



COBie Certified Professional™

Educational Curriculum

Version 1.1
April 2020

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1. Purpose of this document

The purpose of this document is to identify the knowledge and skills necessary for individuals to perform jobs where the Construction Operation Building information exchange (COBie) standard [1] is specified, produced, checked, or used.

2. Background

buildingSMART International (bSI) is the worldwide industry body driving the digital transformation of the built asset industry. bSI has long been concerned with challenges of information flow across the built asset industry and is committed to delivering improvement by the creation and adoption of open, international standards and solutions for infrastructure and buildings. bSI addresses industry need through three programs: **User Program**, **Standards Program**, and **Compliance Program**. The Compliance Program focusses on certifying the implementation of buildingSMART standards. Historically this has been solely software certification for IFC implementation, however, in 2016 buildingSMART began the development of Professional Certification to support the training and certification of practitioners within the field. As of April 2020, there are seventeen Chapters, representing 23 countries, who have committed to the Professional Certification program.

buildingSMART international's Certification Program has identified two skill levels for which it will provide services. The "*Foundation*" level is focused on 'Knowledge and Comprehension' and is intended to (a) convey basic concepts and knowledge about openBIM processes, and (b) to test individuals' learnings in these areas. The "*Practitioner*" level has a much more comprehensive scope, to incorporate applied learning and practical expertise. The *Practitioner* level requires candidates to use and evaluate situations in which key ideas or concepts are applied.

3. Introduction

Although the Construction Operations Building information exchange (COBie) standard [1] has been adopted and/or mandated by many owners, many owners report a wide range in the quality of data being delivered. To assist owners to establish a minimum expectation of bidders' COBie qualifications, buildingSMART international established the COBie Certification Subcommittee in 2019.

Following the approach taken by the buildingSMART international's Certification Program, The COBie Certification Subcommittee has established the curricula and examinations for COBie learning at the *Foundation* and *Practitioner* levels. To emphasize the higher level of knowledge required at the *Practitioner* level, the corresponding exam is called the **COBie Certified Professional™** exam. Additional knowledge, such as the use of commercial software or the ability to create enterprise-wide implementation plans may also be needed. However, such knowledge falls outside the skills required for the bSI *Foundation* and *Practitioner* levels.

4. Application

The information in this document is expected to be used for the following:

1. To assist buildingSMART International's COBie Certification Subcommittee to design examinations at the *Foundation* and *Practitioner* levels.
2. To assist buildingSMART International's COBie Certification Subcommittee to design the COBie Registered Training Provider Program.
3. To assist buildingSMART International's COBie Certification Subcommittee to evaluate COBie Registered Training Provider Program applications.
4. To assist educational providers to create courses that assist students to prepare for buildingSMART *Foundation* and *Practitioner* examinations.
5. To assist educational service providers to understand the educational requirements for participation in the COBie Registered Training Provider Program.
6. To assist individual candidates to evaluate the contents of courses on offer from educational service providers.
7. To assist individual candidates to assess their knowledge and skills when deciding if they are prepared when register for the buildingSMART COBie *Foundation* or COBie Certified Professional™ (i.e. *Practitioner* level) examinations.

5. Outline

The next section of this document provides a series of tables identifying the jobs, specific tasks, and underlying skill level required to create, evaluate, and/or use COBie data during each major stage of a facility's life cycle. Based on the level of skill required, the necessary knowledge to perform a given set of work is defined.

The primary focus of this document is to identify the knowledge and skills required for the buildingSMART COBie *Foundation* and COBie Certified Professional™ (i.e. *Practitioner* level) examinations. Other skillsets, such as specific software proficiency and/or business management knowledge are identified, however, these are outside the scope of the buildingSMART Certification Program and the COBie Registered Training Provider Programs.

In the two sections that follow, the skills required to successfully master the buildingSMART Professional Certification *Foundation* and *Practitioner* examinations are identified. These sections will be of interest to those who are deciding if they need to build their skills prior to sitting for one of the buildingSMART international examinations.

The final sections in the main body of this document provide conclusions, recommendations, and references. Two appendices complete this document.

Appendix A lists common industry job roles and the level of COBie knowledge required of persons who perform those roles. Depending on the specifics of the region and project, these job roles identified may be mapped to a variety of positions within a company or team. Appendix A will be of interest to human resource professionals when writing job descriptions for personnel on projects where COBie data is required.

Appendix B provides example exam questions demonstrating the difference between the levels of knowledge tested at the *Foundation* and *Practitioner* level. This appendix will be of use to educational service providers as they design the content of their courses. These example questions will also be helpful for exam candidates to assess their current level of expertise.

6. Job-Task Analysis

To successfully implement COBie on building projects, input from various parties is required. Each party must understand their role in the process of creating COBie data and execute their roles with respect to COBie delivery. Should one party fail to understand and correctly execute their role, someone downstream must identify, recollect, prepare, and check the required information.

On many projects, it is the case that most participants do not have the necessary COBie skills. The resulting increased cost and decreased quality of handover data can be directly traced to the duplication of effort required to recapture design and construction data at the end of a project, often through the engagement of in-house or 3rd party service providers.

COBie requirements need to be clearly understood, communicated, and applied by all relevant team members, in the same way that the current document-based construction handover delivery method has been learned over many decades by our current industry. Today, our industry has some who are aware of efficient information-based delivery methods, and some are not. The objective of the job-task analysis is to identify the skills needed to move everyone to the required new level of understanding. Our aim in publishing this document is to speed that learning process.

While the tasks identified in the job-task analysis may appear to be something new, they are not. The changes to existing design, construction, and facility management practices are minimal. The changes required simply transform document-centric handover information delivery to information-centric, standards-based, real-time construction handover data capture. To make these small changes across all projects and project teams, we must ensure all parties learn to play from the same sheet of “COBie music.”

The Job-Task analysis was created chronologically from the planning through the operational stages of a building's life cycle. There are five tables containing the needed information as noted below:

- Table 1 contains information related to planning.
- Table 2 contains information related to design.
- Table 3 contains information about the build-stage.
- Tables 4 and 5 contain information about the operational stage.

To concisely provide the needed information, each of the five tables is formatted the same way. The first column in each table provides the list of jobs that will have to be accomplished to correctly require, prepare, update, check, and use COBie data in a building project. The second column identifies the type of task that is required to complete that job. The information provided is a more generic description of the work than appears in the first column.

The third column lists the named duties of those who need to complete the work required as noted in Appendix A. As noted previously, specific individuals may perform more than one of these duties. Therefore, a mapping between the duties outlined in Appendix A and local human resources position classifications should be expected.

The fourth column in, "Required Learning," identifies the skill level required to perform the associated task. The skills listed in this column are based on the highest requirement found in Bloom's taxonomy of learning objectives[2]. Briefly stated these levels are defined as follows:

- Knowledge/Remembering: define, list, recognize
- Comprehension/Understanding: describe, explain, identify, locate, recognize, sort
- Application/Applying: choose, demonstrate, implement, perform
- Analysis/Analyzing: analyze, categorize, compare, differentiate
- Evaluation/Evaluating: assess, critique, evaluate, rank, rate
- Synthesis/Creating: construct, design, formulate, organize, synthesize

The last set of columns in Table 1, "Skill Validation Levels," reflect the coverage of the needed learning in the four-tiered configuration identified by the buildingSMART COBie Certification Subcommittee.

The first tier, *Foundation* refers to the first two levels of Bloom's taxonomy: knowledge and comprehension. The *Foundation* level exam can only be attempted by a candidate who has successfully completed an approved Training course. buildingSMART Chapters are responsible for managing the program in their country or region and use a buildingSMART international Preferred Training Provider process to identify qualified courses.

The second tier, *Practitioner* refers to the set of Bloom’s taxonomy levels required to successfully accomplish a complete set of project-based tasks. *Practitioner* knowledge builds upon *Foundational* knowledge; therefore, *Foundational* skills are also covered in the *Practitioner* exam. Additional knowledge and skill levels are identified by an approved buildingSMART international Certification Committee domain-specific process. Practitioner training requirements are also identified through that bSi Certification approved process.

In the case of the COBie Practitioner exam, buildingSMART international COBie Certification Subcommittee’s Industry Advisory Board identified five levels of Bloom’s taxonomy be included: knowledge, comprehension, application, analysis, and evaluation. The top-level of Bloom’s taxonomy, synthesis, was identified to be beyond the scope knowledge required to support project-based tasks.

At this point, COBie Practitioner level training is not a prerequisite to take the “COBie Certified Professional™” exam. Such training is, however, strongly recommended in bSi messaging. Registered Practitioner exam candidates are provided a sample exam containing questions illustrating the five included levels of Bloom’s taxonomy. This sample exam also highlights the impact of imposed time limitations. Before scheduling their exam session, all candidates are encouraged to assess their personal capabilities to quickly respond to questions on published learning objectives.

In the Job-Task tables, the third training tier, “Technology,” is also identified. This column indicates that the person must also have knowledge at the third level of Bloom’s taxonomy, “Application,” for specific software used on that project. Such training is provided by commercial software and third-party training companies. The COBie exams at *Foundation* and *Practitioner* levels do not assess software proficiency. However, to provide a complete view of the skills required, the job-task analysis below does identify when technology skills are required, the impact of common technology issues are also identified in the *Foundation* and *Practitioner* exams.

It is often the case that a person with basic Technology skills will be put in a position to organize the delivery of COBie data. Unfortunately, this is insufficient because that person is typically not introduced to the COBie *Foundation* skills in software-specific training. Therefore, along with a specific software-based Technology skill, completion of identified tasks also requires *Foundation* or *Practitioner* skills.

The associated skill level is identified by placing an “X” in the appropriate “Skill Validation Level” column. Recall that if the *Practitioner* level is identified, knowledge and skills at five levels of Bloom’s taxonomy including the initial two *Foundation* knowledge levels are required.

Table 1. Job-Task Analysis - Planning Stage

Job	Task	Position(s)	Required Learning	Skill Validation Level		
				Foundation	Practitioner	Technology
Define construction handover requirements	Evaluate and Organize existing COBie data from published guides and client IT systems.	12	Organize		*	
Define appropriate COBie-based deliverables	Formulate required classification, exclusions, properties	12	Synthesize		*	
Deliver example COBie deliverables	Create sample client-specific sample COBie data files	12	Synthesize		*	
Test creation of COBie data from planning systems	Organize and execute plan to extract COBie from published guides and client IT systems.	12	Synthesize		*	
Develop program for use of COBie data in architectural programming stage	Organize and execute plan to extract COBie from published guides and client IT systems.	12	Synthesize		*	
Specify design handover requirements	Create/Apply objectively testable specifications	12, 8	Apply		X	
Specify construction handover requirements	Create/Apply objectively testable specifications	12, 8	Apply		X	
Resolve questions on requirements	Contract management and administration	1,2,6,7	Evaluate		X	
Enforce handover requirements	Contract management and administration	1,2,6,7	Evaluate		X	
Apply adverse actions for enforcement	Contract management and administration	1,6,7	Evaluate		X	

* NOTE: Requirements for this task currently exceeds buildingSMART COBie Certified Professional™ level testing.

In each of the five tables, there is one additional skill level. This skill level is identified by an asterisk in the *Practitioner* column. Bloom's taxonomy identifies skills at this level include "synthesis" skills. To achieve this level, the *Practitioner* skill level is a prerequisite.

Understanding this distinction between what is and is not included in the buildingSMART COBie certification scheme is important for organizations who have delivered COBie on multiple projects. Only those with the skill sets beyond the *Practitioner* level will be able to address questions that arise regarding systemization of COBie delivery across any needed (and ultimately all) project(s). By addressing implementation questions in an organized and rational basis the capture of COBie data can be successfully managed as a holistic business transformation effort.

Table 2. Job-Task Analysis - Design Stage

Job	Task	Position(s)	Required Learning	Skill Validation Level		
				Foundation	Practitioner	Technology
Identify lead COBie manager	Identify team, Enforce contract	2,3,6	Comprehend	X		
Identify architect's COBie producer(s)	Identify team, Enforce contract	2,3,6	Comprehend	X		
Identify consultancy COBie producers	Identify team, Enforce contract	2,3,6	Comprehend	X		
Create project-independent COBie-specific SOP's	Create internal process training for all project teams	3,4	Create		*	
Design and conduct testing to evaluate software performance	Use design software on known test case to ensure setup	3,4	Design		*	
Prepare RFI's to resolve inaccurate/conflicting owner requirement	Assess COBie contract requirements against standard specification	12, 6	Critique		X	
Prepare discipline specific COBie guide for designers/consultants	Formulate project guidance per team skills assessment	12, 6	Construct		X	
Prepare discipline specific COBie guide for BIM technicians	Formulate project guidance per team skills assessment	12, 6	Construct		X	X
Configure software to support COBie guidance	Use design software per instructions	3,4	Apply	X		X
Integrate BIM-based equipment/product schedule generation	Use design software to capture non-excluded COBie Type elements	2,3,4	Apply	X		X
Update BIM-based schedule generation	Organize documents into COBie deliverables	3,4	Apply	X		X
Export discipline specific COBie files	Use design software per instructions	3,4	Apply	X		X
Evaluate discipline specific COBie files	Verify and Validate COBie data and package	2,3,4,5	Evaluate		X	
Prepare COBie deliverable package	Organize documents into COBie deliverables	3,4	Create		X	
Merge discipline specific COBie data	Synthesize discipline-specific deliverables	2,3,4	Create		X	
Deliver design COBie data package	Prepare COBie data package	2,3,4	Apply		X	
Perform design quality assurance	Verify and Validate COBie data and package	2,3,4,5	Evaluate		X	
Perform design quality control	Verify and Validate COBie data and package	6,7	Evaluate		X	

* NOTE: Requirements for this task currently exceeds buildingSMART COBie Certified Professional™ level testing.

