buildingSMART International

Activity Proposal

Project Name:

Facilities Management Handover - COBie 2.5

General Information

Room Governance:
Building Room

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Four (4) software companies
Three (3) expert panel members
Two (2) owner organizations
Three (3) notable individuals

Document Information:

Document/Project ID: BR-2020-1020-AP

Date: 2020-07-15

Version: V1.0

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1   Glossary

Body	Abbreviation	Short summary
buildingSMART International	bSI	
Expert Panel*	EP	Provides expert advice during the project on a voluntary basis during four meetings per year (on average).
Building Room*	BR	Open forum within bSI which is responsible for the Building domain and all developments on IFC within this domain.
Building Room Project Steering Committee*	BRPSC	Body within the Building Room responsible for managing the Building Room projects, which meets once a month and Project Lead presents the Project Dashboard during this meeting.
Building Room Steering Committee*	BRSC	Steers the Building Room and is responsible for setting out strategy and managing initiatives and liaison with other Rooms and bodies.
COBie Certified Professional™	-	An individual recognized as a COBie Certified Professional™, a registry of which can be found at cobie.buildingsmart.org/registry/
Construction Operation Building information exchange	COBie	Technical Standard and package needed to support life-cycle capture and exchange of building equipment handover documentation.
International Standardization Organization	ISO	Please follow this link for more information: http://www.iso.org/iso/home.html
Model View Definition	MVD	Current bSI MVD directory: https://technical.buildingsmart.org/standards/ifc/mvd/mvd-database/
Project Leader	PL	Responsible for managing the project and ensures the project is delivered within budget and on time.
Project Team	PT	Executes a project based on a project plan and delivers the results according to plan.
Standards Committee*	SC	The senior governing body within bSI overseeing the standards process. It is comprised of representatives from members and chapters.
Standards Committee Executive*	SCE	Establishes and manages the bSI standards process and addresses procedural and programmatic issues.
Standards Committee Technical Executive*	SCTE	Provides technical advice to the SC and SCE during the bSI standards process and addresses project technical issues.

* The buildingSMART International Standards Process describes how standards and other technical work is created and governed within buildingSMART International (http://buildingsmart.org/standards/standards-process/).

2   Executive Summary

The COBie 2.5 project will update and internationalize the current Construction Operations Building information exchange (COBie) standard within the buildingSMART community and process. While technical work on the project may be quickly accomplished and published, for these updates to be implemented, the project plan must out of necessity reflect software R&D and product release cycle time horizons. In addition, planning for the education and training tools and resources needed to minimize the cost of building project teams making the transition from prior COBie 2x versions to the new COBie 2.5 bSI-based standard are also to be considered if the work produced is to be successfully applied on live projects.

Based on the author's recognized experience in the field, knowledge of the subject matter, and demonstrated capability to execute successful buildingSMART international sanctioned projects, this activity proposal may exceed the level of detail commonly encountered in a bSI activity proposal. Should this document be sufficient to meet the needs of the bSI activity proposal and project proposal, then bSI is encouraged to move expeditiously to accelerate this project. Doing so will clearly demonstrate the critical role that buildingSMART international plays in solving practical problems such as the commissioning and handover of buildings in the construction industry around the world.

3   Background

3.1   HISTORY

The COBie project was undertaken by United States government personnel in 2006. The first publication of the COBie specification occurred in 2007 [1]. As the name of the specification indicates, its purpose was to capture building construction handover information. Specifically, COBie was designed to identify the minimum data already being delivered at construction handover, for both manufactured building products and equipment requiring preventative maintenance. From the first publication, COBie also identified the sources of and uses for that information throughout a building project's lifecycle. Understanding these processes led to the development of a business process simulation to predict savings earned through capturing data when it is first created and augmenting that information in existing construction administration processes. Delivering this information in an open standard data format provides real-time as-built equipment data during the construction process and eliminates the need to produce traditional operations and maintenance manuals.

Within a year of the first publication of the standard, commercial software companies demonstrated their ability to deliver COBie data at an event held at the United States National Academies of Engineering [2]. This event established COBie as the first standard capable of using non-geometric building information extracted from Building Information Modelling (BIM) software. This meeting also provided the first automated BIM data quality testing. Having quality control requirements designed into COBie has been one of the cornerstones of this effort from the beginning.

Following the initial 2008 demonstration, participating software companies expressed interest in supporting a single internationally recognized construction handover information exchange specification. As a result, all later work on COBie followed relevant international best-practices. This

included participation in International Alliance for Interoperability (IAI) processes and events. For example, the COBie Information Delivery Manual (IDM) was registered with the IAI's international IDM registry. To provide a common technical specification for COBie, the COBie Model View Definition (MVD) was also created. The first MVD was developed based on IFC 2x3 and published by IAI as the FM Handover MVD. Despite many requests from the United States that this depreciated specification be removed, it has yet to be decommissioned by buildingSMART international. The currently implemented COBie MVD is based on IFC4 and is produced by the chair of the buildingSMART MVD technical committee. In 2013, two years before the publication of the COBie standard, the MVD was published by the United States National Institute of Building Sciences [3].

During the initial period of COBie adoption (2008-2014), over 30 commercial software systems were tested [4]. These products supported the entire lifecycle of a building, including the stages of planning, design, construction, and facility management section. Only four (4) of the 30 products tested were designed with BIM software. In a further departure from the traditional IAI/buildingSMART audience, only three (3) of the 30 products tested delivered COBie data in STEP Physical File Format. This means that 90% of software that has undergone formal testing to produce or consume COBie data utilizes the alternative spreadsheet-based Physical File Format documented in the COBie standard.

In 2015, COBie became one of four (4) IFC4-based information exchange standards published as part of the National Building Information Model Standard - United States® (NBIMS-US), Version 3 [5]. The minimum requirements for these standards were the production of IDMs using the Business Process Modelling Notation (BPMN) and MVDs using the ifcXML specification. Beyond the schema requirements analysis (IFM) and schema definition (MVD), each information exchange project was required to provide a business case calculation and example data files, demonstrate the practical use of the MVD using commercial software, and identify training, testing, and implementation resources. A review of the decade long history of the NBIMS-US effort is instructive for understanding why such stringent requirements for technical standards were introduced in Version 3 of the standard [6].

The production of COBie data capable of meeting NBIMS-US V3 quality standards requires that two conditions be met. The first condition is that the software is capable of exporting or importing the required set of COBie data, based on the appropriate phase of a building's lifecycle. Given the technical specification of the COBie standard, this question can be objectively answered using open-source testing software [7][8]. The second condition is that software users know how to use tested software to correctly provide the COBie data required for their specific project. As this is the only available metric for the assessment of information quality, innovative users have also begun also to use COBie to access the quality Building Information Model data directly.

Software testing before NBIMS-US V3 focused on the ability of commercially available software to produce and/or consume COBie data. Given the robust objective testing of over 30 products, it was clear that COBie (at least in spreadsheet format) could be used by any interested commercial software at any stage during the project lifecycle. Since 2015, COBie testing has moved away from questions about software capability to that of users' ability to correctly apply that software. Today, an example lifecycle simulation of one small but interesting building has enabled design and construction professionals to directly test their own software. These test files are freely provided under a Creative Commons license, allowing anyone to check this work [9]. Documentation of the results of these tests provides the "cookbook" needed to seamlessly capture COBie data [10][11].

