.7 Data

Information stored but not yet interpreted or analyzed

4.8 Defining selection

A selection made and recorded to create a product data template in accordance with this Technical Specification.

4.9 Dictionary

Computer system hosting the properties and groups of properties and providing the functions necessary for their management

4.10 Employer

Individual or organization named in an appointment or building contract as the employer

4.11 Essential characteristics

The clauses of a harmonised European Standard, shown in the Annex ZA that identify the information requirements of the mandate given under the Construction Product Regulations

4.12 Executive Relevant Authority

Relevant authority with overall responsibility for the approval of other relevant authorities, unique parameters, information sets and approved product data templates.

4.13 Filter

Filters are used when creating product data templates to identify information sets and unique parameters relevant to the identified product or purpose.

4.14 IFC

ISO 16739 Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries

4.15 Information

Representation of data in a formal manner suitable for communication, interpretation or processing by human beings or computer applications.

4.16 Information set

Pre-defined combination of unique parameters for a given purpose

4.17 Parameter

A factor that defines a product or characteristic and determines (or limits) its performance

4.18 Parameter name

Name of a parameter, which may in itself not be unique

4.19 Priority group

Priority Group number, from 1 to 6 as defined in Section 6.0 of this Technical Specification.

4.20 Product data template

Industry consensus and peer reviewed product information set, created using defined selections from a plain language dictionary compliant with this Technical Specification.

4.21 Relevant Authority

Organisation or individual identified as having the knowledge and responsibility to identify and/or approve unique parameters and information sets

4.22 Responsibility field

A field for users of templates created in line with this Technical Specification to identify responsibilities to provide information in response to a unique parameter

4.23 Responsibility field

Name of source of information requirements and priority group

4.24 Technical Authority

Organisation or individual identified as having the knowledge and responsibility to identify correct mapping between unique parameters and IFC properties or concepts, or other open standards to support the exchange of information

4.25 Unique identifier

A unique identifier generated to identify a unique parameter, template or information set. Generated using an algorithm in conformity with standard ISO 12006-3 sub-clause 4.3.2. It is represented by 22 alphanumeric characters

4.26 Unique parameter

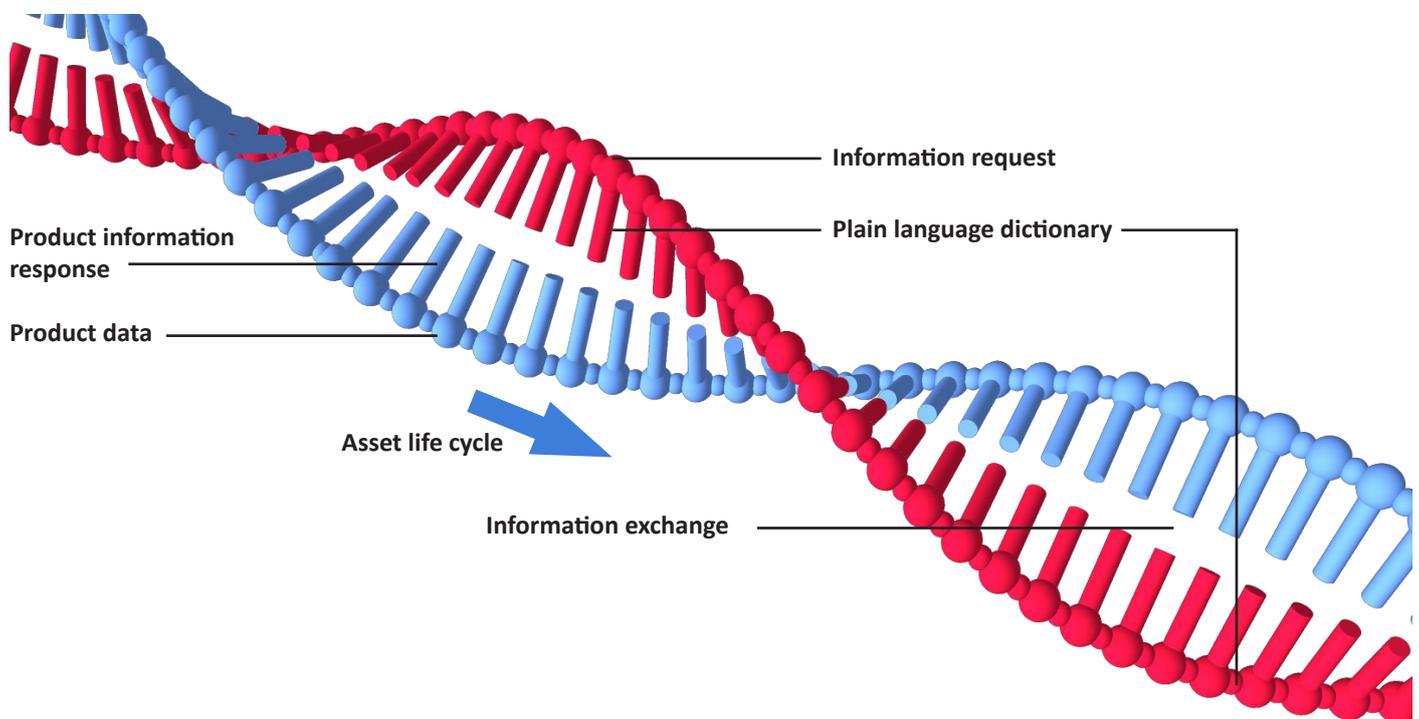
A unique information combination of parameter name, description, data type and source, which can be identified by a unique identifier

4.3 Acronyms

BIM - Building Information Modelling
COBie - Construction Operations Building Information Exchange
CPNI - Centre for the Protection of National Infrastructure
IFC - Industry Foundation Classes

5.0 The concept: Product DNA

Product DNA; information that stays with a product, and continues to grow through the life cycle of the product and assets. To enable consistent definition, production and sharing of product data there needs to be a consistent, accessible language that can be tailored to supply information based on its purpose and audience to support efficient design, delivery and operation of assets.



© Thompson 2016

Figure 2: Product DNA - information that stays with a product, and continues through the life cycle of the product and assets

A consistent approach to product data needs to consider a number of factors, including:

- What are the information requirements for both employers and their supply chains, and indeed for the product manufacturers themselves?
- What capabilities (including skills, software and infrastructure) are required to provide and access product information through a developed process and information sets?

- How is any approach applied and maintained over the long term, and how can it be scaled across sectors and regions?

Figure 2 illustrates the concept of Product DNA. The actor requiring information relating to a product should be able to ask for the information they require in a language they are familiar with, at a relevant stage of the asset's life cycle.

Likewise, the supplier of information in response to the request should be able to provide the information in a language they are familiar with.

Both the request and response use real-world definitions, which in the Product DNA concept form part of a plain language dictionary.

The translation between the two, and the necessary exchange of information, occurs within the virtual world of open information exchange, which the majority of actors within the product and asset life cycles do not need to concern themselves with.

The approach is intended to increase the accessibility of product information for both those requesting and those providing information.

The concept also enables information to be defined at any point in the life cycle, meaning that information sets can be created between the key information exchanges within a project and to track changes in specifications and responsibilities.

Figure 3 uses the Product DNA concept to identify common product data templates through the key stages of asset delivery. These are:

- Product **Production** information - required for the manufacturer to procure resources and produce and distribute their products. These requirements are often overlooked and not typically defined, but provide a significant opportunity for manufacturers and their downstream supply chain.
- **Obtainable** product information - information on a product that can be obtained, but that is application and project agnostic. Potentially wholly supplied by a product manufacturer or distributor.
- Product **Application** information - application and sector specific, this falls into two categories:
 - **Application or sector-specific information** - where information requirements relate to a given application. This can potentially be wholly supplied by a manufacturer or distributor.
 - **Project-specific application information** - where the information requirements relate to a specific project. This type of information is likely to be supplied by a combination of the project team and product supplier

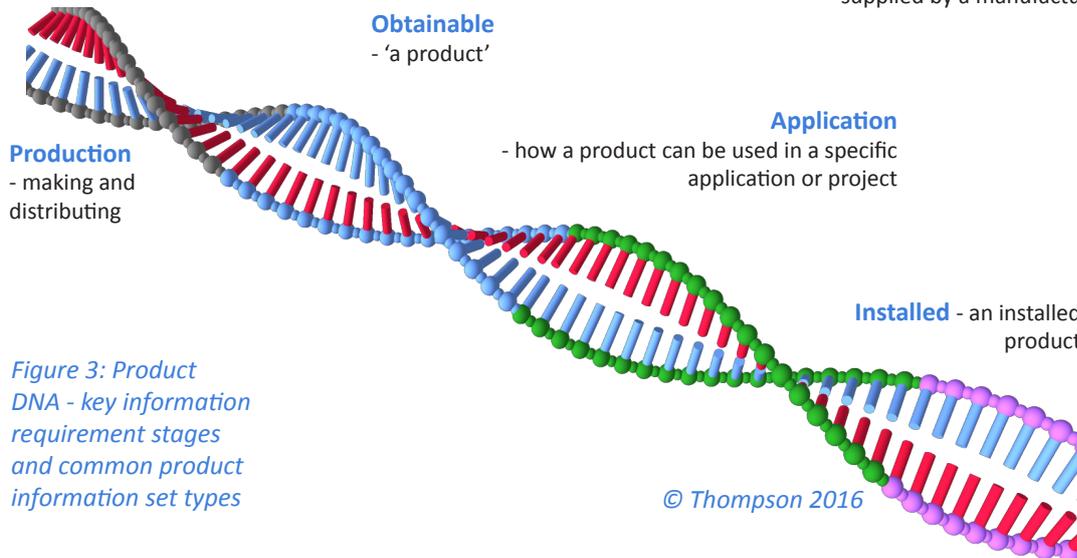


Figure 3: Product DNA - key information requirement stages and common product information set types

In addition to products, systems and elements, the approach can be applied to interfaces such as the junctions between walls and floors, or walls and roofs.

By linking existing common terminology to open exchange standards such as IFC 4 (Industry Foundation Classes), the information from different asset life cycle stages and granularity can be mapped to relevant information requirements at a product level. For example, the need at an early stage for a large clear span space can be mapped to structural systems that are capable of achieving the requirements later in the specification / delivery phase.

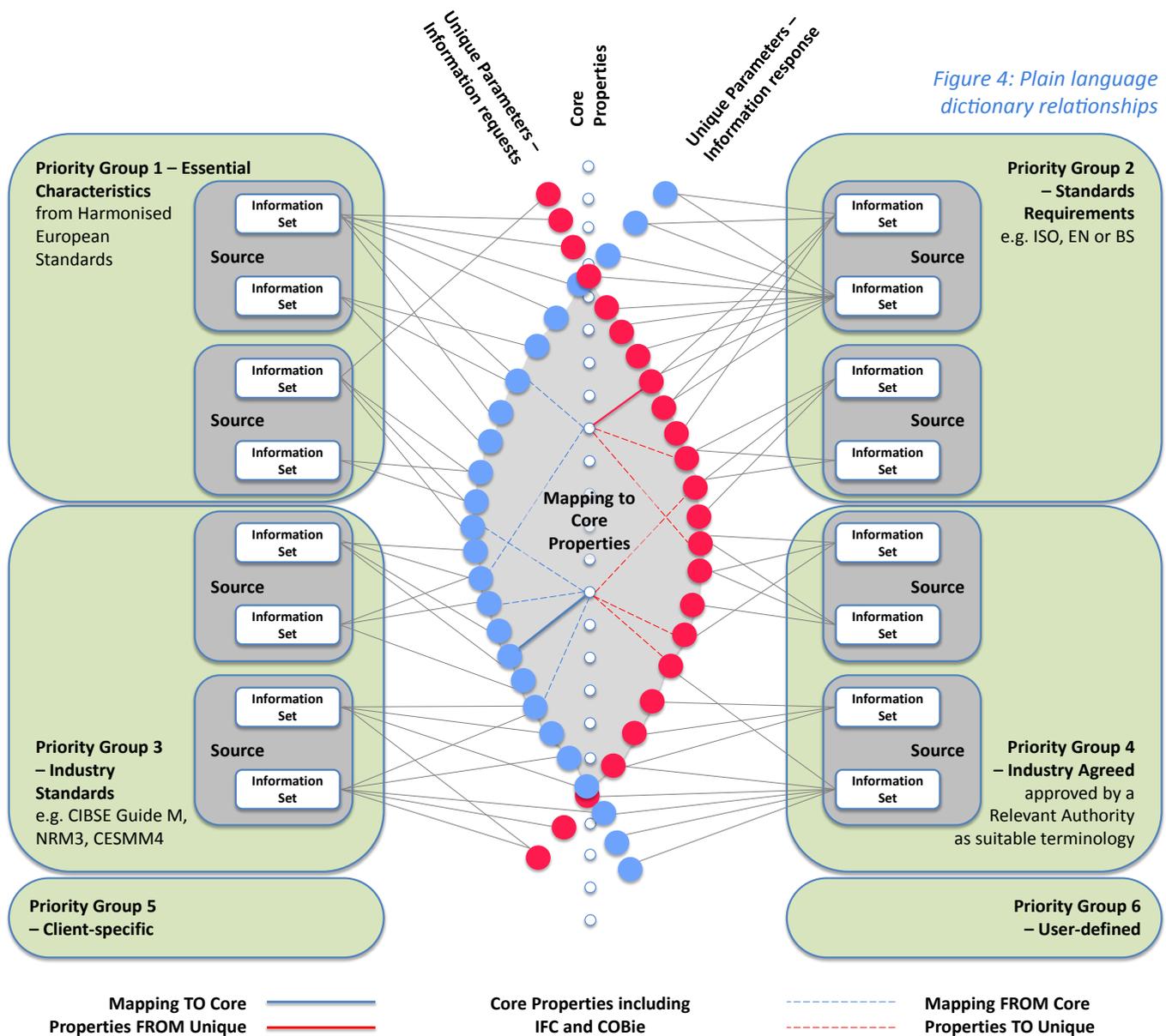
- **Installed** product information - This is likely to include information on a specific occurrence of a product within an asset including warranty and maintenance information relevant. This information is likely to be supplied by a combination of the manufacturer, project team and asset owner over its life cycle.

6.0 Plain language dictionary

The plain language dictionary enables information requirements from existing industry sources to be mapped to open data exchange standards including IFC 4 and COBie. In addition, parameters can be added by registered users and, following approval by Relevant Authorities, be shared with the wider community. Unique parameters include unique identifiers, which enable consistent exchange with many different software platforms.

Introduction

Figure 4: Plain language dictionary relationships



© Thompson 2016

A dictionary that meets this technical specification will consist of **Unique Parameters** which are grouped into **Information Sets**, which come from an identified **Source**. Each Source falls within a **Priority Group** based on the extent of industry recognition and agreement on the validity of the Source.

Unique Parameters within the dictionary will be mapped to a **Core Property** by a **Technical Authority** to enable translation to other Unique Parameters within another Information Set.

Registered users of a dictionary that meets this technical specification can propose new Unique Parameters where they do not currently exist and use them immediately within a user-defined **Product Data Template**. However, these terms will not become part of the dictionary until they are approved by a **Relevant Authority**, at which point the Unique Parameter can be incorporated into an **Approved Product Data Template**.

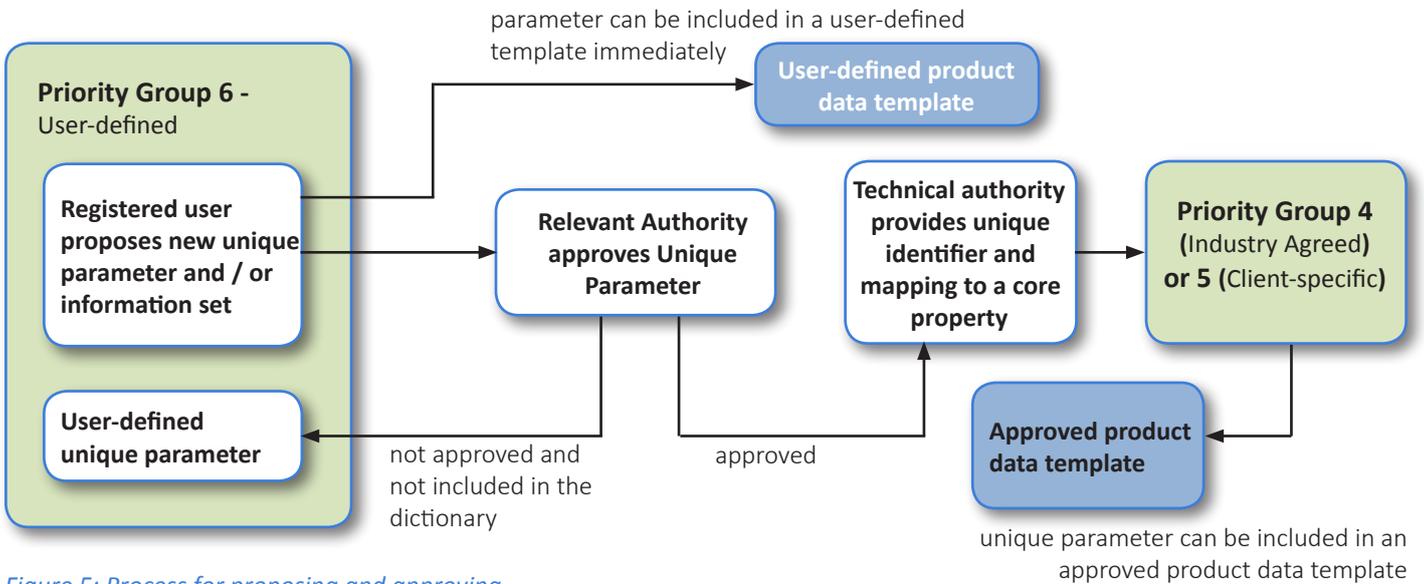


Figure 5: Process for proposing and approving user-defined parameters for inclusion in a dictionary

Definitions

Core property

A property which should be an IFC 4 property where one exists (or clearly defined parameter to another open standard where an IFC property is not available), which relevant unique parameters are mapped to and from to support the exchange of information.

Information set

Pre-defined combination of unique parameters for a given purpose.

Priority group

Priority Group number, from 1 to 6 as defined in Section 6.0 of this technical specification.

Relevant authority

Organisation or individual identified as having the knowledge and responsibility to identify and/or approve unique parameters and information sets.

Product data template

Information set consisting of industry consensus and peer reviewed unique parameters relating to a specific product or purpose, created using defined selections from a plain language dictionary compliant with this technical specification. An **approved product data template** is a template that has been approved by a relevant authority as containing an appropriate information set for a specific product or purpose.

Source

Origin of an information requirement.

Technical authority

Organisation or individual identified as having the knowledge and responsibility to identify correct mapping between unique parameters and core properties or concepts.

Unique parameter

A unique information combination of parameter name, description, data type and source, which can be identified by a unique identifier.

6.1 Parameter and information set source priority groups

To enable a dictionary to continue to develop and incorporate further information requirements from a range of sources, parameter sources are prioritised based on their level of quality management and industry acceptance as recognised terminology. An example of a similar approach can be found in ISO 16739 *Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries*. These priorities are used to create information sets based on common terminology that can be linked to international and industry or sector specific requirements, whilst allowing the flexibility for registered users to create their own terms where they do not currently exist within the dictionary. The priority groups, with the highest priority first, are described below.