Table 3. Job-Task Analysis - Construction Stage

Job	Task	Position(s)	Required Learning	Skill Validation Level		
				Foundation	Practitioner	Technology
Identify contractor COBie manager	Organize team, Enforce contract	2,3,6	Comprehend	X		
Identify contractor COBie producer(s)	Organize team, Enforce contract	2,3,6	Comprehend	X		
Identify subcontractor COBie producers	Organize team, Enforce contract	2,3,6	Comprehend	X		
Develop COBie capture process during construction	Design updated contract admin forms and procedures	12	Design		*	
Create examples for key construction admin. processes	Create examples from commonly available COBie test files	12	Design		*	
Implement and enforce application of COBie-based data capture	Assess and adjust forms and processes for compliance	12	Evaluate		*	
Evaluate stand-alone or integrated COBie capture	Predict coverage of updated processes vs required COBie data	12	Synthesize		*	
Update design COBie data to reflect construction changes	Consistently incorporate COBie construction updates	3,4,5,7	Create		X	X
Update product data based on established process	Update COBie data from construction admin process/sources	3,4,5,7	Apply		X	
Update equipment data based on established process	Update COBie data from construction admin process/sources	3,4,5,7	Apply		X	
Update warranty data based on established process	Update COBie data from construction admin process/sources	3,4,5,7	Apply		X	
Update O&M data based on established process	Update COBie data from construction admin process/sources	3,4,5,7	Apply		X	
Update Spatial data based on established process	Update COBie data from construction admin process/sources	3,4,5,7	Apply		X	
Update COBie document/files	Update COBie data from construction admin process/sources	3,4,5,7	Apply		X	
Prepare COBie deliverable package	Prepare COBie data package	2,3,4,5,7	Apply		X	
Perform construction quality assurance	Verify and Validate COBie data and package	2,3,4,5,7	Evaluate		X	X
Perform construction quality control	Verify and Validate COBie data and package	6,7	Evaluate		X	X

* NOTE: Requirements for this task currently exceeds buildingSMART COBie Certified Professional™ level testing.



The skill required to create and implement information-based Standard Operating Procedures (SOP's) demands significant business management experience. These SOP's will identify opportunities to capture previously "hidden" COBie data within a company and their network of contracting partners and internal stakeholders. New standard operating procedures are required to ensure that COBie data is captured during the process of design and construction, when the information is first recorded. Such a procedure is quite different from the current process of waiting until the end of a project, finding out that a COBie requirement will actually be enforced by an owner, and then bringing in a 3rd party to recollect information that is already present in the construction administration record.

If companies fail to develop or hire expertise at this top tier, then they will be unable to achieve the efficiencies across their portfolios. Only through replacement of traditional document-centric standard operating procedures, will organizations learn efficient COBie processes. Without new COBie-based processes, lessons cannot be learned, and every future project is another pilot project.

Another way to consider the role of the higher-order COBie learning requirements is to note that COBie *Foundation* and *Practitioner* levels identify the knowledge and skill required to successfully implement COBie on individual projects. From the point of view of individual projects, COBie Certified Professional™ skills are applicable to both efficient and wasteful COBie-based business practices.

Table 4. Job-Task Analysis - Facility Management Stage - Maintenance System Data Loading

Job	Task	Position(s)	Required Learning	Skill Validation Level		
				Foundation	Practitioner	Technology
Identify COBie management POC	Organize team	9	Comprehend	X		
Identify COBie technical POC	Organize team	9,10,11	Comprehend	X		
Identify maintenance management system integration POC	Organize team	9,10,11	Comprehend	X		
Identify document management POC	Organize team	9,10,11	Comprehend	X		
Create COBie-based systems(s) instructions	Map COBie structure to maintenance system structures	10,11	Construct		*	
Identify needed classification, exclusions, properties	Design cross-system based data model	10,11	Construct		*	
Identify additional system-specific quality control requirements	Extend minimum COBie verification and validation protocols	10,11	Construct		*	
Create samples and test COBie-based systems(s)	Prepare COBie test files for system testing	10,11	Create		X	
Customize COBie implementation guidance	Create COBie implementation guide based on system testing	10,11	Create		X	
Ensure integration of guidance in design and construction contracts	Cross-organizational coordination	9	Coordinate		*	
Test in-progress construction handover deliverables	Quality assurance testing based on COBie and local guidance	10,11	Evaluate		X	
Test construction handover deliverables	Quality assurance testing based on COBie and local guidance	10,11	Evaluate		X	
Upload maintenance management system data	Utilize data import requirements of related system	10,11	Apply	X		X
Upload document repository system data	Utilize data import requirements of related system	10,11	Apply	X		X
Integrate COBie data into maintenance activities	Identify maintenance activities requiring COBie data	9,10,11,12			*	
Implement life cycle COBie	Evaluate and Adjust COBie data use during maintenance	9,10,11,12			*	

* NOTE: Requirements for this task currently exceed buildingSMART COBie Certified Professional™ level testing.

Table 5. Job-Task Analysis - Facility Management Stage - System Integration

Job	Task	Position(s)	Required Learning	Skill Validation Level		
				Foundation	Practitioner	Technology
Identify COBie management POC	Organize team, Enforce contract	2,3,6	Comprehend	X		
Identify COBie technical POC	Organize team, Enforce contract	2,3,6	Comprehend	X		
Identify COBie integration POC	Organize team, Enforce contract	2,3,6	Comprehend	X		
Identify COBie-fed maintenance, operations, mgmt., and accounting systems	Intra-organization management coordination	12	Organize		*	
Create implementation steering committee	Intra-organization management coordination	12	Organize		*	
Establish corporate support for COBie system integration(s)	Intra-organization management coordination	12	Organize		*	
Identify and Evaluate COBie-fed system(s)	Intra-organization management coordination	12	Organize		*	
Create COBie-based systems(s) instructions	Map COBie structure to relevant/maintained system structures	12	Construct		*	
Identify needed classification, exclusions, properties	Design cross-system based data integration model	12	Construct		*	
Create samples and test COBie-based systems(s)	Prepare COBie test files for system specific testing	12	Create		X	
Ensure integration of guidance in design and construction contracts	Cross-organizational coordination	9	Coordinate		*	
Test in-progress construction handover deliverables	Quality assurance testing based on system specific guidance	10,11	Evaluate		X	
Test construction handover deliverables	Quality assurance testing based on system specific guidance	10,11	Evaluate		X	
Upload system data	Utilize data import requirements of related system	10,11	Apply	X		X
Upload document repository system data	Utilize data import requirements of related system	10,11	Apply	X		X
Integrate COBie data into maintenance activities	Identify maintenance activities requiring COBie data	12			*	
Implement life cycle COBie	Evaluate and Adjust COBie data use during maintenance	12			*	

* NOTE: Requirements for this task currently exceed buildingSMART COBie Certified Professional™ level testing.

A business process transformation, illustrated by the COBie business case [3], is required if prime contractors and subcontractors are to realize direct economic benefit resulting from slashing the costs to re-capture, copy, re-format, double-check, and re-field verify COBie data. A holistic COBie implementation identifies, captures, and manages the systemic elimination of such costs across every project in the portfolio. Nor does the *Practitioner* skill level evaluate a candidate's ability to recognize and achieve the value of providing a single-point of truth with respect to real-time as-built spatial and equipment information in a construction company or within a building manager's portfolio.

In some cases, the requirement to deliver COBie has been implanted as a national standard. In many of these cases, the economic justification for that decision will likely not be known by project-based staff. If, however, an owner has conducted and clearly communicated the results of an economic analysis prior to specifying COBie, a common driver for COBie data delivery can be the immediate reduction in time to load maintenance management computer systems. The tasks and skills required to realize this goal are provided in Table 4.

Nowhere is the need for COBie skill levels that support higher order learning more evident than at the Facility Management - Systems Integration stage. The skills set that will ultimately be required to implement COBie within an owner's office go well beyond those needed by those who are simply reducing the cost of loading data into the system for maintenance management. The Job-Task Analysis for this critical and emerging role are identified in Table 5.

In most owners' organizations, there are likely to be four information technologies that will benefit from the delivery of accurate as-built spatial and equipment information. These are systems supporting maintenance, operations, management, and fiscal control of a new, or renovated facility. Thoughtful owners will understand that for the first time they have access to an accurate catalog of facility information applicable across multiple business lines.

7. Learning Objective Summary

7.1. COBie Foundation

This section identifies the learning objectives necessary to achieve the skills identified at the COBie *Foundation* level which correspond to skills at the Bloom's Taxonomy levels of Knowledge and Comprehension[2]. These consensus objectives were developed by buildingSMART international's COBie Certification Subcommittee's International Advisory Board.

F-1 Describe the basis for COBie requirements.

- F-1.1 Locate the document containing the COBie standard.
- F-1.2 Identify the current version number of the COBie standard.
- F-1.3 Locate the underlying ISO standard upon which COBie is based.
- F-1.4 Describe the file formats allowed for COBie information delivery.
- F-1.5 Describe the parties who contribute to the delivery of COBie data.
- F-1.6 Explain COBie data elements contributed by each party.

F-2 Describe why COBie is needed.

- F-2.1 Describe Facility Owner benefit(s).
- F-2.2 Describe Facility Manager benefit(s).
- F-2.3 Describe Contractors benefits(s).
- F-2.4 Describe Subcontractors benefit(s).
- F-2.5 Describe Designer and Consultant benefit(s).

F-3 Explain what is included in COBie.

- F-3.1 Explain project types for which COBie deliverable is relevant.
- F-3.2 Identify facility elements that may not be included in COBie.
- F-3.3 Identify facility elements that may be included in COBie.
- F-3.4 Explain the method used to adapt the list of elements.
- F-3.5 Explain the role of classification with a COBie data set.
- F-3.6 Locate the default classification contained within the COBie standard.

F-4 Explain how COBie is organized.

- F-4.1 Describe the two hierarchies behind the COBie structure.
- F-4.2 Describe the data sets needed for each hierarchy.
- F-4.3 Describe the data sets used in common.
- F-4.4 Explain each element in all commonly used COBie data sets.
- F-4.5 Explain the allowable data types in a COBie spreadsheet.
- F-4.6 Describe the terminology needed to define a unique COBie object.
- F-4.7 Describe the terminology needed to define relations between COBie objects.

F-5 Explain the COBie process.

- F-5.1 Describe how owners may modify allowed COBie objects.
- F-5.2 Describe how owners may specify COBie object properties.
- F-5.3 Describe how owners may specify COBie object classification.
- F-5.4 Describe how owners may specify COBie relations
- F-5.5 Identify COBie data elements provided during design.
- F-5.6 Identify COBie data elements provided during construction.
- F-5.7 Explain the minimum content in COBie deliverables.
- F-5.8 Explain the artifacts included in a complete COBie deliverable.