Today, COBie requirements can now be found in projects across many countries. In some countries, national governments have mandated the delivery of COBie data. In other countries, COBie requirements are made on a regional- or owner-specific basis. Regardless of an owner's interest in COBie, there has been widespread inconsistency in the specification, enforcement, delivery, and use of COBie data. Furthermore, there has been innovation in real-time as-built data collection by construction companies who typically prefer to add project costs under a traditional handover process. To support those who require and provide standard-compliant COBie deliverables, and to recognize the need for real-time as-built data collection, buildingSMART international formed the COBie Certification Subcommittee. In May 2020, buildingSMART began conferring the title of COBie Certified Professionals™ to those who successfully completed a comprehensive two-hour technical examination. Related examinations such as the introduction of a bSI COBie Foundation exam and a Registered Training Provider process are currently underway.

3.2 OPPORTUNITY & INDUSTRY NEED

With the growing international adoption of COBie as a defacto standard for building handover, there is an opportunity for buildingSMART international to deliver COBie 2.5 as an official bSI Standard. By delivering this project via the bSI "Standards and Solutions" process with participation and consensus by the international buildingSMART community, the continued expansion of COBie's technical development will comply with the bSI development process to the quality required to be designated a Candidate Standard ready for software validation and implementation.

The need for buildingSMART international's leadership in the building handover domain has already been recognized through buildingSMART international's COBie Certified Professional™ effort.

The following specific needs will be addressed in the COBie 2.5 project.

3.2.1 Technical Specification

Practical use of a standard leads to a better understanding of the underlying requirements, which leads to further improvement of the standard itself. The first set of opportunities and needs pertain to the technical details of the COBie MVD.

Specification. The COBie 2.4 schema was produced in what was the state-of-the-art data modelling notation ifcXML. To be more responsive to software implementers, buildingSMART international has announced plans to follow the STEP community by moving away from EXPRESS-based schema notation and toward Unified Modelling Language (UML) schema definition. COBie 2.5 provides buildingSMART international a crucial opportunity to demonstrate the usefulness of this new technical approach.

Corrected Mappings. The existing COBie 2.4 spreadsheet specification contains several typographic errors that will be corrected in COBie 2.5. These errors directly affect a user's understanding of the purpose of specific COBie fields.

Simplified Mappings. Mapping data from a complex EXPRESS data schema into the COBie 2.4 spreadsheet schema has been reliably accomplished; however, use of the COBie standard has demonstrated the need for additional collapsing of IFC data structures representing building systems, component assemblies, and component connections. COBie 2.5 presents an opportunity to

document additional mappings, as explicitly allowed under ISO 16739, to further simplify the COBie 2.4 structure.

Additional Mappings. While some information in the COBie MVD can be simplified, the use of COBie has demonstrated the need for other types of object mappings to be expanded. These expansions do not add to the scope of COBie, but rather directly support improvements in the COBie data model that are needed in practice. Specifically, this set of changes supports the identification maintenance requirements and replacement products related to building systems, rooms, or the facility itself.

3.2.2   Internationalization

As the adoption of COBie has grown, so have the requirements for translations and extensions to the COBie standard. These opportunities and needs are described in the paragraphs below.

Translations. COBie 2.4 is a US-English standard. To ensure the widest possible use of COBie, buildingSMART international can support the translation of key COBie information, including schema and physical format translations within the context of the buildingSMART Data Dictionary (bSDD). It is expected that the bSDD will provide web services that allow software vendors to lookup translations of key COBie concepts to enable native language COBie usage.

Extensions. As has been demonstrated by the widespread use of COBie, once there is a good tool for one purpose, people will want to adapt that tool to other jobs as well. To clearly distinguish between the core set of building product and equipment information that is well represented in COBie, and the requirements for extended data, the rules for regional adaptation of COBie will be made explicit.

In COBie 2.4, owners may adapt COBie to their projects by identifying (1) local, regional, or project-specific classification, (2) additionally excluded entities, and (3) required properties of included entities. In COBie 2.5, these three types of "customizations" will also be allowed.

There have been many additional proposed extensions. Those experienced in the development of standards will know that what comprises international use of a standard cannot be entirely predicted by standards developers. Readers of this proposal will clearly understand that one individual IFC MVD can support every possible data exchange requirement [13]. In some cases, these "extensions" must be developed as separate MVDs. In the view of this project, buildingSMART international must be agnostic about these changes and provide a method for such decisions left to the local bSI Chapter.

Four such extensions can be found in the spreadsheet specification of the COBie 2.4 standard. In the COBie spreadsheet extensions are the COBie.Coordinate, COBie.Issue, and COBie.Impact tabs as well as extended use of product properties in COBie.Type. These extensions were not developed in the actual COBie 2.4 standard and must therefore be refactored out of COBie 2.5. Provision for documenting any needed IFC information exchange requirement is provided by the 2020 bSI Technical Roadmap. Should it be relevant for those projects, the required information may be mapped into spreadsheet physical file format under a separate project to be coordinated under the COBie roadmap.

3.2.3   Implementation & Outreach

The effort to produce a technical statement of requirements is not the end of the process. In fact, the technical specification is simply the "end of the beginning" of moving our conservative industry forward. To support COBie 2.5 implementation clear guidance about the meaning of COBie requirements, examples, and testing capabilities are mandatory.

Examples. Providing examples of the changes recommended and finalized is an essential opportunity for buildingSMART international to demonstrate its leadership in support of creating standards that are standards in fact, not just standards in name. Documenting changes allows those who used COBie 2.4 to quickly transition to COBie 2.5. Having a life cycle set of COBie 2.5 example project data provides a clear path to those who would specify, product, consume, and implement COBie 2.5.

Testing. As noted in previous history of COBie 2.4, objectively testing COBie data files and using scripted software import testing with common models has become the gold standard for verifying and validating the information contents in commercial software. A key aspect of this testing has been the availability of open-source software tools that can be downloaded for free by anyone on any project team. These software tools will need to be updated to support COBie 2.5.

Beyond updating software tools, the creation of a world-wide registry of software demonstrated to be able to correctly produce or consume COBie will provide a focal point for the recognition of the value of buildingSMART international beyond simply creating standards. As part of this project, buildingSMART international will establish and publish objective software testing protocols and invite self-tested software products to be independently evaluated against standard test models by anyone, anywhere.

Commentary. An essential element in the application of every building code or standard is a document called a "commentary." Though a US-based COBie Guide was published ten years ago [12] which has been widely cited, there has been no process established for feedback and lessons learned. To support the adoption of COBie, there must be an international consensus on the use of the standard for the most common set of alternative project configurations. As has been demonstrated by recent COBie publications [10][11], while countries may have slightly different terminology for their specific processes and deliverables, the basic mechanisms of the design and construction process are surprisingly consistent across countries. These must be documented in a COBie Commentary and published by buildingSMART international.

Ensuring that the scope of the COBie standard remains consistent, focusing on the delivery of building product and equipment data, the number of alternative project configurations to be addressed in a commentary is well understood by the cadre of COBie Certified Professionals™.

3.3   PROJECT GOVERNANCE

The proposed project will be executed and governed as a buildingSMART international project within the Building Room and executed in accordance with the bSI Process and in particular to Addendum 3 Project Delivery. As set out in detail in section 6 below the project will include both a Technical Lead and a Project Lead.

The results of the project will also be coordinated with the buildingSMART international Certification Committee that is currently operating the COBie Certified Professional™ and COBie Foundation

exams. The COBie Certified Professional™ website, cobie.buildingsmart.org, will be expanded to support COBie 2.5, in addition to the current certification mission.

3.4   RELATIONSHIP TO BSI STANDARDS, TECHNICAL WORK, AND TECHNICAL ROADMAP

COBie is, by definition, an IFC MVD. The purpose of this project is to update COBie for to conform with new bSI technical requirements and formats. As part of that effort, a minor technical update will be made that emphasizes how the core COBie use cases a provide a clear path for international versions of the core COBie and regional COBie extensions. Provided the bSDD has the capability to support the functionality described under the "Opportunities" section above, the bSDD will prove to be an important resource to coordinate COBie implementation.

This project is expected to generate a series of bSI technical reports. In this proposal, the publication of an ongoing series of reports is preferred rather than waiting until the end of the project for the publication of a full opus. These reports serve to document the approach, requirements, and integrity of the COBie 2.5 process, and provide regular tangible demonstration of results achieved. These reports include the updated COBie MVD and spreadsheets named Physical File Format mappings, Implementation Guides, and Educational Curriculum. One Educational Curriculum-related publication is already under consideration as a bSI report. Some of these documents, such as implementation guides or testing guides, may be developed as paid products.

Regarding the coverage of COBie with respect to other published MVDs, a detailed coverage analysis was a mandatory component of the technical documentation of the NBIMS-US V3 process. That coverage analysis has not changed with COBie 2.5. A series of papers summarizing the verification and validation of the resulting real-time building performance management framework were previously published. A summary of the objective of these MVDs as part of "A Domain-Independent Facility Control Framework" can be found in the referenced citation [12].

The current COBie standard (version 2.4, published in NBIMS-US V3) was developed based on expected US and UK requirements identified a decade ago. Since that time, there have been technical improvements in the specification of buildingSMART standards and increased knowledge of the actual application of that original specification. In addition, several potential improvements that simplify the mapping of COBie spreadsheet Physical File Format to IFC data model entities have been identified.

3.5   RELATIONSHIP TO OTHER STANDARDS AND TECHNICAL WORK

COBie 2.5 is based on COBie 2.4, which is the current internationally referenced COBie standard. COBie 2.4 is published "in form" by the United States National Institute of Building Sciences, a small not-for-profit organization operating in Washington, D.C., USA. While COBie 2.4 is contained in NIBS' National Building Information Modelling Standard - Untied States (NBIMS-US), Version 3, Chapter 4.2 and Annexes, COBie was developed by the United States government. Under United States federal law, the content and organization of products developed by the US government may not be copyrighted.

4   Scope & Objectives

4.1   SCOPE STATEMENT

This project will transition the "current" FM Handover MVD (COBie 2.26) and draft COBie MVD (version 2.4) in the bSI MVD directory to a an updated COBie (version 2.5) specification reflecting requirements of bSI's 2020 Technical Roadmap, lessons learned during widespread COBie use, and need for non-English implementations. To ensure the success of this COBie 2.5, buildingSMART international will support software companies and users by providing tools needed for understanding, testing, and using COBie.

4.2   OBJECTIVES

This section identifies the work packages required to address the opportunities and issues described previously.

4.2.1   Work Package 1: Specification

This work package includes tasks required to document technical updates to the COBie 2.5 MVD and mapped spreadsheet physical file format.

WP1.1 Schema. Using the modelling tools outlined by the bSI Technical Roadmap, the entities and relationships required to model the life-cycle delivery of manufactured building products and equipment requiring regular maintenance will be documented. As the underlying COBie IDM has not changed, this effort is simply a translation of the existing ifcXML MVD specification to the new bSI technical specification requirements.

WP1.2 Mapping. Based on feedback from use of the COBie 2.4 spreadsheet physical format, several corrections and changes to mappings which are needed to flatten IFC entity complexity will be documented. Spreadsheet fields beyond those documented in COBie 2.5 MVD will be removed from the spreadsheet mapping. This mapping document will also provide the explicit rules for verification of data file standard compliance, and validation of data content based on project-specific information.

WP1.3 Examples. Example data files will be created using the "Dormitory" project model which received an honourable mention at the bSI awards in 2018. Example files and presentations which highlight the differences between COBie 2.4 and 2.5 will be created. Prairie Sky Consulting will provide a licence for the Dormitory project to bSI during the developmental phase of COBie 2.5. Upon successful transition to COBie 2.5, Prairie Sky Consulting will donate all relevant data and files to buildingSMART international and redirect all inquiries for these materials to bSI.

WP1.4 Guidance. There are several matters of practical import that could be implemented in a variety of ways. These issues will be documented by COBie Certified Professionals and an authorized method for implementation will be clearly documented. Examples include implication of parametric design on the delivery of COBie data, placement of roof- and site-mounted equipment, designation of grouped spaces based the use of signage, determination of door and window access and egress, and other detailed topics.

4.2.2 Work Package 2: Implementation

This work package supports software vendors' implementation of COBie 2.5 and establishes the rules for testing and optionally testing the extension framework.

WP2.1 Preparation. A proposed package of sample files and testing rules will be established for design-stage, construction-stage, and construction-handover stage exchanges. These rules will be presented to self-selected candidate software companies to support their need to request feature changes and resources.

WP2.2 Support. Once the schedules for software implementations have been announced, the bSI team will provide monthly implementer's meetings to address any issues that arise. Each issue will be addressed and documented as an annex to the specification guide developed in WP1. As needed, changes will be made to example files and test rules.

WP2.3 Test Platform. An update to the current open source COBie verification software will be completed to provide all implementers and future COBie 2.5 users a tool that can be freely used to determine if the submitted files have met technical specifications.

WP2.4 Testing. Testing will be conducted based on software vendor's implementation of COBie 2.5 and submission of sample files whose contents can be automatically verified and validated against associated BIM objects and drawings (in the case of the production of design, construction, and handover files). Testing of facility maintenance, operations, and asset management software will be conducted based on a script where inspection of imported data can be checked.

WP2.5 Publication. After review of independent testing results, vendors may agree to have bSI publish their results. These results will be presented in both narrative and side-by-side comparison formats.

4.2.3 Work Package 3: Outreach

This work package will provide general information about the COBie 2.5 effort, document the progress of the project, and support those who would eventually implement COBie 2.5. This effort will also set the schedule for a formal transition from COBie 2.4 to COBie 2.5.

WP3.1 Outreach. An introductory presentation and video will be produced and distributed by bSI to raise awareness, generate interest, and set expectations of the goals of COBie 2.5. The release of these materials will be accomplished via cobie.buildingsmart.org, whose format will have to be expanded beyond the current Certification program content.