1 Harmonised European Standard Essential Characteristics

Information identified in Appendix ZA of a harmonised European Standard (hEN) as being an Essential Characteristic that must be provided to comply with the European Construction Product Regulations (Regulation (EU) No 305/2011).

2 Standards requirements

Information required to demonstrate compliance against relevant ISO, EN or BS standards other than those requirements identified in Appendix ZA of a harmonised European Standard (hEN).

3 Industry recognised requirements

Information identified within recognised industry or sector standards or recommendations. This group includes two categories:

3A Mandated requirements

Information required to comply with identified standards within a specific sector or application other than those falling under groups 1 and 2 above. An example of this category is *NRM 3 : Order of cost estimating and cost planning for building maintenance works*

3B Non-mandated requirements

Information identified as recommended within a specific sector or relating to a given application. An example is *CIBSE Guide M: Maintenance Engineering and Management*

4 Industry agreed requirements

Information requirements identified and agreed by a relevant industry group. This may include information identified by a professional institute, trade association or cross-industry group (for example in a product data template) that is not included in groups 1, 2 or 3 above. Unique parameters must be approved by a relevant authority before being categorised within this group.

5 Client-specific requirements

Clients registered to use the dictionary will be able to create their own information sets and parameters to ensure any specific requirements not identified in the main dictionary can be incorporated.

6 User-defined requirements

Unique parameters identified by a registered user of the dictionary that do not fall within groups 1-4 above. Unique parameters in this category will be created using parameter names, descriptions and sources already within the dictionary where possible. These unique parameters can be used by the registered user who has added the parameter as described in Figure 5, however the unique parameter will not be visible to others searching the dictionary, or receive a unique identifier until the term is approved by a Relevant Authority and upgraded to Group 4 above. This enables users to include bespoke requirements whilst maintaining the consistency and rigour of the dictionary itself. Information requirements required to propose a new unique parameter are described in Section 6.2.

6.2 Information required to propose a new unique parameter

Information requirements for a registered user (of a dictionary complying with this technical specification), to propose a new unique parameter are described in Figure 6.

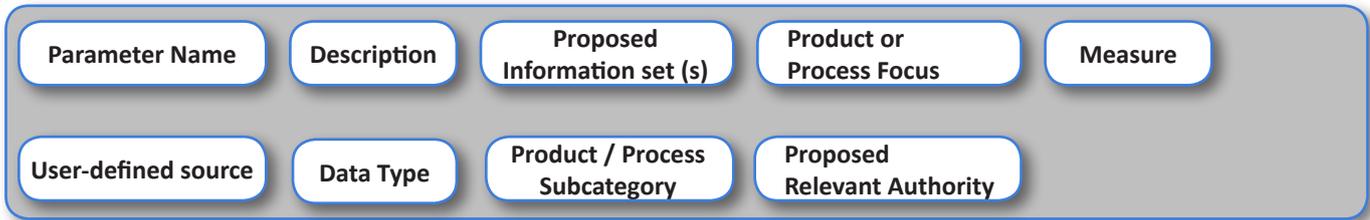


Figure 6: Information required to propose a new unique parameter in Priority group 6 - user-defined

Definitions

| | |
|--------------------------------------|--|
| Data Type | Type of input required, e.g. integer, Boolean, list, range, text string |
| Description | Clear description of what application the unique parameter relates to, and what information is required |
| Measure | Type of measure, e.g. length, force |
| Parameter Name | Name of parameter, which may not be unique |
| Proposed Information Set (s) | Information sets that the proposed unique parameter relate to. These can include information sets already within the dictionary, or new user-defined information sets |
| Product or Process Focus | Identifying whether the proposed unique parameter is predominantly relevant to a product(s) or other physical entities or to process(es) relating to a discipline or role. For more information refer to Section 6.3 |
| Product / Process Subcategory | Identified product or process subcategory from a published list of available options |
| Proposed Relevant Authority | An existing relevant authority suggested by the user to approve the proposed unique parameter. |
| User-defined Source | Source that the proposed unique parameter originates from. This may include a Source already within the dictionary, or a new user-defined source |

Filters

Filters are used when creating product data templates to identify information sets and unique parameters relevant to the identified product or purpose. Refer to Section 6.7.2 on how to apply filters.

| | |
|-------------|--|
| Unit | Relevant units for a given view or application of the unique parameter |
|-------------|--|

6.3 Relevant authorities

Relevant authorities play a key role in the successful application of a dictionary compliant with this technical specification.

A relevant authority is an organisation or individual with expertise relevant to a product, process or discipline involved in the design, delivery and operation of physical built assets. It is the role of a relevant authority to approve proposed unique parameters, information sets, product data templates and sources, and in some cases new relevant authorities.

It is envisaged that most unique parameters will not only be relevant to one particular product type or discipline. As such the approval of a unique parameter should be considered by more than one organisation or relevant authority. relevant authorities fall into two categories, those that are predominantly relevant to a product or other physical entity, and those that are relevant to a discipline or role. Organisations wishing to become relevant authorities should be required to apply to become an authority, with the information identified in Section 6.4 as a minimum requirement.

Relevant authorities for product related parameters are likely to be trade associations where they exist for the relevant product or system types. Where they do not exist, the request will be considered by the next highest tier, with the Construction Products Association acting as the lead authority for product related requests.

Relevant authorities for parameters relating to processes, disciplines or roles are likely to be industry bodies, professional institutes or recognised groups that may have been set up with the purpose of defining information requirements. The BIM4Steering Group will act as the lead authority for non-product related request. In addition the BIM4Steering Group, consisting of the Chairs of the BIM 4 Communities groups, will also act as the Executive Relevant Authority, with overall responsibility for the approval of other relevant authorities, unique parameters, information sets and approved product data templates.

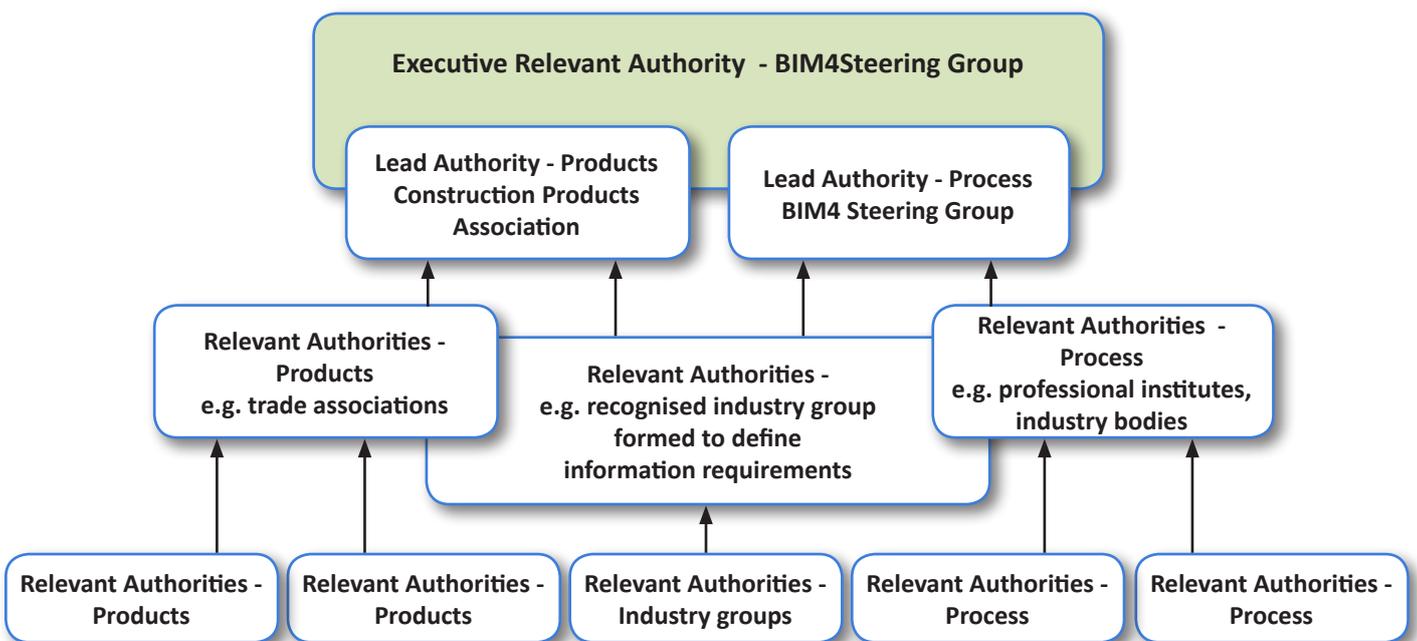


Figure 7: Relevant authorities structure

A full list of existing relevant authorities must be accessible for any dictionary compliant with this technical specification, and include the areas of expertise that each authority covers.

When a new unique parameter, information set, source or relevant authority is proposed, in addition to the user having the ability to nominate a relevant authority at least two relevant authorities should be identified to consider the request representing a combination of product and process authorities where possible. The relevant authorities will be identified by the selection made in the product or process categories within the request, as described in Figure 6. Available subcategories for both product and process related requests will be clearly visible when submitting a proposed unique parameter, information set, source or relevant authority.

The identified relevant authorities should be notified automatically that they have an approval to consider, and a clear and consistent time scale identified for approval. Once the identified time has elapsed, agreement cannot be reached by the relevant authorities or the request is outside of the area of expertise of the relevant authorities, the request will automatically be referred to the next highest authority, which may be a lead authority. There must then be a clear and consistent time scale identified for approval.

Once the identified time has elapsed, if no decision is made the request must be referred to the Executive Relevant Authority to consider and respond within a clearly identified time scale, at the end of which the request will be deemed to be approved if no decision is otherwise confirmed, and the user requesting the approval will be notified automatically, with the proposed unique parameter, information set, source or relevant authority automatically being added to the dictionary.

