EXECUTIVE SUMMARY

COBie is an international standard that delivers managed asset information. COBie stands for the Construction Operations Building information exchange. Today, COBie can be created and exchanged using over 20 commercial software systems. COBie can also be created and exchanged using simple spreadsheets, if that is more helpful for the team. This chapter begins by describing the motives behind the COBie project. The spreadsheet format for COBie is described. Steps to implement COBie at a facility management office and ongoing work complete this chapter. The authoritative source for information about COBie is the Whole Building Design Guide’s COBie web site where technical documentation, example models, and instructional videos can be found (East 2008).

WHY COBIE?

In 1983 a leading panel of experts convened by the National Research Council concluded that “much valuable data associated with the design, construction, and operation of a facility is lost during its life span” (National Research Council
1983). That statement is as true today as it was during the advent of modern construction practice, which began with the invention of scaled construction drawings in the Renaissance period. The impact of the loss of this design and construction information is felt in many ways that are simply part of the way that facility managers do business. Following are some examples of real stories told to me about problems that could be easily solved if design, construction, and facility information were available as secure, shared information to facility managers.

The first example is the case of a broken industrial trash compactor at a commissary on a large Army installation. To replace this trash compactor should have been a simple matter of determining what was already installed and purchasing a replacement. Had the information been available in data form, then the job would have been completed in minutes. In reality, a midlevel facility management staff member needed two days to comb through project records before the original product data for the equipment could be found.

The second example comes from needing to replace a specific part of a complex piece of equipment. The heating element of a boiler had corroded out until it was no longer safe to use. The pressure vessel part of the boiler was in good shape, but the heating element had to be replaced. There was no information on the heating element at all since the manufacturer was out of business. The original specifications for the heating element could not be found. To purchase a new heating element based on incomplete information or to wait for an entirely new boiler installation were the choices left to the facility manager.

Facility managers are often responsible for both operations and maintenance (O&M) and tenant management. The last anecdote shows the potential impact of maintaining multiple building asset records in a major hospital. Following a change to departmental assignments tenants assigned to wings or floors of buildings often make changes in the way that those spaces are used, without providing feedback to the facility management office. To compare the two different databases about spaces and their uses I randomly selected a floor and picked a room directly behind that wing’s central nurse station. To my surprise the tenant management database indicated that the room was a medicine preparation area and the facility management database indicated that the same room belonged to housekeeping. The questions that arose included, “Does the janitorial staff have keys to the room in which restricted medications are kept?” and “Are the mop and bucket being kept in the same space as medicine preparation?”

While many facility management (FM) organizations have spent vast quantities of financial, organizational, and human resource capital for the purchase of complex
systems to manage maintenance, operations, and assets, these systems cannot be effectively used today. This is because the introduction of technology has demonstrated the enormous expense of loading data from design and construction into maintenance management systems. A recent presentation reported that six technicians working overtime and weekends for 5 months were required to load equipment manufacturer and model information into a maintenance management system for a mid-size medical facility (Medellin 2010). Clearly, most facility managers do not have the resources to pay for such overtime and weekend work. I have personally visited facilities that employ one or more full-time data-entry clerks to enter such information. One maintenance management system software company recently reported that on a small campus of five administrative buildings cost and time savings on preventative maintenance and service orders could reach one quarter of a million dollars per year (Siorek 2010).

After a 2011 plenary presentation to a major national construction association, the president of that organization thanked me for the presentation on COBie, but then added, “You know, Bill, we know all about this problem.” What struck me as so odd was the fact while an entire industry sector is acutely aware of the waste associated with problems of facility handover, they were not interested in reducing their wasted effort to effectively increase their profit and/or improve productivity.

While this chapter will address the new national standard developed specifically to streamline the delivery of managed building assets through the planning, design, and construction process, the real question for facility managers is, “Why hasn’t anyone fixed this before now?” After an explanation of the COBie format, I will return to this question again to discuss an implementation checklist for a simple, step-by-step method through which facility managers may begin to gain productivity for both technical and administrative staff through the application of secure, shared, and structured building information.

**HOW WAS COBIE DESIGNED?**

When designing buildings, architects need to understand what activities will take place in the building, structural engineers need to know the types of loads those activities will generate, and mechanical engineers will have to know the extent to which temperature and humidity must be controlled to support these activities. In some ways, developing an information exchange standard is no different from the design of a building. There are requirements to be identified. There is a solution to be designed based on those requirements. There is a process by which the design is built and tested. Finally, the building is used by those who
designed it. The development of COBie directly followed this pattern to ensure that when people were ready to use COBie, it would provide the information needed for them to maintain, operate, and manage facilities.

Determining what should be included in COBie and what should be left out is complicated because of the technological, contractual, and process constraints on the practical delivery of the required information. Rather than ignore such constraints, the design of COBie directly addresses the practicalities of scope, technology, contract, and process. The criteria used to arrive at the current scope of the COBie standard reflect current contractual requirements of different parties that enforce the delivery of construction handover information. Included in this data set is a list of managed assets initialized in design schedules, updated by the construction contractor, and finalized during commissioning processes. Product data sheets are provided by product manufacturers. System layout drawings are provided by the subcontracting fabricator. Because of the different sources of construction handover information, three projects were developed to reflect differences in the way that the information would have to be created and contractually specified.

The first of these projects, COBie, focused on replicating the current lists of managed assets and related information developed by the contractor and commissioning agent (East 2007). The second project focused on obtaining manufacturer’s product data for those assets. The second project is called the Specifiers’ Properties information exchange (SPie), East 2012b. The third project focused on the definition of the connections among components to create system-oriented information. The third project, originally called the Equipment Layout information exchange (ELie) project has now become four separate projects covering heating, ventilating, and air conditioning (HVAC) systems; electrical systems; water distribution; and building automation systems. While this chapter focuses on COBie, more information on each of the other projects may be found on the buildingSMART alliance information exchange project pages (For a list of all active bSa projects: www.buildingsmartalliance.org/index.php/projects/activeprojects).

**Managed Asset Inventory**

At construction handover, the essential responsibility of facility managers is to ensure that the facility’s fixed assets deliver the services needed in each of the spaces in the facility. Managed assets are those assets that require management, maintenance, consumable parts, regular inspections, and so on. Such assets are of two types. First are the assets that are typically managed through computer-aided facility management (CAFM) systems (i.e., spaces). Second are
The equipment and product assets related to building services such as HVAC, electrical, water, and the like that are typically managed through a computerized maintenance management system (CMMS). Information about structures and architectural elements, to the extent that such products are actively managed, may also be included in COBie.

For the purpose of managing facility assets, the absolute location of each piece of equipment is not required. As long as equipment can be identified as within a given space, then the technician will be able to perform the required maintenance or repair activity. As a result, COBie requires all products and equipment to be identified within a specific space. Furthermore, the placement of that equipment in walls, under floors, or in plenums versus visible within the space may be included in COBie.

Knowing the properties of a given piece of equipment is also important for the facility manager. Having such information on hand can significantly reduce the time to repair or replace broken equipment. While the SPIe project will ultimately allow manufactures to directly provide required information through the design and construction process, the COBie Guide provides a minimum statement of properties required for managed assets (East 2012b).

The organization of assets across multiple facilities is also of importance when obtaining COBie data. Repair and replacement decisions reviewed across an organization can improve the reliability of the entire facility inventory. Having a consolidated picture of assets across an entire campus may also result in improved staffing and management decision making. To compare information delivered on several facilities the facility manager must identify and require that assets are consistently classified.

Classification of spaces as well as equipment is also required in COBie. This allows the facility manager to more fully allocate occupants to spaces that meet their specific needs. The utilization of underallocated spaces may be adjusted. The facility manager will also be able to more quickly respond to changes in mission of tenants and emergency operations. Again, the COBie Guide provides recommendations about the types of classifications needed (East 2012b).

**Operations and Maintenance Requirements**

Current construction handover specifications require the delivery of information from manufacturer’s regarding equipment preventative maintenance plans, startup, shutdown, and emergency operational procedures. Commissioning agents or subcontractors also prepare documents that provide operational
information about entire building systems. Such information is critical since failure of a building’s systems can impact building occupants if such steps are not followed. Failure to follow proper shutdown procedures on HVAC system, for example, closing dampers without first turning off fans, may cause sufficient negative pressure to collapse ductwork. Failure to follow standard operational settings, such as decreasing the proportion of outside air to recirculated conditioned air has, for example, resulted in increased rates of infection in medical facilities.

COBie organizes all task-based actions that need to be documented at construction handover into one common format of “jobs.” Each job is identified as to the type of work, preventative maintenance, startup procedures, emergency operations procedures, and so on. In many cases, specialized tools, training, or materials may also be needed to complete the work. These resources are also captured. In addition to allocating correctly trained and outfitted technicians for a specific job, the facility manager may also use this information to document annual training and equipment budgets. Other O&M information contained in COBie includes warranty terms, documents, and guarantor information, and spare and consumable parts information.

Technological Constraints

An important factor in the development of any standard is making sure that the people who need to use it have the technology to enable them to produce, review, and use the information. Since the start of the personal computer age, software and media used in the design and construction industry have been rapidly changing. In many ways this change in technology, while being sold with the expectation of increasing efficiency, has directly contributed to the loss of valuable project information.

Consider that the state of the art 30 years ago was linen and ink drawings. Such documents, if kept dry and away from light, could easily last centuries. The longevity of this medium was commensurate with the expected life of a building. Now consider computer-aided drafting and design software files for buildings produced on 5.25-inch floppy disks. Five years after the receipt of those drawings, the media has likely been demagnetized, and there may not be a computer in the office able to read the files. Even if there is still a floppy disk drive, the software needed to open, update, and print those drawings is not likely to be available or supported.

The most important decision regarding technology made in the development of COBie is that proprietary standards or those that require specific media formats
or software systems will not be usable over the expected life of a given facility or campus. As a result, an open international standard data exchange format was selected as the underlying format for COBie data. Using open standards allows the facility manager to secure, own, access, and update his/her information over the entire life of the project. Decisions of software can be made on the ability of that software to utilize open standard data to support facility management operations, and not on the next technology fetish.

One of the international drivers for the creation of COBie was the German state of Bavaria. Every five years the management of public buildings in Bavaria is put out for bid. A part of that bid is the transfer of information from one company's maintenance management system to the new company's system. Such a transfer before COBie was very difficult and required specialized software.

Once the decision to use open standards was made, standards for the expression of the complete set of managed facility asset information were reviewed. The only format sufficient to capture COBie requirements was found to be the industry foundation class (IFC) model. As a result, the underlying format of all buildingSMART alliance projects is an ISO standard for building information called the Industry Foundation Class, IFC, Model (ISO 26739). IFC model information is typically exchanged through a complex computer-to-computer information exchange format called STEP (ISO 10303). The formal specification of COBie is called the Facility Management Handover Model View Definition (East and Chipman 2012).

While the formal specification for COBie envisions the performance-based delivery of computer-to-computer of facility information, that day has not yet arrived. As a result COBie was developed so that the data could be easily accessible to those with no computer programming skills, using the most modest of software. As a result the spreadsheet was chosen as the format for COBie information that would be most widely presented. To ensure compliance with the underlying international standard format, a set of translation rules were used to allow software developers to translate between IFC-based formats and the spreadsheet format. For those needing the precise technical specification of COBie, including IFC mapping rules, should review the COBie Responsibility Matrix (East, Bogen, and Love 2011).

**Contracting Constraints**

History has shown that rarely are project owners willing to spend more during planning and design, even if the result is a more operationally efficient building. Asking for additional fee from designers and contractors to produce electronic
design and construction information would, therefore, be an untenable position. As a result COBie is specifically designed to only include the delivery of information that is already found in typical design and construction contracts.

It is quite easy for the casual observer to consider that once the list of equipment is provided in electronic format that all the properties of that product could also be provided. Such an observation does not, however, take into account the practicality of the contractor obtaining product information in data, versus product data format. Without all manufacturers directly providing product data in a COBie-compatible format, contractors will have to type in product attributes. Since retyping manufacturers’ product data is not currently required, there would be a significant additional cost to include such attributes in a specification for the delivery of COBie. As a result, product attribute data is necessarily left out of the basic COBie specification.

There is, however, some product data that could be required. Since COBie captures information about managed assets we can see that these managed assets will typically appear on product schedules on design drawings. The COBie Guide, released for public comment in July 2012, specifically requires that COBie file attributes about scheduled equipment match the attributes that are found on the design schedules (East 2012b). Given that the criteria is simply that the COBie information match the information found on design drawings, such a quality standard may be defensible from a contracting cost point of view.

**Process Constraints**

While there has been much interest in lean construction practices for builders, few have considered the impact of emerging standards, such as COBie, to eliminate wasteful administrative processes. As an example of such a wasteful process, a former research assistant employed on my team had, between undergraduate and graduate schools, the summer job of copying paper submittal documents to create O&M manuals for a large construction project. This procedure was wasteful since all the information needed to create these manuals was already processed through the contract administration process related to construction submittals. Had the electronic form of approved submittals been captured, during the submittal process, a very bright student could have been spared the mind-numbing job of making paper copies of formerly electronic documents. The typical process for documenting scheduled equipment nameplate data is by walk-through at the end of the project. This “job crawl” captures information that could have been documented at installation, startup, or testing of the equipment with very little additional effort.
The COBie process is based on a simple assumption. This assumption is that COBie data should be provided by the party who is traditionally and contractually required to create that information. The only real difference in COBie-based process is that the deliverable is a data file (or files) and not paper. Architects, for example, create designs that identify spaces and equipment. Space and equipment schedules produced in a COBie format should be directly exported to COBie from design software as simply as those design products print construction drawings. Product data sheets and other file-based information, captured through an electronic submittal process, eliminate the need for a contractor to scan such information. If the contractor, when documenting the installed and on-site equipment for payment purposes, is required to submit their report using COBie, then there will be no delay at the end of the project. In short, a new information-based process of design, construction, and handover can be supported using COBie as the information exchange format. The generic specification of what information is provided by whom and when in the facility life cycle is defined in the Life-Cycle Information Exchange Project (East 2010).

With scope, technology, contracting- and process-related decisions made in the early design phase of the COBie standard, what remained was to determine the most compact and mutually agreeable format for the delivery of managed assets and associated O&M information. The following section describes the COBie data model and explains how each of the parts of that model connect.

**WHAT IS INCLUDED IN COBIE?**

The overall structure of a COBie data set at the construction handover stage of a project is shown in Figure 5.1. There are three types of information in COBie. The first is information that is created by designers, shown in the blue box in Figure 5.1. The second, information created by contractors, is shown in the orange box. The third is supporting information that is created by both designers and contractors, shown in the green box.

COBie’s requirements for designers reflect the two major categories of assets: spatial and equipment assets. Spaces within a building are organized by facility, floor, and then the space. There is a correlation between the idea of a Space and a physical room in COBie. If a given physical room has several functions, or different parts of it belong to different departments, then that physical space may be defined by several individual spaces. Often, the designer already identifies these differences by adding letters after a room number, such as “101-A” and “101-B.” As the project progresses from design to handover, the final signage outside each
of the rooms of the facility often does not match the room numbers provided by
the designer. The contractor adds the signage information once that is known
as the Space.RoomTag value.

Figure 5.2 provides an example of how spaces are organized into zones in one
portion of a medical clinic building. At the top left of Figure 5.2, the name of the
facility is shown as “Medical Clinic.” This information is captured in the “Facility”
area of COBie. Under the facility are the different vertical slices through that facility. These are called “Floors” in COBie. As shown in the figure, even the site and the roof are listed as COBie floors. The working areas of the buildings, for example, “101 Reception,” are the spaces in COBie. If we were interested in identifying some aspects of groups of rooms, we would use a COBie “zone.” In the figure,
the focus is on identifying the department occupying the spaces. The pediatrics department uses spaces 101 through 103. The pharmacy uses a single space, 110. The emergency department uses 121 through 123.

Groups of spaces are managed in zones; therefore, zones are found in COBie. In a given building there are always many different kinds of zones, all of which can be represented in COBie. Figure 5.2 is an example where spaces are organized by department. There could also be circulation zones that indicate public and private space and zones for spaces that reflect specific types of building services such as heating and cooling zones or fire protection zones. Each of these zones has a separate list of categories, just as the department zone in Figure 5.2 has three different categories, but all zones refer back to the same list of spaces that make up the building.

The second major category of assets in facilities is scheduled equipment and tagged products. All equipment assets are organized by the type of asset, that is, the manufacturer and model number, and then each of the individual components. During design, equipment schedules are found on the design drawings and should be fully reflected in a COBie file. