buildingSMART FM Aquarium – criteria for quality assessment and verification

The buildingSMART Facility Management (FM) aquarium aims at improving the life-cycle building information interoperability using commercially available releases of Building Information Modeling (BIM) planning, design, construction, and commissioning software and the Computer Aided Facility Management (CAFM) and Computerized Maintenance Management System (CMMS) applications used in facilities management for the operation phase. The main goal of the project is to prove that the use of open standards is an enabler for the intended process integration. This proof requires two parts a Certification and a Challenge.

The Certification ensures compliance with the international standard, namely that portion of the Industry Foundation Classes (IFC) model needed to support Facility Management, this portion has been identified as the buildingSMART International "Basic FM Handover View". The requirements for information exchanges needed for the FM Handover domain are documented in an internationally finalized Exchange Requirements (ER's). The definition of that portion of the IFC model required to support those exchanges are documented in an internationally finalized FM Handover Model View Definition (MVD). A certification issued by the international buildingSMART indicates that those firms providing the FM MVD information in the IFC format meet the format and quality requirements of the FM MVD.

The FM Handover Certification process is organized by the buildingSMART international according to the official buildingSMART certification procedure. Workshops as part of the certification process are expected to be held twice a year, once in the United States and once in a European country. The first FM Handover Certification will occur at the National Institute of Building Sciences (NIBS) national conference, Washington, DC, December 2009.

The Challenge ensures that the information content, either in the IFC model format or equivalent formats, may be created by typical end-users with today's commercial products and instructions provided by software companies. One of the formats through which FM Handover information may be exchanged, that has begun to be used in the United States is the Construction-Operations Building information exchange (COBie) format. COBie is an XML format that may be directly viewed with commercially available spreadsheet software. As part of the FM Aquarium, COBie has been simplified and updated to ensure compliance with the international MVD. Those firms meeting the COBie2 Challenge will have demonstrated their ability to produce and/or consume the required COBie2 information as relevant to that firm's position with the project life-cycle. Thos supplying COBie2 information will be evaluated against automated COBie2 format and quality checks. Those consuming COBie2 information will be evaluated against a quality control/assurance review of that software's use of COBie2 information.

The COBie2 Challenge is organized by the buildingSMART alliance and a consortium of United States federal government agencies. COBie challenge events are expected to be held once a year in the United States. The first COBie2 Challenge will occur at the NIBS national conference, Washington, DC, December 2009. Annual follow-up challenges are expected to also occur as part of the NIBS annual conference.

The following table should document the commonalities and differences between the Certification and Challenge process and the quality criteria that are established to measure success rates and failures for the December 2009 events.

	Challenge	**Certification**
Common Goal	The primary criterion is based on the owner/operator receiving useful information about his facility, during design, construction and commissioning from BIM authoring tools and construction/commissioning software and users.	
Organizer	buildingSMART alliance North America	buildingSMART international
Guiding principles	Challenge organization as organized for COBie1	buildingSMART international new certification procedure
Focus	Interoperability between BIM and construction software and CAFM/CMMS software based on COBie2 compliant datasets provided in IFC, ifcXML, or COBie2 xml format.	Interoperability between BIM and construction software and CAFM/CMMS software based on IFC MVD *Basic FM Handover* compliant datasets provided in IFC or ifcXML format.
Scope	Interoperability based on the FM Aquarium exchange requirements and the identified set of COBie2 datasets.	Interoperability based on the FM Aquarium exchange requirements and model view definition based on the IFC / ifcXML exchange format
Test cases	The enhanced test case “Railyard Maintenance Facility" (updated from original COBie format)	Multiple test cases, including those provided by the problem owners internationally: - FM-10 reference file for MVD - Railyard Maintenance Facility (US) - School building of university hospital (Bavaria) - xxx (Norway) - xxx (Finland) - other test cases
Test procedure	Pre-testing by each vendor, public demonstration for the challenge used for import check-list and life presentation of the export automatic checks.	Certification process guided by the buildingSMART certification database with online access and validation. Final certification workshop with random checks and publication of results.

	Challenge	Certification
Basic criteria	The COBie2 relevant dataset, as formalized in the FM Aquarium exchange requirements, have to be passed from the BIM authoring tool to the CAFM/CMMS application as provided in the quality of the “Railyard Maintenance Facility" project. Applicable formats for the exchange are IFC and ifcXML (for the FM Handover MVD) and COBie2 xml.	The exchange of the FM handover data between the BIM authoring tools and the CAFM / CMMS applications is based on the information set as stipulated by the exchange requirements. In addition the exchange format has to follow the buildingSMART Model View Definition of the Basic FM Handover. Applicable formats for the exchange are IFC and ifcXML.
Basic criteria for export	The quality of the data output from BIM is validated by automatic validation tools (see below).	The quality of the data output from BIM is validated by automatic validation tools based on the provided IFC or ifcXML export files and by a random manual check based on neutral IFC/ifcXML data viewers.
Basic criteria for import	The quality of the import into the CAFM/CMMS application is validated manually by the check-list provided.	
Additional criteria	Provision of a user guideline on how to achieve the results (including information about how to use configurations and template files).	
		A vendor support documentation as part of the official buildingSMART certification rules (e.g. to state noted and accepted exceptions from the MVD support).
Quality rules	No quality issues for the owner/operator should arise if the data, based on the Railyard Maintenance Facility" is (a) insufficiently detailed (b) not manageable by the owner/operator	The data must be compliant to the schema, validate against the schema and model view definition and formatted correctly. The data content should reflect the quality of the provided test cases, i.e. FM relevant data stipulated in the MVD and contained in the test file shall not be lost during transformation.
Compliance rules	COBIE2_rules.xls, including notes of mandatory fields.	buildingSMART MVD “Basic FM Handover” IFC/ifcXML syntax, i.e. IFC + MVD specific implementer agreements. The MVD specific rules (as published in the MVD) maybe coded in executable verification rules for the export checking, or used for manual check of export data.
Syntax validation rules	Data must validate against one of (a) IFC2x3_TC1.exp (b) IFC2x3.xsd (c) Readable by Microsoft Office 2009 Excel	Data must validate against one of (a) IFC2x3_TC1.exp (b) IFC2x3.xsd