The approval time scale may be stepped based on the number of requests submitted by the user, but this must be clearly identified at the beginning of the approval process. Through automating the process it is envisaged that once submitted, the approval process will be timely and typically a matter of days or weeks, not months.

All decisions and referrals will be reported to the lead authorities and Executive Relevant Authority to a regular time scale, which must be identified at the beginning of the proposal process.

6.4 Application requirements to become a relevant authority

Figure 8 describes the information required to propose a new relevant authority.



Figure 8: Information requirements to propose a new relevant authority

Definitions

| | |
|--|---|
| Relevant Authority Name | Name of the organisation looking to become a relevant authority |
| Description | Short description of the organisation |
| Point of Contact | Contact details including a named representative and email address |
| Industry Role | Role within industry, e.g. a trade association, professional institute, charity, volunteer organisation |
| Product or Process Focus | Identifying whether the organisation is predominantly focussed on product(s) or other physical entities or to process(es) relating to a discipline or role. For more information refer to 6.3 |
| Product / Process Subcategory | Identified product or process subcategory from a published list of available options |
| Umbrella Organisation | Does the proposed authority report to an umbrella organisation? |
| Member Organisations | Do other organisations report into the proposed authority? |
| Areas of Expertise | Identified areas of expertise other than those identified as product / process subcategories |
| Overlapping Relevant Authorities | Identified existing relevant authorities that have similar expertise and product or process focus |
| Overlapping Trade Associations or Industry Bodies | Identified industry organisations that have similar expertise and product or process focus |

6.5 Information required to propose a new source

Figure 9 describes the information required to propose a new relevant authority.



Figure 9: Information requirements to propose a new source

Definitions

| | |
|--------------------------|---|
| Authority Type | Identifying whether the organisation is predominantly focussed on product(s) or other physical entities or to process(es) relating to a discipline or role. For more information refer to 6.3 |
| Authority Sub-type | Identified product or process subcategory from a published list of available options |
| Description | Clear description of the proposed Source |
| User-defined Source Name | Name of source. When referring to standards, name should include document reference, e.g. EN 10210-1 |

6.6 Information required to propose a new information set

Figure 10 describes the information required to propose a new Relevant Authority.



Figure 10: Information required to propose a new information set

Definitions

| | |
|----------------------|--|
| Country / Region | Country or region where the parameter applies if country or region specific |
| Description | Clear description of what application the information set relates to, and what information is required |
| Information set name | Name of proposed Information set |
| Source | Name of source of information requirements |

6.7 Unique parameter information requirements

Figure 11 describes the minimum information requirements for a unique parameter to be included in a dictionary meeting this technical specification. Each unique parameter must be assigned to at least one property set.

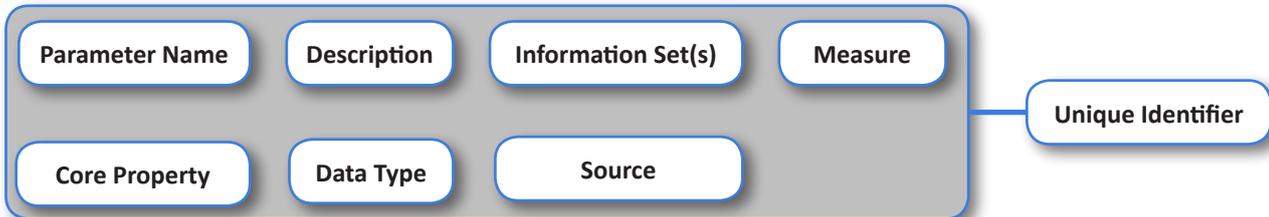


Figure 11: Unique parameter information requirements

Definitions

| | |
|----------------------------------|---|
| Core Property | A property which should be an IFC 4 property where one exists (or clearly defined parameter to another open standard where an IFC property is not available), which relevant unique parameters are mapped to and from to support the exchange of information. |
| Data Type | Type of input required, e.g. integer, boolean, list, range, text string |
| Description | Clear description of what application the unique parameter relates to, and what information is required |
| Parameter Name | Name of parameter, which may not be unique |
| Measure | Type of measure, e.g. length, force |
| Relevant information Sets | Identifies which information sets will include the unique parameter. |
| Source | Name of source of information requirements and priority group |
| Unique Identifier | A unique identifier generated by the dictionary to identify the unique combination of parameter name, description and source |
| | |
| Filters | Filters are used when creating product data templates to identify information sets and unique parameters relevant to the identified product or purpose. Refer to Section 6.7.2 on how to apply filters. |
| | |
| Relevant Actors | Actor (s) that the unique parameter is likely to be relevant to |
| Relevant Life cycle Stage | Identifies potential life cycle stages where the unique parameter is likely to be relevant |
| Unit | Relevant units for a given view or application of the unique parameter |

6.7.1 Data type

The type of data required should be compatible with the options identified in ISO 16739 buildingSMART IFC 4 IfcValue or other pre-defined data types including the following:

- Range (specifying a 'from' and 'to')
- Pre-defined list
- Percentage

Where the data is limited to a predefined list, the potential options forming the list must be clearly identified.

6.7.2 Filters

Where relevant, unique parameters should be assigned selections to each of the filters described in Figure 11, to enable the effective creation of product data templates as described in this technical specification. Relevant values must be provided for each information set that the unique parameter applies to, which will then be filtered during template creation.

6.8 Removing parameters and approval process

Unique parameters and information sets can be removed from use in a dictionary complying with this technical specification by a relevant authority with the agreement of related relevant authorities. However, the term or information set being removed must remain in the dictionary and include both an explanation of the reason for removal, and where applicable any replacement unique parameters or information sets.

6.9 Source information requirements

Figure 12 describes the minimum information requirements to define a source of information sets or parameters. Each unique parameter must be assigned to at least one information set, and each information set must be assigned to a source, to enable mapping to product information requirements.

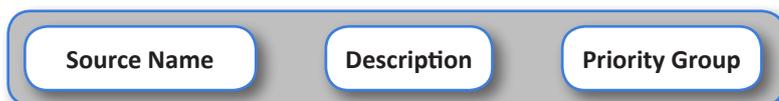


Figure 12: Source information requirements

Definitions

| | |
|-----------------------|--|
| Description | Clear description of what information is required and what the unique parameter or information set applies to. |
| Priority Group | Priority group number, from 1-5 as described below. |
| Source Name | Name of source. When referring to standards, name should include document reference, e.g. EN 10210-1 |

6.10 Information sets

Each unique parameter must be included in one or more information set within the dictionary. The information sets are then assigned to relevant product, system and element types which enables the creation of product and application-specific data sets. Data sets can be defined in a number of ways, including:

- by product, system and element type in accordance with an identified classification system or source, such as Uniclass 2015 or NRM 3
- by life cycle stage
- by region
- by actor
- by source

The minimum information requirements for a unique information set are identified in Figure 13. The approval process for information sets is the same as for unique parameters.



Figure 13: Information set information requirements

Definitions

| | |
|-----------------------------|---|
| Country / Region | Country or region where the parameter applies if country or region specific |
| Description | Clear description of what application the information set relates to, and what information is required |
| Information set name | Name of Information set |
| Source | Name of source of information requirements and priority group |
| Unique Identifier | A unique identifier generated by the dictionary to identify the unique information set name, description and source |

Information sets can be created for interfaces between physical elements (for example a junction between two walls, or between a wall and roof), in which case the specific nature of the application must be clearly defined. Information sets can also be defined for specific information requirements such as gross internal floor area (GIFA) or activities, with clear responsibilities identified for completing information at a parameter level.

7.0 Product data templates

7.1 Product identification

Information sets will be applied to specific physical entities, life cycle stages, actors, interfaces or activities. These must be linked to an IFC4 entity where one exists, be classified within a recognised classification system compliant with ISO 12006-2 *Building construction -- Organization of information about construction works - Part 2: Framework for classification* (for example Uniclass 2015) or alternatively classified in line with a source document in priority groups 1-4 as defined in this technical specification. The hierarchy and relationship between different tables in Uniclass 2015 are illustrated in Figure 14. Figure 15 illustrates the levels of measurement according to NRM3, and how these are applied through a building’s life cycle. Information sets can be applied to create product data templates specific physical entities or activities using these and other classification approaches.

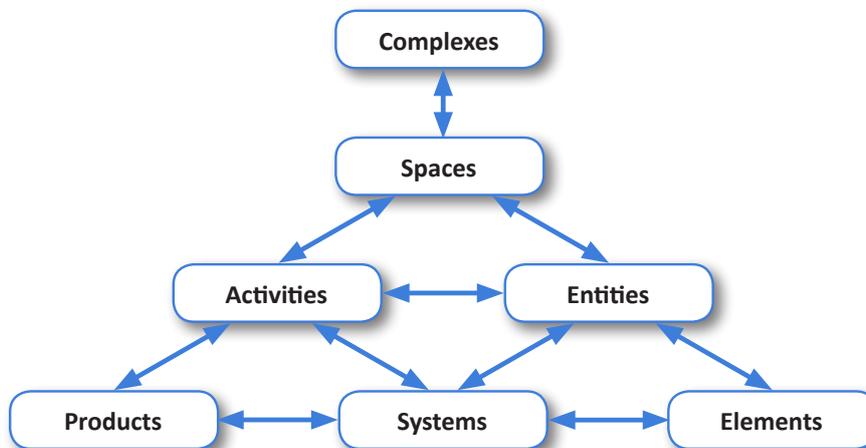


Figure 14: Uniclass 2015 table hierarchy. Source: NBS

| | Built asset (level 0) | Grouped element (1) | Element (2) | Sub-element (3) | Component (4) |
|---------------|---|--|--|--|---|
| Construct | m ² or function unit | Construct work cost estimates (m ²) | Cost planning (concise) | Cost planning (amplified) Detailed measurement | Cost planning (specific) Detailed measurement |
| Renewal | m ² /pa or function unit | Renewal work cost estimates (m ² /pa) | Renewal work cost estimates (m ² /pa) | Cost planning (various) Detailed measurement | Cost planning (various) Detailed measurement |
| Maintain | m ² /pa or function unit | Maintenance work cost estimates (m ² /pa) | Cost planning (various) | Cost planning (various) Detailed measurement | Cost planning (various) Detailed measurement |
| Other aspects | As agreed in scope (e.g. end of interest) | Relevant maintenance considerations | Relevant maintenance considerations | Relevant maintenance considerations | Relevant maintenance considerations |

Figure 15: Levels of measurement undertaken during the building’s life cycle. Source: Figure 2.3 NRM3

Where an information set does not directly link to specific physical entities, life cycle stages, actors or activities as identified in a recognised classification system or entity within an open standard, the purpose of the information set must be clearly defined. Information sets are prioritised in the same way as unique parameters, using priority groups 1-6.