WP3.2 Chapter POC's. bSI chapter POCs will be invited to join the outreach aspect of the project to promote and facilitate the implementation of COBie 2.5 within their regions. POCs will be asked to provide a notional plan for regional outreach and report against those plans. As bSI provides further updates, these POCs will be relied upon to report their local outreach activities.

WP3.3 Transition. The plan to transition from COBie 2.4 to COBie 2.5 will be established to coordinate the activities of the international and regional chapters. This includes the identification and recommended removal of depreciated bSI and regional COBie specifications, as well as setting the timetables for expected requirements for updated specifications.

WP3.4 Progress. When deliverables have been completed, progress presentations and videos will be produced and distributed by bSI to maintain interest in COBie 2.5 and clarify project goals as questions arise.

WP3.5 Releases. At key milestones, bSI will provide formal press releases pertaining to COBie 2.5 to appropriate outlets of record. bSI will work with chapter POC's to distribute this information.

4.2.4 Work Package 4: Translation

bSI chapter members participating in the documentation of the COBie 2.5 specification can provide translated COBie specification documentation and examples in languages other than English. bSI chapters may use such information for outreach efforts in specific regional markets. Where appropriate information developed through these projects will be published in the bSDD to support automated software localization. These translation projects will be defined, approved, and managed as separate projects under the bSI COBie Roadmap.

4.3 APPROACH

Given the existing installed base of COBie users, and extent of the work required, management of this project will be coordinated between the Project Chair and the Technical Chair. The Project Chair will be responsible for coordination of activities between the team executing the project, led by the Technical Chair and building SMART international organizational bodies and reporting requirements.

The Technical Chair will be responsible for the execution of all four of the work packages outlined in this project. Each work package will also require international collaboration as evident in the number of project teams identified in the prior "Resources & Skills" section.

During the execution WP1 "Specification", the Technical Chair will organize the Technical Team, comprised of those identified as COBie Certified Professionals™. The bSI Technical Director will also be asked to sit on the Technical Team. Provided that the open-source version of the IFC UML tool is available, it is expected that this technical work will be completed, and a document will be drafted within six (6) months of project initiation. At the conclusion of WP1, the Technical Team will move into a support role to assist those creating Translation or Content Extensions and software implementers.

Implementation of the new COBie 2.5 specification, in WP2, will be accomplished by the Implementation Team. Implementation Team will be formed from the Technical Team, whose members will transition into a supporting role. The Implementation Team will be chaired by the Project Technical Chair. The Project Chair will solicit participation in the Implementation Team by contacting major bSI designers, contractors, and facility owners. In addition, the Project Chair will solicit participation in the Software Development Team, whose members will be comprised of software companies, including those who currently produce or consume COBie 2.4 data.

The implementation stage of the COBie 2.5 project may begin as early as the completion of the draft COBie 2.5 specification, and the schedule for COBie software implementation will require a minimum of two (2) years. Most of that time will be spent waiting for the resources allocated by software companies to become available to complete the work.

As software companies' implementation becomes ready for testing, specific Software Testing Teams will be created to follow the test scripts created by the Implementation Team. Depending on the number of concurrent tests required, the Implementation Team may take the place of separate Software Testing Teams. Prior to the publication of the results of the objective testing conducted by the Software Testing Teams, the Implementation Team will review the test report and require a written release from the software companies prior to test report publication.

Once software companies have successfully implemented COBie export or import routines, the time required to schedule and report testing results should not exceed four (4) weeks.

Critical to the effective use of the software that has been tested is the work identified in WP3 "Outreach," the Project Chair will be the primary point of contact for buildingSMART international in organizing and supporting outreach activities. The Project Chair will be assisted in this effort by a specific Outreach Team as well as a Publication and Website Team.

Translation activities will be completed in parallel under WP4. Depending on the need and interest of bSI chapters, translations of COBie specification, testing, and outreach may be accomplished in parallel to that described above. Such projects will be defined and managed as separate projects.

Should the undocumented extensions introduced to the COBie 2.4 spreadsheet continue to be needed by local bSI chapters, additional projects following the bSI Technical Roadmap may be introduced. To the extent that such projects expect to provide mappings to a spreadsheet physical file format based on COBie 2.5 these projects will be included in the overall COBie roadmap.

4.4   CHALLENGES

There are few technical challenges facing the creation of COBie 2.5. Most of the work involved will be to translate the existing COBie 2.4 into the new UML-based format. There is also likely to be little misunderstanding of purpose and scope of the technical standard, given the more tightly focused scope of COBie 2.5, that was the case with the current standard. Thus, the only challenge to completing the technical work required to publish the draft of COBie 2.5 is having the authorization and resources necessary to begin.

Likewise, implementation of the COBie standard within those companies who already support COBie is also likely to be simplified. For software companies, the major concern will be that buildingSMART international assures that they are properly coordinating the handoff of COBie management from NIBS to buildingSMART international.

Given the level of interest in the core COBie 2.5 requirement, and the relative ease with which software companies can implement these requirements, there are two primary purposes of COBie 2.5 outreach activities. Each of these will have its own challenges. The first purpose of COBie 2.5 outreach will be to reduce the difficulty of transitioning from COBie 2.4 to 2.5. To accomplish this, buildingSMART international will need to identify and work alongside key chapter members and software developers on the Outreach Team to provide information and support during the transition.

buildingSMART international will be able to use this project as a "reboot" of the perception that COBie has been a US- or UK-only requirement, and that the deliverables required are somehow less appropriate for use in a non-English speaking country. In this regard, key bSI chapter members have a role to play as supported by the project's Outreach Committee. To assist in this regard, it would be

highly recommended for the Project Chair and Technical Chair to directly participate and support outreach activities as international COBie ambassadors.

The development of Translation projects should be quite straightforward, provided the rules for documenting the translation in bSDD have been clearly specified. With these rules in place, the only impediment for translation and use of COBie in all bSI member languages will be the time and resources of those providing the translations. Testing of non-US-English (or multi-lingual) software may be conducted by having Translation Team members participate as Software Testing Team members.

5   Deliverables

The following deliverables can be expected from each work package as noted below.

5.1   WORK PACKAGE 1: SPECIFICATION

- WP1.1 COBie 2.5 IFC Class Diagram and Report.
- WP1.2 COBie 2.5 Mapping Requirements and Report.
- WP1.3.1 Design Stage Example File
- WP1.3.2 Construction Stage Example File
- WP1.3.3 Handover Stage Example File
- WP1.3.4 Example File Report.
- WP1.4 Implementation Guide Report.

5.2   WORK PACKAGE 2: IMPLEMENTATION

- WP2.1 Expected Test Package.
- WP2.2 Monthly Support Meeting Minutes.
- WP2.3. QC Test Platform Software and Documentation.
- WP2.4.1 Updated Test Package.
- WP2.4.2 (Internal only) Test Result Memo.
- WP2.5 Test Result Publication web pages.

5.3   WORK PACKAGE 3: OUTREACH

- WP2.1.1 Initial Outreach Presentation.
- WP2.1.2 Initial Outreach Video.
- WP2.2.1 Chapter POC Registry.
- WP2.2.2 Chapter Outreach Planning Memo.
- WP2.3.1 Draft bSI Transition Plan
- WP2.3.2 Draft Chapter Transition Plans
- WP2.3.3 Transition Plan Updates
- WP2.4 Periodic Progress Briefings
- WP2.5 Periodic Press Releases

5.4 WORK PACKAGE 4: TRANSLATION

A translated set of documents mirroring those above will need to be produced under separately managed COBie Roadmap projects.

6 Resources & Project Execution

6.1 RESOURCES & SKILLS

Project Chair/Leader. A project administrator will be required to work with bSI to capture the necessary resources to accomplish this project.

Project Technical Chair/Leader. A technical chair will be required to guide the consistent completion of many of the activities identified in this project.

Project Team. Several different project teams will be needed to support the activities of this project:

Technical Team - comprised of COBie Certified Professionals and software implementers.

Translation Teams - several sub-teams who will translate technical specifications.

Extension Teams - two sub-teams who will document the two noted extension examples.

Implementation Teams - bSI chapter leader and members supporting regional implementation.

Software Development Teams - software company internal teams.

Software Testing Teams - comprised of Technical Team subsets and Software Teams.

Outreach Team. Composed of bSI Marketing chairs, this team works with key bSI Chapter Implementation Teams.

Publication Team. Resources for technical editing and report administration.

Website Team. Resources for updating cobie.buildingsmart.org.

6.2 PROJECT EXECUTION & MANAGEMENT

The details of project execution & management have been fully addressed in the previous "approach" and "challenges" section of this activity proposal.

6.3 LIAISONS

bSI Technical Director. For conformance with bSI technical requirements.

bSDD Liaison. For translation and extension projects.

bSI Chapter Liaisons. For regional implementation and outreach.

NIBS Liaison. For coordination to ensure the use of COBie 2.5 as a reference standard within a future NBIMS-US version.

Stakeholder liaisons. Specific attention must be paid to several key national organizations who are individually identified as project stakeholders. These stakeholders will be further identified during the first year of the project.

7 Work & Time Schedule

This is a five (5) year plan. Most of this time will be taken up by the requirement to support the scheduling and budgeting cycles of software companies' in-kind resources, which are needed to implement and/or update to COBie 2.5.

The following schedule can be expected for each deliverable, provided that resources are available as noted in the following section. Note that all times are noted as the quarter from project start. Thus, the timing items noted below range from the first quarter to the 20th quarter.

When noted below, "website" refers to the updated cobie.buildingsmart.org website.

When noted below, "Report" refers to an official bSI publication of some type. The specific categories of publication will need to be addressed by those who understand the types and protocols for such documents.

7.1 WORK PACKAGE 1: SPECIFICATION

This set of tasks is the responsibility of the Project Technical Chair, with help and review by the Technical Team, Implementation Team, and Software Development Teams.

- WP1.1 COBie 2.5 IFC Class Diagram and Report.
    - (prerequisite - open source UML diagram)
    - Technical Work and Draft Report   1Q
    - Draft publication on website   2Q
    - Published bSI Technical Report   3Q

- WP1.2 COBie 2.5 Mapping Requirements and Report.
    - (prerequisite - completion of draft report)
    - Draft report for spreadsheet mapping   1Q
    - Draft publication on website   2Q
    - Published bSI Technical Report   3Q

- WP1.3.1 Design Stage Example File
    - (prerequisite - draft spreadsheet mapping)
    - Prepare and publish on website   2Q

- WP1.3.2 Construction Stage Example File
    - (prerequisite - design stage example file)
    - Prepare and publish on website   2Q

- WP1.3.3 Handover Stage Example File
    - (prerequisite - construction stage example file)
    - Prepare and publish on website   2Q

- WP1.3.4 Example File Report.
    - (prerequisite - handover stage example file)
    - Draft report and publish on website   2Q
    - Published bSI Technical Report   3Q

- WP1.4 Implementation Guide Report.
    - (prerequisite - draft example file report)
    - Draft Report and publish on website   2Q
    - Published bSI Technical Report   3Q

7.2   WORK PACKAGE 2: IMPLEMENTATION

- WP2.1 Expected Test Package.
This set of tasks are the responsibility of the Project Technical Chair, with help and review by the Technical Team, Implementation Team, and Software Development Teams.

    - (prerequisite - completion of WP1 draft files)
    - Software Company's Test Plan Input   3Q
    - Description of Test Scripts using example files   4Q
    - Draft report and publish on website   5Q
    - Published bSI Technical Report   6Q

- WP2.2 Monthly Support Meeting Minutes.
  bSI administrative support will be required to coordinate this activity.

    - (prerequisite - technical coordination calls begin at start of project)

- WP2.3. QC Test Platform Software and Documentation.
  This set of tasks are the responsibility of the Project Technical Chair, with help and review by the Technical Team, Implementation Team, and Software Development Teams.

    - (prerequisite - expected test package)
    - (prerequisite - donated resources to update existing test software)
    - Prepare review software specifications   5Q
    - Update existing open source verification testing software   5Q
    - Conduct testing of verification software   5Q
    - Draft report and publish to website   5Q
    - Published bSI Technical Report   6Q

- WP2.4.1 Updated Test Package.

This set of tasks are the responsibility of the Project Technical Chair, with help and review by the Technical Team, Implementation Team, and Software Development Teams.

- o Update implementation guide, test package, and test platform as needed to support software development efforts.   6Q

- WP2.4.2 (Internal only) Test Result Memo.
  This set of tasks are the responsibility of the Implementation Team and Software Development Teams. The expectation is that large vendors have a two-year (i.e. 8Q) resource allocation window. To ensure fairness between large and small vendors, and to limit disruption of existing COBie 2.4 activities, testing will respect this reality of the software development process.

  - o (prerequisite - technical specification, mapping, examples)
  - o Identify developer resources and request resources   3Q
  - o (prerequisite - expected test package)
  - o (prerequisite - expected test platform)
  - o Software developer resource availability   11Q
  - o Vendor schedule tests   12Q
  - o Conduct vendor tests and provide feedback   12Q
  - o Vendor results publication request   13Q

- WP2.5 Test Result Publication web pages.
  This set of tasks are the responsibility of the Implementation Team.

  - o (prerequisite - final test packages and scripts)
  - o Publish update to updated developer instructions to website   10Q
  - o (prerequisite - tranche of vendor test results)
  - o Publish vendor test results to website   13Q
  - o Provide video of testing procedures and publish to website   13Q

  This set of tasks assists software users to have bSI recognition for conducting their own tests that confirm static software tests conducted by the Implementation Team, in conjunction with software vendors. Additional discussion of this task will require further bSI coordination.

  - o Solicit 3rd party design/construction/FM professionals to test   13Q
  - o Facilitate publication of 3rd party software tests/cookbooks   15Q

7.3   WORK PACKAGE 3: OUTREACH

The schedule below reflects the need for a consistent set of bSI messaging about COBie 2.5 from the start of the project to all participants and stakeholders.

The following tasks will be accomplished by the Project Chair and Project Technical Chair.