NOTE: COBie Foundation knowledge pertains only to information provided in COBie Spreadsheet format, as defined by the COBie Standard. Knowledge regarding the relationship between the Industry Foundation Classes Model (ISO 16739) is explicitly not included.

7.2. COBie Certified Professional™ (Practitioner)

This section identifies the learning objectives necessary to achieve the skills identified at the COBie *Practitioner* level. It is assumed the candidate will have fully mastered the *Foundation* requirements. The *Practitioner* learning objectives correspond to skills at Bloom's levels of Application, Analysis, and Evaluation[2]. These objectives were developed buildingSMART international's COBie Certification Subcommittee International Advisory Board.

P-1 Assess the application of the COBie data structure in context.

- P-1.1 Define all COBie data structure elements found in COBie standard, Annex A.
- P-1.2 Apply COBie data structure to organize provided project data.
- P-1.3 Estimate COBie data based on provided project descriptions.
- P-1.4 Evaluate COBie data based on project phase requirements.
- P-1.5 Evaluate COBie data based on standard quality control rules.

P-2 Analyze COBie regional customizations.

- P-2.1 Identify allowed COBie customizations.
- P-2.2 Identify requirements for customizing classifications.
- P-2.3 Evaluate the quality of proposed classification customizations
- P-2.4 Evaluate proposed customizations to the COBie exclusion lists.
- P-2.5 Verify COBie property set customizations
- P-2.6 Validate COBie property set customizations

P-3 Assess COBie best-practices during design.

- P-3.1 Describe the conditions required to export BIM-based COBie data.
- P-3.2 Adapt BIM-use for export of Architectural COBie data.
- P-3.3 Adapt BIM-use for export of MEP COBie data.
- P-3.4 Conduct Quality Control of COBie data exports.
- P-3.5 Exchange and merge COBie data.
- P-3.6 Package a design-stage COBie deliverable.

P-4 Assess COBie best-practices during construction.

- P-4.1 Evaluate COBie construction data's applicability to design BIM.
- P-4.2 Evaluate construction administration processes for COBie data.
- P-4.3 Describe the process used to exchange and merge COBie data.
- P-4.4 Package a construction-stage COBie deliverable.

P-5 Assess COBie Quality Management practices.

- P.5.1 Justify the need for objective testing of BIM-based deliverables.
- P.5.2 Justify the COBie standard Quality Management process.
- P.5.3 Justify the requirement for automated COBie data testing.
- P.5.4 Evaluate COBie design data for compliance with standard.
- P.5.5 Evaluate COBie construction data for compliance with standard.
- P.5.6 Evaluate COBie design data for applicability to project.
- P.5.7 Explain why objective testing of BIM data is necessary.

P-6 Describe the relationship between COBie and IFC.

- P-6.1 Identify all COBie reference standards.
- P-6.2 Describe COBie in the context of the current set of IFC MVD's.
- P-6.3 Identify the IFC standard section pertaining to allowable file formats.
- P-6.4 List the file formats in which COBie data may be provided.
- P-6.5 Identify inefficient methods for delivering COBie data.

NOTE: COBie Practitioner knowledge primarily pertains only to information provided in COBie Spreadsheet format, as defined by the COBie Standard. However, knowledge regarding the relationship between the Industry Foundation Classes Model (ISO 16739) is included in the exam.

8. Conclusion

Those encountering COBie requirements or mandates for the first time, often treat COBie data collection as a new owner requirement requiring specialized consultants and added costs. Those who have followed the curriculum outlined in this publication will have developed the skills needed to integrate COBie data collection directly into design and construction practice regardless of the type of facility or set of business partners. On these projects, COBie data collection can be integrated within the design and construction process. For those who move beyond project-specific COBie implementation, this document outlines the tasks needed to realize enterprise-wide reductions in project overheads.

As the first publication providing a comprehensive set of tasks and educational requirements for project-based and organization-wide implementation of the COBie standard, this document provides an important milestone for the adoption of life cycle building information through the design, construction, and management industries.

These requirements were developed through a consensus process by the buildingSMART international COBie Subcommittee and International Advisory Panel and thus represents an international perspective of a standard initially published in the United States. This work demonstrates the international utility of the COBie standard.

9. Recommendation

This document should be used as a resource by members of the design, construction, and facility management industry including, but not limited to, educators, practitioners, owners, and human resource professionals. Several paragraphs below identify how this document can support each party.

This document may be used by educational service providers as the basis for course development. Course developers will now be able to map their course syllabi to the Foundation or Professional curriculum to support their submission to the COBie Registered Training Provider Program.

Currently a certificate of training completion from a Registered Training Program is not required to register for the COBie Certified Professional™ examination. In addition to the publication of this document through the buildingSMART international COBie website, a copy of this document will be provided to anyone registering for the COBie Certified Professional™ examination. buildingSMART international will encourage all registrants to review these learning objectives prior to sitting for the exam.