7.2 Format options and export capability

A product data dictionary and template tool compliant with this technical specification must include the capability to create product data templates as described in this section from the relevant information sets and unique parameters within the dictionary.

The capability to create templates must include:

- ability to download, save or export templates including a record of the selections on which the template is created and date of template creation
- ability to remove unique parameters from the template and a record kept of those that have been removed
- ability to add parameters to the template from the dictionary and a record kept of those unique parameters that have been added
- searchable library of approved product data templates

7.3 User-defined and approved product data templates

As described in Section 6.0, registered users of a dictionary and template tool in accordance with this technical specification can create specific product data templates based on the unique parameters and information sets included in the dictionary. Whilst the unique parameters and information sets in themselves have been approved by a relevant authority (with the exception of proposed unique parameters), the templates themselves are not approved, and as such these templates remain as **user-defined product data templates** until they are approved by a relevant authority.

A **client-specific product data template** is created in the same way as a user-defined template, but includes information sets defined by the client, and should be clearly identified as being approved by the client and should include the relevant client name within the template.

Both user-defined and client-specific product data templates must identify unique parameters that are not approved parameters within a dictionary that meets this technical specification.

Once a template in the dictionary has been approved by a relevant authority it becomes an **approved product data template**, meaning that the combination of information sets and unique parameters are deemed suitable for the identified purpose.

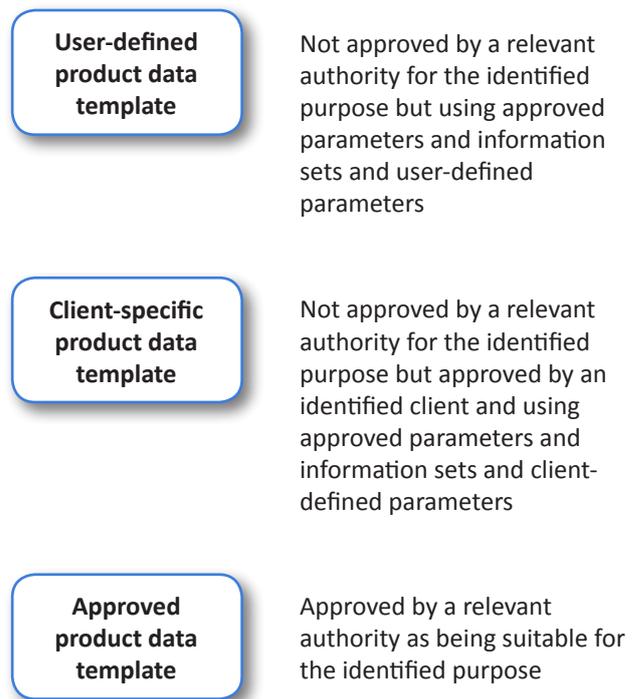


Figure 16: Product data template types

An approved product data template must include details of the relevant authority that has approved the template.

Product data templates compliant with this technical specification include responsibility fields for each unique parameter. These fields provide the ability to:

- Identify who is **responsible** for entering the parameter values
- identifying who has **entered** the parameter values

These fields are important to provide clarity and confidence that those responsible and capable complete the necessary fields.

7.4 Product data template format

Figure 17 identifies the minimum information required within a product data template that is compliant with this technical specification.

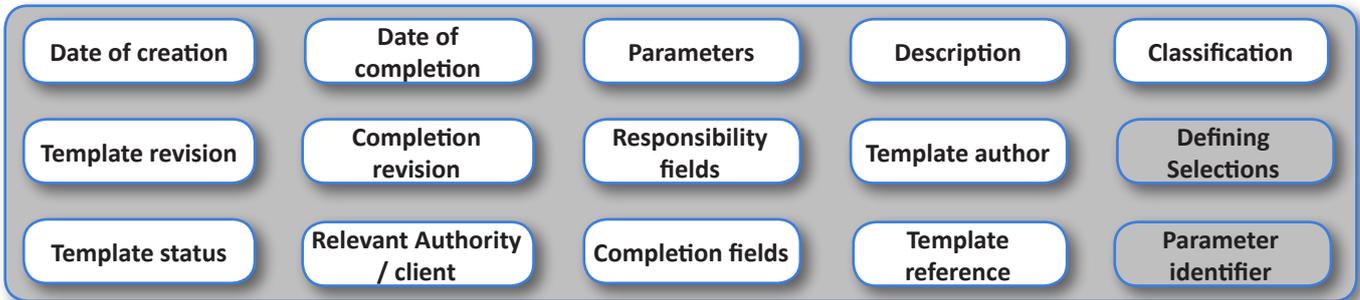


Figure 17: Product data template information requirements

Information visible on templates

| | |
|-----------------------------|---|
| Classification | Classification code and description that the template relates to. |
| Completion fields | Fields to identify who has provided values against each unique parameter |
| Completion revision | Revision of the completion of the template |
| Date of completion | Date and time that the template was last completed |
| Date of creation | Date and time that template was saved or exported from the dictionary |
| Description | Clear description of the template created. This may include the selections made. |
| Parameters | List of unique parameters included in the template including parameter name, description, entry field, data type, units, measure |
| Relevant Authority / client | If the template has been approved, identifies the relevant authority. If the template is a client-specific template identifies the client |
| Responsibility fields | Fields to identify who is responsible for providing values against each unique parameter |
| Template author | Registered user or organisation that created the template |
| Template reference | Reference number of the template to be defined by template author |
| Template revision | Revision of the template creation |
| Template Status | Identifies the template as user-defined, client-specific or approved |

Information that is not required to be visible to those using the templates but must remain accessible

| | |
|----------------------|--|
| Defining Selections | List of selections made to create the template from the dictionary, including any parameters added or removed following those selections |
| Parameter identifier | A unique identifier generated by the dictionary to identify the unique combination of parameter name, description and source |

8.0 Use Cases

This section describes four example use cases of the potential application of this technical standard. These are:

- A user-defined template for structural steel hollow sections
- A client-specific template relating to a sensitive built environment as defined in PAS 1192-5
- An approved product data template
- Mapping of information requirements between different approved information sources for life cycle costing

8.1 User-defined template

As described in Section 7.3 of this technical specification, a user-defined product data template is one that has not been approved by a relevant authority, but still uses unique parameters that are within a dictionary in line with this technical specification. This example is based on a user defining a product data template for structural steel hollow sections. The template includes user-defined information requirements for geometry and performance, and requirements from within sources that would be approved as part of a dictionary meeting this technical specification, including:

- Essential Characteristics from BS EN 10210-1: Hot finished structural hollow sections of non-alloy and fine grain steels
- Non-essential requirements from BS EN 10210-1

Figure 18 illustrates the mapping of these different sources to core properties, and then from these to a user-defined product data template. Figure 19 provides an extract from the resulting product data template.

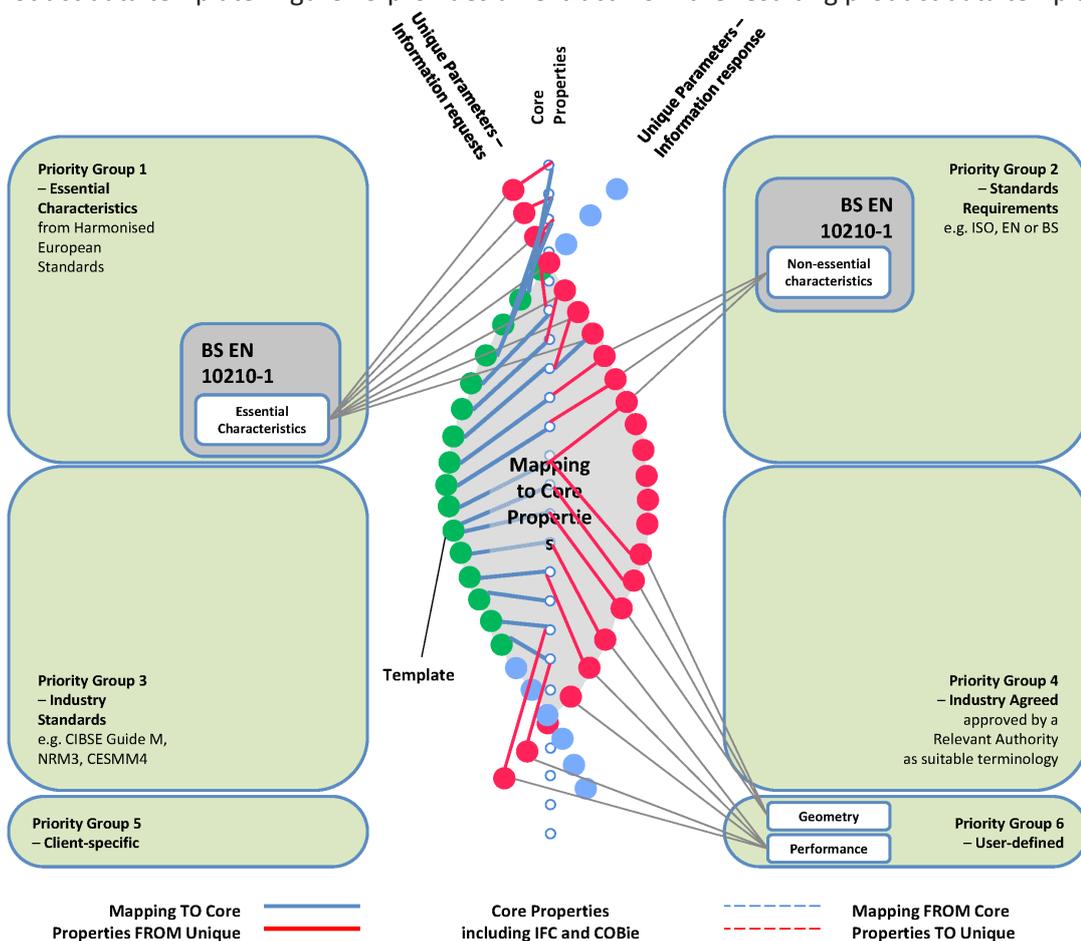


Figure 18: Information sources and mapping for example user-defined template, template represented by green dots