- WP3.1.1 Initial Outreach Presentation.

    o Create standard presentation for project team members. 1Q
    o Publish PDF to website   1Q
    o Provide quarterly presentation updates (ongoing)
- WP3.1.2 Initial Outreach Video.
    o Record standard information video   2Q
    o Publish video to website   2Q
    o Provide quarterly video updates (ongoing)

The following tasks will be accomplished by the Outreach Team in working with local bSI chapters. The key idea of these tasks will be to establish an international release of COBie 2.5 implementation. The reason for this is to limit the cost of changing from COBie 2.4 to COBie 2.5 and to ensure there are sufficient resources available to support the change-over on a region-by-region basis. Additional detail on these tasks will be developed upon formation of the Outreach Team.

- WP3.2.1 Chapter POC Registry
- WP3.2.2 Chapter Outreach Planning Memo
- WP3.3.1 Draft bSI Transition Plan
- WP3.3.2 Draft Chapter Transition Plans
- WP3.3.3 Transition Plan Updates
- WP3.4 Periodic Progress Briefings
- WP3.5 Periodic Press Releases

8 Budget & Funding

8.1 WORK PACKAGE 1: SPECIFICATION

- WP1.1 COBie 2.5 IFC Class Diagram and Report.

    o (prerequisite - open source UML diagram)
     bSI costs on this line item not included in this proposal.

    o Technical Work and Draft Report   1Q
     Project announcement

Technical Team Chair (draft)	4 hr	paid
Project Chair (review)	2 hr	in-kind
bSI webmaster (cobie.buildingsmart.org)	8 hr	paid
bSI newsletter	1 hr	no cost

     Technical Team Formation

Technical Team Chair (draft)	2 hr	paid
Project Chair (review)	2 hr	in-kind
Technical Team Member (emails)	2 hr (each)	in-kind
bSI webmaster (cobie.buildingsmart.org)	2 hr	paid

Prepare COBie 2.5 UML Baseline

Technical Team Chair (draft)	40 hr	paid

Six Bi-weekly Technical Team Meetings
(agenda for all meetings is the "Monday" project task lists)

Technical Team Chair (meeting chair)	2 hr (each)	paid
Project Chair	1 hr (each)	in-kind
Technical Team Member	2 hr (per/each)	in-kind
bSI admin	1 hr	paid

o   Draft publication on website   2Q

Prepare COBie 2.5 UML Draft

Technical Team Chair (draft)	24 hr	paid
Project Chair (review)	1 hr (each)	in-kind
Technical Team Member (review)	2 hr (per/each)	in-kind
Technical Team Chair (revise)	8 hr	paid
Technical editor	8 hr	paid
bSI webmaster (cobie.buildingsmart.org)	2 hr	paid
bSI newsletter	1 hr	no cost

o   Published bSI COBie UML Technical Report   3Q
bSI costs on this line item not included in this proposal.
Report author time review time billings to be added.

- WP1.2 COBie 2.5 Mapping Requirements and Report.

   o   (prerequisite - completion of draft report)
       Completed in a prior task.

   o   Draft report for spreadsheet mapping   1Q
       Prepare COBie 2.5 Spreadsheet Mapping
       (work accomplished in previously noted bi-weekly team meetings)

Technical Team Chair (draft)	24 hr	paid
Project Chair (review)	1 hr (each)	in-kind
Technical Team Member (review)	2 hr (per/each)	in-kind
Technical Team Chair (revise)	8 hr	paid
Technical editor	8 hr	paid

   o   Draft publication on website   2Q

bSI webmaster (cobie.buildingsmart.org)	2 hr	paid
bSI newsletter	1 hr	no cost

   o   Published bSI Spreadsheet Mapping Technical Report   3Q
       bSI costs on this line item not included in this proposal.
       Report author time review time billings to be added.

- WP1.3.1 Design Stage Example File

    - o (prerequisite - draft spreadsheet mapping)
      Completed in a prior task.

    - o Prepare and publish on website   2Q

      <u>Transfer Ownership of COBie 2.5 Dormitory Project to bSI</u>

Technical Team Chair (legal coordination)	8 hr	paid
Prairie Sky Consulting Licensing Costs	none	donation

      <u>Prepare Design Stage Example File</u>

Technical Team Chair (draft)	24 hr	paid
Technical Team Member (review)	1 hr (per/each)	in-kind
Project Chair (review)	1 hr (each)	in-kind
Technical Team Chair (revise)	8 hr	paid
bSI webmaster (cobie.buildingsmart.org)	2 hr	paid
bSI newsletter	1 hr	no cost

- WP1.3.2 Construction Stage Example File

    - o (prerequisite - design stage example file)
      Completed in a prior task.

    - o Prepare and publish on website   2Q

Technical Team Chair (draft)	16 hr	paid
Technical Team Member (review)	1 hr (per/each)	in-kind
Project Chair (review)	1 hr (each)	in-kind
Technical Team Chair (revise)	4 hr	paid
bSI webmaster (cobie.buildingsmart.org)	2 hr	paid
bSI newsletter	1 hr	no cost

- WP1.3.3 Handover Stage Example File

    - o (prerequisite - construction stage example file)
      Completed in a prior task.

    - o Prepare and publish on website   2Q

Technical Team Chair (draft)	16 hr	paid
Technical Team Member (review)	1 hr (per/each)	in-kind
Project Chair (review)	1 hr (each)	in-kind
bSI webmaster (cobie.buildingsmart.org)	1 hr	paid
bSI newsletter	1 hr	no cost

- WP1.3.4 Example File Report.

    - o (prerequisite - handover stage example file)
      Completed in a prior task.

- o Draft report and publish on website   2Q

Technical Team Chair (draft)	16 hr	paid
Technical Team Member (review)	1 hr (per/each)	in-kind
Project Chair (review)	1 hr (each)	in-kind
Technical Team Member (review)	2 hr (per/each)	in-kind
Technical Team Chair (revise)	8 hr	paid
Technical editor	8 hr	paid
bSI webmaster (cobie.buildingsmart.org)	1 hr	paid
bSI newsletter	1 hr	no cost

- o Published bSI Technical Report   3Q
  bSI costs on this line item not included in this proposal.
  Report author time review time billings to be added.

- **WP1.4 Implementation Guide Report.**

  - o (prerequisite - draft example file report)
    Completed in a prior task.

  - o Draft Report and publish on website   2Q
    <u>Prepare COBie 2.5 Implementation Guide Outline</u>

Technical Team Chair (request contributions)	8 hr	paid
Technical Team Chair (collate/coordinate)	8 hr	paid
Technical Team Chair (draft)	24 hr	paid
Technical Team Members (contribute)	8 hr	in-kind

<u>Four Bi-weekly Technical Team Meetings</u>
(agenda for all meetings is the "Monday" project task lists)

Technical Team Chair (meeting chair)	2 hr (each)	paid
Project Chair	1 hr (each)	in-kind
Technical Team Member	2 hr (per/each)	in-kind
bSI admin	1 hr	paid

<u>Prepare COBie 2.5 Implementation Guide</u>

Technical Team Chair (draft)	80 hr	paid
Technical Team Members (contribute)	16 hr	in-kind
Project Chair (review)	1 hr (each)	in-kind
Technical Team Member (review)	2 hr (per/each)	in-kind
Technical Team Chair (revise)	8 hr	paid
Technical editor	8 hr	paid
bSI webmaster (cobie.buildingsmart.org)	2 hr	paid
bSI newsletter	1 hr	no cost

  - o Published bSI Technical Report   3Q
    bSI costs on this line item not included in this proposal.