Practitioners may use this document to evaluate course offerings based on their personal skills assessment. For the most experience of these, published learning objectives help to identify areas for self-study. For those who do not have extensive current experience with all aspects of the COBie standard, published learning objectives will enhance the recognition that formal training is required.

Owners or others preparing COBie specifications may use this document to help justify their requirement to engage COBie certified personnel. Only when those bidding on projects, or internally using COBie data, have the agreed upon level of understanding will it be possible for COBie data to be delivered on every project, regardless of the contract parties. Including the requirement for a demonstration of skills is, ultimately, the only way for owners to ensure that bidders have not omitted or ignored COBie deliverables.

To fully integrate COBie data delivery into everyday use, the skills identified in this document must ultimately be included in job descriptions. Given the set of generic job roles, identified in the Appendix, and the tasks provided in Tables 1 through 5, human resources professionals have an initial start at development job descriptions that include COBie requirements.

Beyond the use of this document as a resource to industry personnel, it is recommended that buildingSMART international use this document as well. First, this document should be the basis for the COBie Registered Training Providers Program currently under development. Second, this document should be the basis for communication from buildingSMART international about requirements for project-based and organization-wide COBie implementation. Finally, this document along with the passing rate of the COBie Certified Professional™ examination maybe be used to adjust the content of future exams or provide specific educational emphasis.

10. References

[1] NIBS (2015) “National Building Information Model Standard - United States,” National Institute of Building Sciences, Version 3, Chapter 4.2 and Annexes.

[2] Bloom’s taxonomy descriptions provided courtesy of www.library.illinois.edu/staff/infolit/learningoutcomes/

[3] Fallon, Kristine, et. al. (2013) “Assessment of Life Cycle Information Exchanges (LCie): Understanding the Value-Added Benefits of a COBie Process,” Engineer Research and Development Center, CR-13-6

[4] Job descriptions provided courtesy of BIM Dictionary. <https://bimdictionary.com/>

Appendix A – Job Functions

Many parties that contribute to the successful execution of standards based COBie data delivery. The paragraphs below provide a brief description of common job. It should be noted that for many projects people perform more than one of these jobs. In addition, a given individual's official job title within a given company may not fully reflect the duties identified.

- (1) **Project Manager** - A person responsible for delivering a building design or construction project. Project Managers may be found within each tier of design and construction contracting as well as within owner organizations.
- (2) **Project BIM Manager** - A person responsible for the overall implementation of a BIM Management Plan across all relevant design and construction companies. Coordinates data-exchange activities according to contract requirements. [4]
- (3) **BIM Manager** - A person responsible for leading the BIM implementation process within a design or construction company supporting developing/delivering new BIM services and model-based efficiencies. [4]
- (4) **Technical Staff** - Technical staff who focus mainly on the technical aspects of generating and maintaining models, drawings or similar Project Deliverables. [1]
- (5) **Quality Management Staff** - Technical staff who have responsibility for assuring the quality of a deliverable during the production process or responsibility for evaluating the quality of a deliverable upon receipt of that deliverable.
- (6) **Project Engineer** - A person responsible to the contracting agency to evaluate all or part of the design or construction process to ensure terms of the contract are being fully met. Often responsible recommending payment invoices and providing quality management functions. Also called, Owner's Representative.
- (7) **Construction Administration Staff** - Technical staff who have the responsibility for coordinating the selection and delivery of manufactured products and equipment. Also called, Office Engineer.
- (8) **Specification Writers** - Technical staff who have responsibility for ensuring owner's requirements are translated into contracts and requirements that may be reasonably met by designers and contractors.
- (9) **Facility Manager** - A person responsible for the overall operations, maintenance, and management of a building or building portfolio. In large organizations these responsibilities are split among the following positions. Asset Managers are responsible for managing the occupancy of building spaces. Fiscal Managers are responsible for managing the financial accounting of building assets. Maintenance Managers are responsible to maintain building equipment and grounds sufficiently to allow required occupant activities. Operations Managers are responsible for the use of the facility in accordance with guidelines necessary to support required occupant activities.



- (10) Facility Repository Manager** - A person responsible for setting the policy and procedure for the acceptance of construction handover documents. Identifies deliverable policy and procedures to ensure long-term availability and, where applicable, use and re-use of building information.
- (11) Facility Management Technician** - Technical staff responsible for the operation and maintenance of a building or building portfolio.
- (12) Organizational Manager** - A “catch all” general job responsibility category that often requires the creation and management of a team whose skills include management, business process analysis, and information technology. Team members will also need extensive design, construction, and/or facility management expertise. The skills required to fulfill this role are not addressed by the buildingSMART COBie programs.

Appendix B – Example Questions

Some readers may not be familiar with the levels of knowledge identified in Bloom's taxonomy[2]. To assist these readers, five sample questions illustrating each of the Bloom's levels covered by the buildingSMART COBie Foundation and Professional exams are provided.

It should be noted that unless stated otherwise, all questions pertain to the spreadsheet presentation of the COBie standard. In addition, multiple choice answers noted to be correct are the "best" answers. Detractors will often include selections reflecting commonly held, but incorrect knowledge.