© Thompson 2016

| Template Reference 1234 | | | | Template Revision 1 | | Defining Selections | | |
|---|-------|-------|--|-------------------------------------|---------------------|---------------------|-------------------------|---|
| Classification Pr_20_76_52_16_Carbon steel hot finished hollow sections | | | | Template Revision Date 2016-04-12 | | | | |
| Description Hot finished structural hollow sections - example | | | | Completion Revision 1 | | | | |
| Template Author Me | | | | Completion Revision Date 2016-04-12 | | | | |
| Template Status User-defined | | | | Relevant Authority A N Other | | | | |
| Parameter | Value | Units | Description | Measure | Responsibility | Completed By | Unique Identifier | Information Sets |
| Tolerances | | mm | Tolerances on dimensions and shape for hot finished structural hollow sections | Length | Manufacturer | | OZMi60qRqHuO00025QrE\$V | BS EN 10210 1_2006_EssentialCharacteristics |
| Elongation | | % | Elongation in accordance with Tables A.3 and B.3 of BS EN 10210-1: 2006 | Ratio | Manufacturer | | OZMi60qRqHuO00026QrE\$V | BS EN 10210 1_2006_EssentialCharacteristics |
| Tensile strength | | N/mm2 | Tensile strength in accordance with Tables A.3 and B.3 of BS EN 10210-1: 2006 | Force | Manufacturer | | OZMi60qRqHuO00027QrE\$V | BS EN 10210 1_2006_EssentialCharacteristics |
| Yield strength | | N/mm2 | Yield strength in accordance with Tables A.3 and B.3 of BS EN 10210-1: 2006 | Force | Manufacturer | | OZMi60qRqHuO00028QrE\$V | BS EN 10210 1_2006_EssentialCharacteristics |
| Impact strength | | N/mm2 | Impact strength in accordance with Tables A.3 and B.3 of BS EN 10210-1: 2006 | Force | Manufacturer | | OZMi60qRqHuO00029QrE\$V | BS EN 10210 1_2006_EssentialCharacteristics |
| Weldability | | | CEV value specified, in accordance with Tables A.2 and B.2 of BS EN 10210-1: 2006 | - | Manufacturer | | OZMi60qRqHuO00030QrE\$V | BS EN 10210 1_2006_EssentialCharacteristics |
| Durability | | | In accordance with Clause 6.7.2 of BS EN 10210-1: 2006 | - | Manufacturer | | OZMi60qRqHuO00031QrE\$V | BS EN 10210 1_2006_EssentialCharacteristics |
| Outside diameter | | mm | Outside diameter D of hollow section | Length | Structural Engineer | | OZMi60qRqHuO00032QrE\$V | BS EN 10210 1_2006_NonEssential |
| External perimeter | | mm | External perimeter of square, rectangular or elliptical section | Length | Structural Engineer | | OZMi60qRqHuO00033QrE\$V | BS EN 10210 1_2006_NonEssential |
| Steel grade | | | Steel name, e.g. S355NH | - | Structural Engineer | | OZMi60qRqHuO00034QrE\$V | BS EN 10210 1_2006_NonEssential |
| Cross Sectional Area | | cm2 | Cross sectional area of the section | Area | Structural Engineer | | OZMi60qRqHuO00035QrE\$V | CircularHollowSection_Geometry |
| Thickness | | mm | Specified thickness | Length | Structural Engineer | | OZMi60qRqHuO00036QrE\$V | CircularHollowSection_Geometry |
| Mass | | kg/m | Mass per unit length | Mass | Structural Engineer | | OZMi60qRqHuO00037QrE\$V | CircularHollowSection_Performance |
| Second Moment of Area | | cm4 | Second Moment of Area | Moment of Inertia | Structural Engineer | | OZMi60qRqHuO00038QrE\$V | CircularHollowSection_Performance |
| Radius of Gyration | | cm | Radius of Gyration | Length | Structural Engineer | | OZMi60qRqHuO00039QrE\$V | CircularHollowSection_Performance |
| Elastic Section Modulus | | cm3 | Elastic Section Modulus | Section Modulus | Structural Engineer | | OZMi60qRqHuO00040QrE\$V | CircularHollowSection_Performance |
| Plastic Section Modulus | | cm3 | Plastic Section Modulus | Section Modulus | Structural Engineer | | OZMi60qRqHuO00041QrE\$V | CircularHollowSection_Performance |
| Torsional Inertia Constant | | cm4 | Torsional Inertia Constant | Moment of Inertia | Structural Engineer | | OZMi60qRqHuO00042QrE\$V | CircularHollowSection_Performance |
| Torsional Modulus Constant | | cm3 | Torsional Modulus Constant | - | Structural Engineer | | OZMi60qRqHuO00043QrE\$V | CircularHollowSection_Performance |
| Width | | mm | Specified side dimension of a square hollow section. Specified dimension of the shorter side of a rectangular hollow section. Specified outside dimension of an elliptical section on its minor axis | Length | Structural Engineer | | OZMi60qRqHuO00044QrE\$V | CircularHollowSection_Geometry |
| Height | | mm | Specified dimension of the longer side of a rectangular hollow section. Specified outside dimension of an elliptical section on its major axis | Length | Structural Engineer | | OZMi60qRqHuO00045QrE\$V | CircularHollowSection_Geometry |

User-defined parameters highlighted in blue

Figure 19: Example user-defined product data template

8.2 Client-specific product data template

Where possible, a client-specific product data template should be based on the unique parameters and information sets within a dictionary that meets this technical specification. Where a project relates to a sensitive built asset as defined in PAS 1192-5, the information requirements relating to products are likely to be sensitive, and the asset is likely to include products within the CPNI (Centre for the Protection of National Infrastructure) secure extranet hosting the restricted data on secure assets. In this case, the CPNI may act as a relevant authority for product data, and a client-specific template may include both approved information sets and client-specific information sets for restricted data.

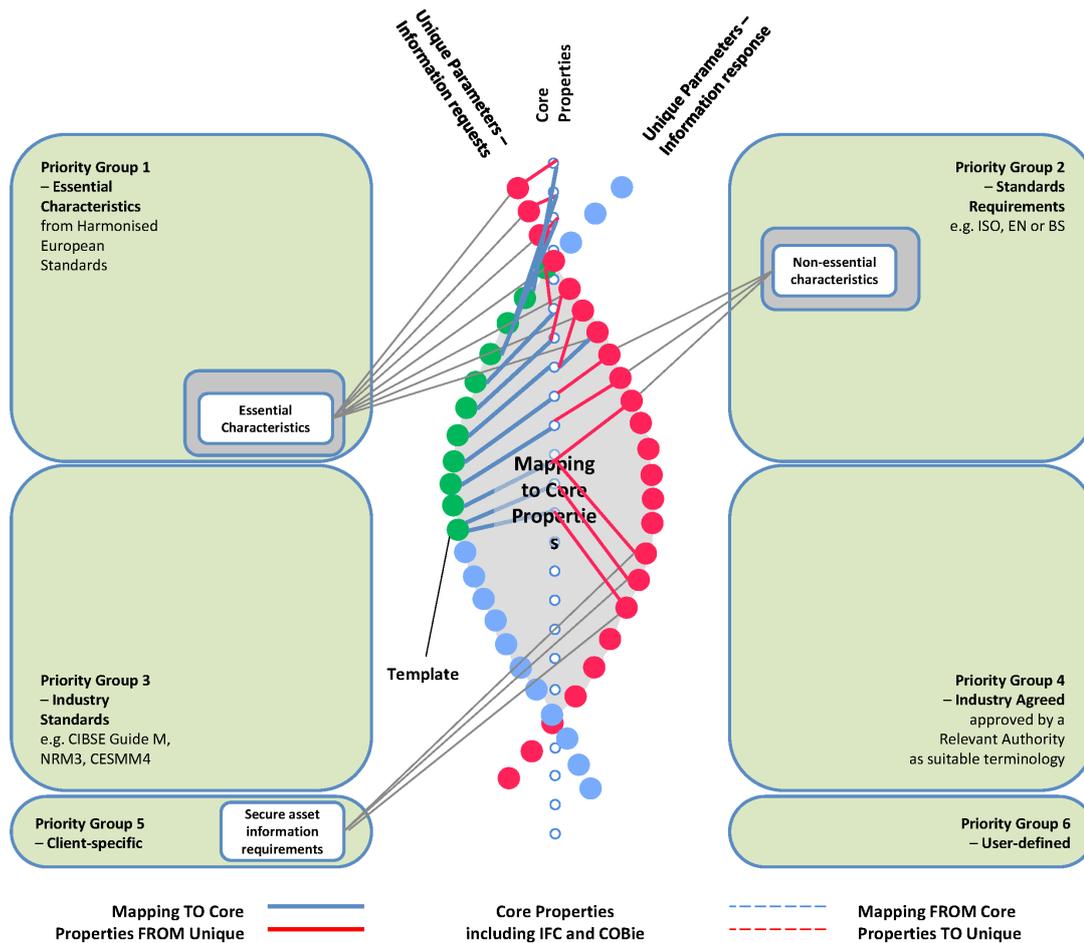


Figure 20: Information sources and mapping for example client-specific template for a sensitive asset, template represented by green dots