Report author time review time billings to be added.

8.2 WORK PACKAGE 2: IMPLEMENTATION

- WP2.1 Expected Test Package.

    - (prerequisite - completion of WP1 draft files)

        bSI Software Developer Team(s) Stand-up

Technical Chair announcement preparation	8 hr	paid
Project Chair review announcement	4 hr	in-kind
Technical Chair video production	16 hr	paid
bSI webmaster posts video	4 hr	paid
bSI press release	2 hr	paid

        bSI Software Testing Team(s) Stand-Up

Technical Chair announcement preparation	8 hr	paid
Project Chair review announcement	4 hr	in-kind
Technical Chair video production	16 hr	paid
bSI webmaster posts video	4 hr	paid
bSI press release	2 hr	paid

    - Software Test Plan Input   3Q

        Draft COBie 2.5 Production/Consumption Test Plan

Technical Chair prepares draft test plan	24 hr	paid
Technical Team reviews draft	2 hr (each)	in-kind
Project Chair reviews draft	2 hr	in-kind
Technical chair revises draft test plan	8 hr	paid
Presentation to Software Team(s)	8 hr	paid
Presentation to Testing Team(s)	8 hr	paid
Technical chair revises draft test plan	8 hr	paid
bSI press release	2 hr	paid

    - Description of Test Scripts using example files   4Q
    Completed in the previous task.

    - Draft report and publish on website   5Q

Technical Chair revises draft	36 hr	paid
Technical editor	8 hr	paid
Project Chair reviews draft	1 hr	in-kind
Technical Team Chair makes video	16 hr	paid
bSI webmaster posts requirements	4 hr	paid

    - Published bSI Technical Report   6Q
    An overview report should be published about translation testing.   *in-kind*
    bSI costs on this line item not included in this proposal.

Report author time review time billings to be added.

- WP2.2 Monthly Support Meeting Minutes.

  NOTE: Funding of the activities identified here should be paid for by software companies themselves under a separate budget line item. It is assumed that there are enough COBie 2.5 implementers to ensure sufficient funding for all noted activities.

  o (prerequisite - technical coordination calls begin at start of project)

  12 Months of Software Support Calls

Technical Chair holds monthly meetings	8 hr (each)	paid
Software developer attendance	2 hr (each/per)	in-kind
bSI admin documents minutes	8 hr	paid
Testing/Technical Chair updates Test Script	1 hr (per)	paid
Testing/Technical Chair updates Test Models	1 hr (per)	paid
Testing/Technical Chair Updates Guide	1 hr (per)	paid
Testing/Technical Chair website updates	1 hr (per)	paid
Project Chair reviews draft	1 hr	in-kind
bSI webmaster posts requirements	2 hr (per)	paid

- WP2.3. QC Test Platform Software and Documentation.

  o (prerequisite - expected test package)
  Completed in the previous task.

  o (prerequisite - donated resources to update existing test software)
  Completed in the previous task.

  o Prepare review software specifications   5Q

Testing Team to review documentation	2 hr (each/per)	in-kind
Testing Team to recommend updates	4 hr (each/per)	in-kind
Testing/Software Teams Schedule Session	2 hr (each/per)	in-kind

  o Update existing open source verification testing software   5Q

Update open-source QC Checker	40 hr	paid

  o Conduct testing of verification software   5Q

Testing Team tests QC Checker	2 hr (each)	in-kind
Software systems verify QC Checker	12 hr	in-kind
Testing/Technical Chair draft Checker memo	4 hr	paid
Project Chair reviews draft	1 hr	in-kind
bSI webmaster posts requirements	2 hr (per)	paid

- o Draft report and publish to website   5Q

Testing/Technical Chair revises draft	36 hr	paid
Technical editor	8 hr	paid
Project Chair reviews draft	1 hr	in-kind
Technical Team Chair makes video	16 hr	paid
bSI webmaster posts requirements	4 hr	paid

- o Published bSI Technical Report   6Q

  An overview report should be published about translation testing.   in-kind
  bSI costs on this line item not included in this proposal.
  Report author time review time billings to be added.

- **WP2.4.1 Updated Test Package.**

  - o Update implementation guide, test package, and test platform as needed to support software development efforts.

    Publication of updated information accomplished as noted above.

- **WP2.4.2 (Internal only) Test Result Memo.**

  - o (prerequisite - technical specification, mapping, examples)
    Completed in the previous task.

  - o Identify developer resources and request resources   3Q
    Software company tasks outside this scope.

  - o (prerequisite - expected test package)
    Completed in the previous task.

  - o (prerequisite - expected test platform)
    Completed in a previous task.

  - o Software developer resource availability   11Q
    Software company tasks outside this scope.

  - o Vendor schedule tests   12Q
    Completed in a previous task.

  - o Conduct vendor tests and provide feedback   12Q

Test Team Meetings (expected 3 meetings)	8 hr (each/per)	in-kind
Software Development Team	16 hr (each/per)	in-kind
Test Team result memo (private)	4 hr (per)	in-kind
Testing/Tech Chair oversight	4 hr (each/per)	paid

      ○ Vendor results publication request   13Q

Successful test result obtained

Test Team result memo draft	4 hr (per)	in-kind
Test Team Chair makes video	16 hr	in-kind
Testing/Tech Chair review	4 hr (per)	paid
Project Chair reviews draft	1 hr	in-kind

- WP2.5 Test Result Publication web pages.

Technical editor	8 hr	paid
bSI webmaster posts result/summary page	8 hr	paid

8.3   WORK PACKAGE 3: OUTREACH

bSI Outreach Team Stand-up

Technical Chair announcement preparation	8 hr	paid
Project Chair review announcement	4 hr	in-kind

bSI Outreach Team Meetings

Monthly Outreach Team Meetings	8 hr (each)	paid
Draft Outreach Team messaging	4 hr (each/per)	in-kind
Publish draft COBie presentations	16 hr (each/per)	in-kind
Project Chair review	2 hr (each)	in-kind
Presentation video production	24 hr (each/per)	paid
Video closed captioning post-production	16 hr (each/per)	paid
bSI press release	4 hr	paid

bSI Chapter Outreach Team(s) Stand-Up

Project Chair review Chapter announcement	4 hr	in-kind
bSI Chapters adapt template for local video	16 hr	paid
bSI Chapters post video	4 hr	paid
bSI Chapters press release	2 hr	paid

bSI Chapter Outreach Team Meetings

Monthly Outreach Team Meetings	8 hr (each)	in-kind
Draft Outreach Team messaging	4 hr (each/per)	in-kind

- WP3.1.1 Initial Outreach Presentation.