Knowledge/Remembering: *define, list, recognize*

question type - manually type in a short answer

What is the Primary Key for the COBie.Type Tab?

Type.Name (*correct*)

Comprehension/Understanding: *describe, explain, identify, locate, recognize, sort*

question type - select all correct answers

Which COBie.Type fields are **NOT** required by standard at construction?

- (a) Manufacturer
- (b) ModelNumber
- (c) WarrantyGuarantorParts
- (d) WarrantyDescription
- (e) ReplacementCost (*correct*)
- (f) ExpectedLife (*correct*)
- (g) ModelReference (*correct*)
- (h) Weight (*correct*)

Application/Applying: *choose, demonstrate, implement, perform*

question type - select one correct answer

How are COBie equipment assets located outside a building?

- (a) COBie.Component rows are identified by COBie.Space (*correct*)
- (b) COBie.Type rows can be located outside the building
- (c) COBie.Component rows' attributes identify their location as outside the Facility
- (d) COBie.Component rows reference the COBie.Facility row

Analysis/Analyzing: analyze, categorize, compare, differentiate

question type - select one correct answer

The installed equipment model numbers often differ from the approved number. In these cases, installed model numbers are best captured where?

- (a) Attribute.Value (*correct*)
- (b) Type.ModelReference
- (c) Type.ModelNumber
- (d) Type.CodePerformance
- (e) Not Allowed

Evaluation/Evaluating: assess, critique, evaluate, rank, rate

question type - select one correct answer

In the figure below, scan the row inside the highlighted box to find the column containing an error. (*CTRL + to zoom in, CTRL - to zoom out*)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Name	CreatedBy	CreatedOn	Category	Description	AssetType	Manufacturer	ModelNumber	WarrantyComponentParts	WarrantyDurationParts	WarrantyComponentLabor	WarrantyDurationLabor	WarrantyDurationUnit	Custom
2	AC Unit Type 1	bill.east@	2011-09-1	23-75 10 2	Horiz. D.X.	Fixed	sales@mit	n/a	sales@mit	1	sales@mit	1	year	n/a
3	AC Unit Type 2	bill.east@	2011-09-1	23-75 10 2	Horiz. D.X.	n/a	sales@dat	DAPA-2.5	sales@dat	1	sales@dat	0	year	n/a
4	AC Unit Type 2	bill.east@	2011-09-1	23-75 10 2	Horiz. D.X.	Fixed	sales@dat	DAPA-2.5	sales@dat	1	sales@dat	0	year	n/a
5	AHU	bill.east@	2011-09-1	23-75 35 1	n/a	Fixed	sales@Yor	AP-500	sales@Yor	1	sales@Yor	1	year	Autoc
6	Air Compressor - D	bill.east@	2013-01-2	23-65 55 1	Duplex Pad	Fixed	manufactu	DAC-M55	manufactu	n/a	manufactu	0	manufactu	n/a
7	Air Cooled Chiller	bill.east@	2011-09-1	23-75 10 2	633-703 k	Fixed	sales@Yor	YCAS01508	sales@Yor	1	sales@Yor	1	year	Autoc
8	Air Cooled Condens	bill.east@	2011-09-1	23-75 10 2	3500 Watt	Fixed	sales@dat	DRCU-031	sales@dat	1	sales@dat	0	year	n/a
9	Air Cooled Condens	bill.east@	2011-09-1	23-75 10 2	2500 Watt	Fixed	sales@mit	PUG248KB	sales@mit	1	sales@mit	1	year	n/a
10	Air Separator	bill.east@	2011-09-1	23-75 50 1	Centrifuga	Fixed	info@amtr	6-AS	info@amtr	1	info@amtr	1	year	n/a
11	Backflow Preventer	bill.east@	2011-09-1	23-65 55 1	20 mm	Fixed	sales@apx	RP40	sales@apx	5	sales@apx	0	year	Autoc
12	Ball Valve 100 mm	bill.east@	2011-09-1	23-65 55 1	100 mm	Fixed	sales@apx	64-10A	sales@apx	2	sales@apx	2	year	n/a
13	Ball Valve 150 mm	bill.east@	2011-09-1	23-65 55 1	150 mm	Fixed	sales@apx	SS-P76	sales@apx	2	sales@apx	2	year	Autoc
14	Ball Valve 50 mm	bill.east@	2011-09-1	23-65 55 1	50 mm	Fixed	sales@apx	64-108	sales@apx	2	sales@apx	0	year	Autoc
15	Ball Valve 65 mm	bill.east@	2011-09-1	23-65 55 1	65 mm	Fixed	sales@apx	64-109	sales@apx	2	sales@apx	0	year	Autoc
16	Ball Valve 80 mm	bill.east@	2011-09-1	23-65 55 1	80 mm	Fixed	sales@apx	64-100	sales@apx	2	sales@apx	0	year	Autoc

- (a) Name (*correct*)
- (b) Category
- (c) Description
- (d) AssetType
- (e) No Error

{end of document}