© Thompson 2016

8.3 Approved product data template

An approved product data template is a template where all unique parameters, information sets and their combination have been approved by a relevant authority as being suitable for the purposes that the template is defined against. An example template may include the same information requirements as the user-defined template in Section 8.1, but the user-defined requirements have now been approved by a relevant authority. Figure 21 shows the updated template with all parameters now approved, and Figure 22 presents the updated mapping of information requirements.

| Template Reference 1234 | | | | Template Revision 1 | | | Defining Selections | |
|---|-------|-------|--|-------------------------------------|---------------------|--------------|-------------------------|---|
| Classification Pr_20_76_52_16_Carbon steel hot finished hollow sections | | | | Template Revision Date 2016-04-12 | | | | |
| Description Hot finished structural hollow sections - example | | | | Completion Revision 1 | | | | |
| Template Author Me | | | | Completion Revision Date 2016-04-12 | | | | |
| Template Status Approved | | | | Relevant Authority A N Other | | | | |
| Parameter | Value | Units | Description | Measure | Responsibility | Completed By | Unique Identifier | Information Sets |
| Tolerances | | mm | Tolerances on dimensions and shape for hot finished structural hollow sections | Length | Manufacturer | | OZMi60qRqHu000025QrE\$V | BS EN 10210 1_2006_EssentialCharacteristics |
| Elongation | | % | Elongation in accordance with Tables A.3 and B.3 of BS EN 10210-1: 2006 | Ratio | Manufacturer | | OZMi60qRqHu000026QrE\$V | BS EN 10210 1_2006_EssentialCharacteristics |
| Tensile strength | | N/mm2 | Tensile strength in accordance with Tables A.3 and B.3 of BS EN 10210-1: 2006 | Force | Manufacturer | | OZMi60qRqHu000027QrE\$V | BS EN 10210 1_2006_EssentialCharacteristics |
| Yield strength | | N/mm2 | Yield strength in accordance with Tables A.3 and B.3 of BS EN 10210-1: 2006 | Force | Manufacturer | | OZMi60qRqHu000028QrE\$V | BS EN 10210 1_2006_EssentialCharacteristics |
| Impact strength | | N/mm2 | Impact strength in accordance with Tables A.3 and B.3 of BS EN 10210-1: 2006 | Force | Manufacturer | | OZMi60qRqHu000029QrE\$V | BS EN 10210 1_2006_EssentialCharacteristics |
| Weldability | | | CEV value specified, in accordance with Tables A.2 and B.2 of BS EN 10210-1: 2006 | - | Manufacturer | | OZMi60qRqHu000030QrE\$V | BS EN 10210 1_2006_EssentialCharacteristics |
| Durability | | | In accordance with Clause 6.7.2 of BS EN 10210-1: 2006 | - | Manufacturer | | OZMi60qRqHu000031QrE\$V | BS EN 10210 1_2006_EssentialCharacteristics |
| Outside diameter | | mm | Outside diameter D of hollow section | Length | Structural Engineer | | OZMi60qRqHu000032QrE\$V | BS EN 10210 1_2006_NonEssential |
| External perimeter | | mm | External perimeter of square, rectangular or elliptical section | Length | Structural Engineer | | OZMi60qRqHu000033QrE\$V | BS EN 10210 1_2006_NonEssential |
| Steel grade | | | Steel name, e.g. S355NH | - | Structural Engineer | | OZMi60qRqHu000034QrE\$V | BS EN 10210 1_2006_NonEssential |
| Cross Sectional Area | | cm2 | Cross sectional area of the section | Area | Structural Engineer | | OZMi60qRqHu000035QrE\$V | CircularHollowSection_Geometry |
| Thickness | | mm | Specified thickness | Length | Structural Engineer | | OZMi60qRqHu000036QrE\$V | CircularHollowSection_Geometry |
| Mass | | kg/m | Mass per unit length | Mass | Structural Engineer | | OZMi60qRqHu000037QrE\$V | CircularHollowSection_Performance |
| Second Moment of Area | | cm4 | Second Moment of Area | Moment of Inertia | Structural Engineer | | OZMi60qRqHu000038QrE\$V | CircularHollowSection_Performance |
| Radius of Gyration | | cm | Radius of Gyration | Length | Structural Engineer | | OZMi60qRqHu000039QrE\$V | CircularHollowSection_Performance |
| Elastic Section Modulus | | cm3 | Elastic Section Modulus | Section Modulus | Structural Engineer | | OZMi60qRqHu000040QrE\$V | CircularHollowSection_Performance |
| Plastic Section Modulus | | cm3 | Plastic Section Modulus | Section Modulus | Structural Engineer | | OZMi60qRqHu000041QrE\$V | CircularHollowSection_Performance |
| Torsional Inertia Constant | | cm4 | Torsional Inertia Constant | Moment of Inertia | Structural Engineer | | OZMi60qRqHu000042QrE\$V | CircularHollowSection_Performance |
| Torsional Modulus Constant | | cm3 | Torsional Modulus Constant | - | Structural Engineer | | OZMi60qRqHu000043QrE\$V | CircularHollowSection_Performance |
| Width | | mm | Specified side dimension of a square hollow section. Specified dimension of the shorter side of a rectangular hollow section. Specified outside dimension of an elliptical section on its minor axis | Length | Structural Engineer | | OZMi60qRqHu000044QrE\$V | CircularHollowSection_Geometry |
| Height | | mm | Specified dimension of the longer side of a rectangular hollow section. Specified outside dimension of an | Length | Structural Engineer | | OZMi60qRqHu000045QrE\$V | CircularHollowSection_Geometry |

Figure 21: Example approved product data template

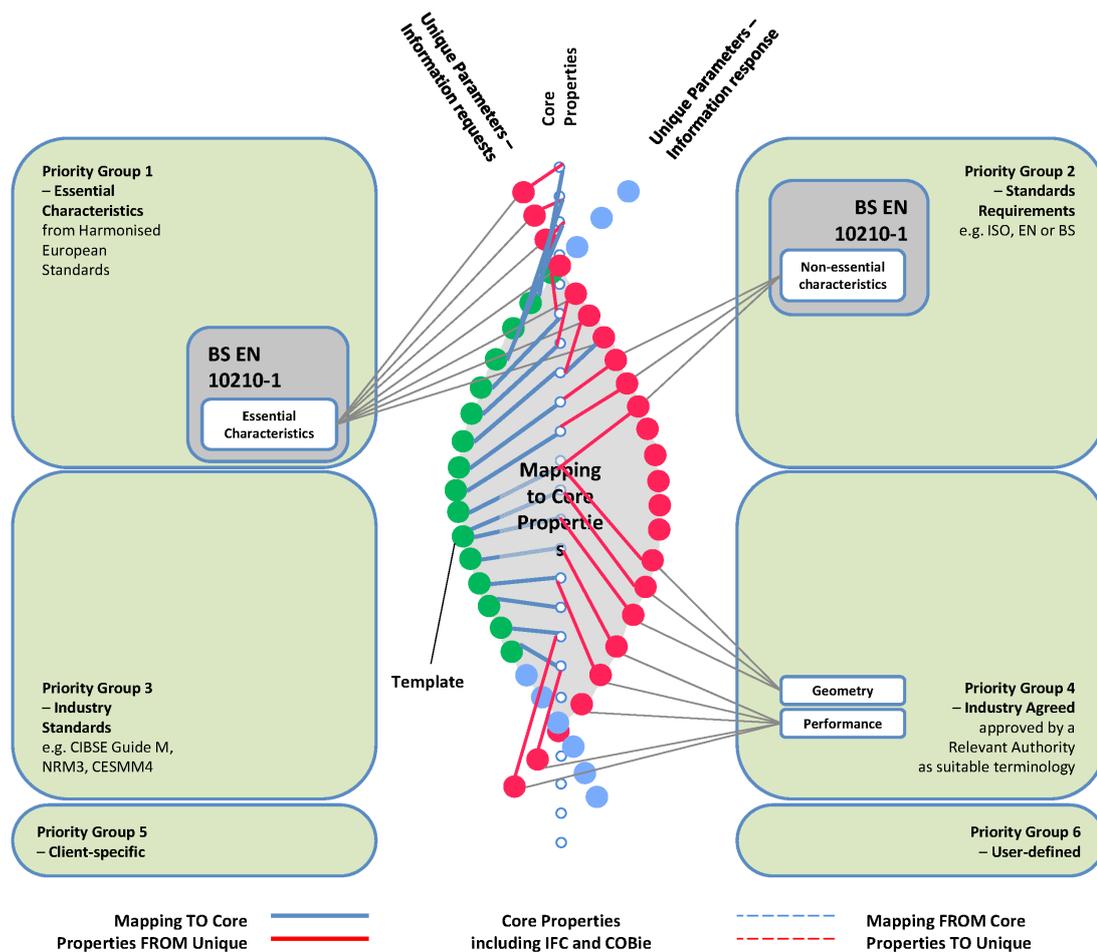


Figure 22: Information sources and mapping for example approved template represented by green dots

© Thompson 2016

8.4 Mapping information requirements for life cycle costing

In addition to creating product data templates as a combination of different information sets, a dictionary compliant with this technical specification can also be used to map different information requirements against each other to provide a more complete picture. An example of this is life cycle costing (LCC). NRM 3 introduces the 'CROME' concept, which identifies the constituent parts of a building's life cycle costs. These include:

- **C** - Construction costs
- **R** - Renewal costs
- **O** - Operation and occupancy costs
- **M** - Maintain costs
- **E** - Environmental and/or end of life costs

Faithful + Gould have combined the following information sources, and mapped these to COBie properties to enable a clear picture of the information requirements for whole life costing:

- NRM 3: Order of cost estimating and cost planning for building maintenance works
- SFG20 Standard Maintenance Specification for Building Services
- CIBSE Guide M: Maintenance Engineering and Management
- Uniclass 2015

Figure 23 illustrates a sample of the cross-referencing between sources, and Figure 24 represents the mapping of the different information sets to cover each of the constituent parts of a building's life cycle costs.