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Formatting rules	(a) IFC - .ifc (step physical file) (b) IFCXML .ifcxml IFC (xml file) (c) COBIE2 .xls (d) COBIE2 .xml (Spreadsheet 2003 XML)	(a) IFC - .ifc (step physical file) (b) IFCXML .ifcxml IFC (xml file) (Data can be read or written to/from COBie2, but the transformations are in the responsibility of the vendor and are not certified, essentially the ifc to COBie2 transformation is treated as a toolbox).
Verification tools	Format Syntax check: - for ifc (step physical file): express parser (EPM, ecco, or others) based on IFC2x3TC1 express schema - for ifcXML (xml file): AltovaXML / xmlspy validation against ifcXML2x3 XSD schema	
	- for COBie2 xml: Excel 2009 correct handling	
	COBie2 check - AEC3 bimSevices Compliance1 - AEC3 bimSevices Transform1 to generate reports / ratios	FM Handover MVD check: - express or xml parser (see above) with MVD specific schema subset and MVD specific rules - AEC3 bimSevices Transform1 to generate COBie2 xml for visual check of data compliance

Specific rules to assess the quality in terms of pass/fail and success rate/benchmark include:

	Challenge	**Certification**
Are there controls on Name attributes? (string values for names)	Yes, Duplicated names will disqualify. In the case of Attributes, the name must be unique within an object: so an object cannot have two values for an attribute. This may show as failure during interoperability transformations or during validations or during inspection.	Name attributes have to follow the MVD requirements in terms on mandatory/optional. There are no controls on duplications of name attributes (i.e. two spaces in the facility having the same name) as long as the mandatory requirement: all objects have unique GUID's (globally unique id's) are maintained. Attributes within the same property set for an object shall not have the same name (individual attributes does not carry an GUID).
Are there controls on individual Names?	Commas and colons may prove disruptive in COBie2 and shall be prevented.	Name attributes shall be correct string values within the given character set (for now ISO-8859) and within the string length as required by IFC.
Will the absence of mandatory attributes disqualify?	Yes. Compliance rules include mandatory attributes. Validation rules verify that all mandatory attributes are included.	Mandatory attributes as requested by the MVD shall be included, if the test case data includes them (i.e. the name of the flooring of a space is mandatory, and if the original BIM model contains it, the ifc exchange file shall contain it as well). Note: the BIM vendor should include the guideline on how to assign the conformant attributes in the BIM tool.
Will the absence of zones and systems disqualify?	Yes. At least two of each. Reason: Systems and Zones are vital for the management of facilities. The number of systems and zones, populated with components and spaces, is a good indicator of quality.	If the test case data includes them (i.e. zones in an architectural BIM, or systems in an MEP BIM tool), the ifc exchange file shall contain it as well. (See note above on guidelines).
Will types and components be checked?	Yes. A 1:1 ratio of typed components to types is a fail. Reason: Facilities are managed through the types. A poor ratio of typed components to types makes the information un-manageable. Whilst it is allowed to have one type for one component, overall the ratio should be much higher. E.g. average type to component ratios of less than 4:1 for standard commercial projects will be considered as "poor" and should be accompanied by specific justifications. The number of component to type ratio at 1:1 will be specifically identified and considered "poor".	The types of components (or families, cells, styles) are included in the MVD and shall be contained in the ifc exchange file. Exceptions shall be stated in the vendor support description (see above).

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Will the use of proxy elements lower the quality assessment?	Yes, this indicates poor modeling, and a high proportion of such objects will adversely affect the assessment. Proxy elements without type will fail.	Export of semantically identifiable components in the test case data as proxies would not satisfy the certification criteria (e.g. the BIM model contains a furniture element that is knows as furniture or could be classified as furniture). (See note above on guidelines). Proxies are permissible if they represent a true proxy, i.e. an object unknown to the software and the IFC schema.
Will classification of spaces and components be checked?	Classification is vital for reporting and comparing facilities. Data will be reviewed for its accurate use of classification. Classification must be consistent against the COBie2 picklists and the Omniclass or other regional conventions.	For those elements where the MVD requires classification (e.g. spaces) a classification assigned to the element in the BIM model has to pass through the ifc exchange file. Omitting it is non-compliance. (See note above on guidelines). The classification system can be any established classification as used in the test cases (Omniclass, DIN, etc.), the minimum information to pass is the classification key and title and the name of the classification system.