  ○ Create standard presentation for project team members.   1Q

  ○ Publish PDF to website   1Q

  ○ Provide quarterly presentation updates   (ongoing)

- WP3.1.2 Initial Outreach Video.

o Record standard information video	2Q
o Publish video to website	2Q
o Provide quarterly video updates	(ongoing)

9   References

[1] East, E. William (2007) "Construction Operations Building Information Exchange (COBie) Requirements Definition and Pilot Implementation Standard," U.S. Army, Corps of Engineers, Engineer Research and Development Center, TR 07/30

[2] East, E. (ed.) "BIM Information Exchange Demonstration," The proceedings first COBie Challenge at the National Academy of Engineers, National Institute of Building Sciences, Washington DC, 2008

[3] Chipman, T., East, B., (2013) "Model View Definition: Construction-Operations Building information exchange", buidingSMART alliance, National Institute of Building Sciences, Issued 2013-10-30

[4] East, E. (2014) "buildingSMART alliance information exchanges: Means and Methods," National Institute of Building Sciences, https://www.nibs.org/page/bsa_cobiemm

[5] buildingSMART alliance (2015) "United States National BIM Standard, Version 3.0," National Institute of Building Sciences, Available free of charge from https://www.nationalbimstandard.org/

[6] East, E., Smith, D. (2016), "The United States National Building Information Modeling Standard: The First Decade," in Proceedings of the 2016 CIB W078 Conference, Brisbane, Australia, October 2016.

[7] COBieQCReporter on github.org as documented in East, E., Bogen, A., (2016) "Construction-Operations Building information exchange (COBie) Quality Control," Prairie Sky Consulting, 2016, ISBN: 978-1-365-41018-5.

[8] COBie Plugin for BIMserver.org on github.org as documented in East, E., Bogen, A., (2016) "Construction-Operations Building information exchange (COBie) Quality Control," Prairie Sky Consulting, 2016, ISBN: 978-1-365-41018-5.

[9] East, E., et. al (2020) "Software Testing: East Dormitory Project," Prairie Sky Consulting, https://www.prairieskyconsulting.com/testing.htm

[10] East, E., et. al (2017) "Delivering Construction-Operations Building information exchange (COBie) in Autodesk Revit," Prairie Sky Consulting, 2017, ISBN: 978-1-387-20091-7.

[11] East, E., Jackson, R. (2016) "Delivering Construction-Operations Building information exchange (COBie) in GRAPHISOFT ARCHICAD," Prairie Sky Consulting, 2016, ISBN: 978-1-365-26840-3.

[12] East, E. (2012) "The COBie Guide," Working draft document released through the National Institute of Building Sciences.

[13] Hartman, T., Amor, R., East, E. (2017) "Information Model Purposes in Building and Facility Design," Journal of Computing in Civil Engineering, 31(6), November 2017.

[12] East, E., Bogen, A. (2015) "A Domain-Independent Facility Control Framework," in "Building Information Modeling: Applications and Practices," ed. Issa, R., Olbina, S., American Society of Civil Engineers, Chapter 12, June 2015.

10 Appendix A. Contacts

As a result of informal canvasing, the following individuals have identified themselves, bSI chapters, and organizations as interested in participating in the COBie 2.5 project. Listed in alphabetical order.

10.1 BSI CHAPTERS

Korea. POC Jisu Han, buildingSMART Korea Head Researcher

Spain. POC Sergio Muñoz Gómez, Secretario buildingSMART Spanish Chapter.

United States. POC Ian Howell, US Representative for buildingSMART international.

10.2 SOFTWARE COMPANIES

AutoDesk. Revit design software. Current implementer of COBie 2.4. POC Mr. Frank Moore.

EcoDomus. A software company supporting Construction and FM activities. Current implementer of COBie 2.4. POC Mr. Igor Starkov.

Microsoft. Participation as a software company and facility management user. Not a current COBie implementer. POC Ms. Salla Eckhardt.

Onuma System. A software company supporting Architectural Planning and BIM innovation. Creator of "BIM Storm" events. Current implementer of COBie 2.4. POC Mr. Kimon Onuma.

10.3 OWNER ORGANIZATIONS

Statsbygg (Norway) Preparing to participate in the bSI COBie 2.5 project and potentially apply the results of the effort within Norway. POC Steen Sunesen.

Digital Build Britain (United Kingdom) A proposal to formally support bSI COBie 2.5 has been submitted by Mr John Ford, see below, to the organization attempting to simplify and align COBie-UK requirements across owners.

10.4 EXPERT PANEL MEMBERS

Mr. John Ford (United Kingdom) Galliford-Try. Construction company representative with extensive field expertise using COBie. Mr. Ford is a member of the Digital Build Britain team currently evaluating COBie use in the UK. Mr. Ford is a bSI COBie Certified Professional™.

Dr. Shawn O'Keeffe (Ireland) MMA Environmental/BIM & Scan. Consulting engineer and educator with extensive field experience managing projects where IFC data is utilized. Dr. O'Keeffe is a bSI COBie Certified Professional™.

Mr. Daniel Schwarz (Switzerland) LIBAL Schweiz GmbH. Construction company and BIM process expert. Provides COBie training in German. Mr. Schwarz is a bSI COBie Certified Professional™.

10.5 INDIVIDUALS

Mr. Bill Brodt (United States) NASA. Client of first COBie specification in 2007. A key US Govt. proponent for supporting COBie and other open-standard projects such as standardizing requirements for delivery of product properties.

Mr. Stephen DeVito (United States) Procon Consulting. Primary BIM management consultant to the US General Services Administration (GSA).

Mr. Dana Smith (United States) DKSIC. Former Executive Director, buildingSMART alliance (the former bSI-USA chapter).

11 Appendix B. Selected Reading List

This Appendix is provided to be an organized "reading list" that may be distributed to those interested the COBie 2.5 project as a stand alone set of documents. Once COBie 2.5 is approved, this curated list will be provided on cobie.buildingsmart.org. Where possible URL's for the document of record is provided (as of 22-Jun-20).

COBie Standards and Guidance

2007. Initial COBie 1.0 defining process-based information transactions during design and construction. https://apps.dtic.mil/dtic/tr/fulltext/u2/a491899.pdf. Freely available.

2008. Publication of "Installation Technology Transfer Program: COBie IFC Model View". Not available by URL.

2009. Publication COBie 2.0 as the Basic FM Handover IFC 2.3 MVD, published by buildingSMART. https://standards.buildingsmart.org/MVD/RELEASE/IFC2x3/TC1/FMHandover/BasicFMHandover.zip.

2011. Publication of COBie 2.0 on the buildingSMART international IDM Confluence Repository. Site no longer active.

2012. Publication of COBie 2.26 in in National BIM Standard - United States®, Version 2.0, https://www.researchgate.net/file.PostFileLoader.html?id=56fcf972cbd5c24b0e5fee71&assetKey=AS%3A345644616175616%401459419506830

2012. Draft COBie Guide, the commentary to NBIMS-US v2 to be used for local adoption. https://portal.nibs.org/files/wl/?id=GvMvniYRQOUN77pPyhtx2QXVqOgNmpie

2013. Publication of COBie 2.26 as the COBie MVD, IFC4 (backward compatible with IFC 2.3), http://docs.buildingsmartalliance.org/ MVD_COBIE/

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