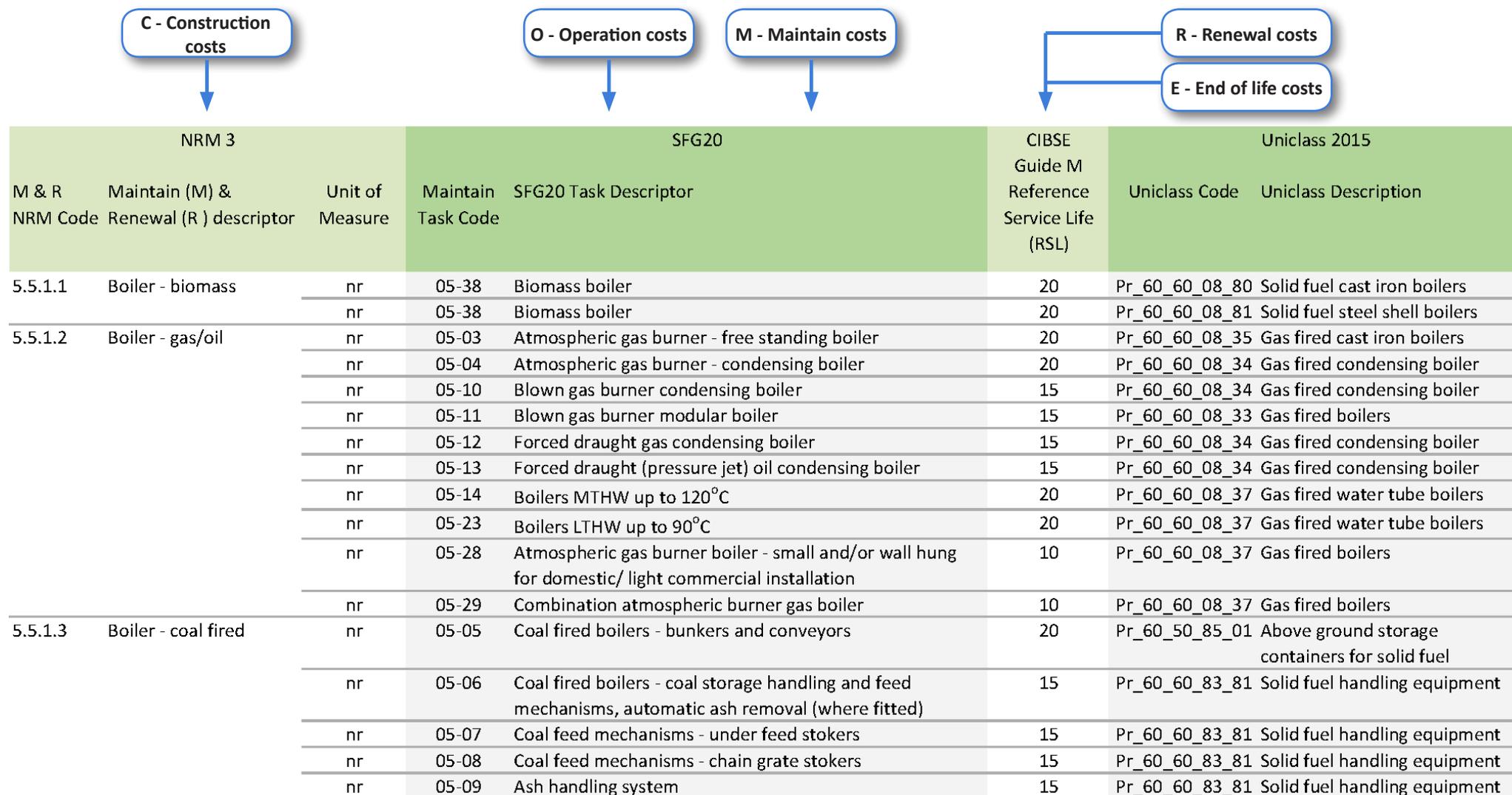


Figure 23: Mapping between NRM3, SFG 20, Uniclass 2015 and CIBSE Guide M to provide information requirements to support life cycle costing.

Source: Andy Green, Faithful + Gould

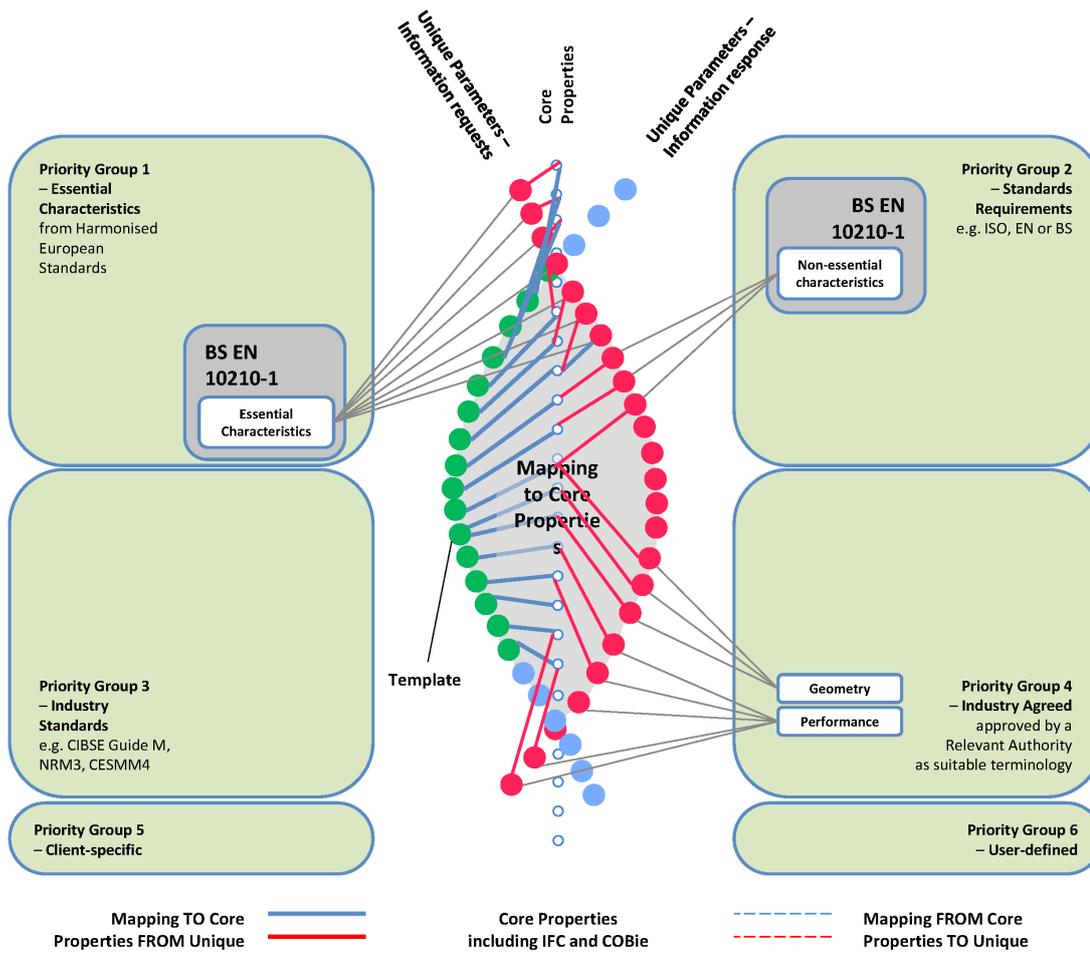


Figure 24: Information sources and mapping to support life cycle costing

© Thompson 2016

Bibliography

BS 1192, Collaborative production of architectural, engineering and construction information. Code of practice

PAS 1192-2 Specification for information management for the capital/delivery phase of construction projects using building information modelling

PAS 1192-3 Specification for information management for the operational phase of assets using building information modelling

BS 1192-4 Collaborative production of information – Part 4: Fulfilling employer's information exchange requirements using COBie. Code of practice

BS 8541-1 Library objects for architecture, engineering and construction. Identification and classification. Code of practice

BS 8541-3 Library objects for architecture, engineering and construction. Shape and measurement.

BS 8541-4 Library objects for architecture, engineering and construction. Attributes for specification and assessment. Code of practice

BS 8541-5 Library objects for architecture, engineering and construction. Assemblies. Code of practice

BS 8541-6 Library objects for architecture, engineering and construction. Product and facility declarations. Code of practice

ISO 12006-3 Building construction - Organization of information about construction works - Part 3: Framework for object-oriented information

ISO 16739 Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries

RICS New Rules of Measurement
NRM 3: Order of cost estimating and cost planning for building maintenance works

RICS New Rules of Measurement
NRM 1: Order of cost estimating and cost planning for capital building works

SFG20 Standard Maintenance Specification for Building Services

BS 8544 Guide for life cycle costing of maintenance during the in use phases of buildings

CIBSE Guide M: Maintenance Engineering and Management

Government Soft Landings, Cabinet Office

Uniclass 2015

Civil Engineering Standard Method of Measurement, Fourth edition (CESMM4)

Construction Product Regulations, REGULATION (EU) No 305/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 9 March 2011 laying down harmonised conditions for the marketing of construction products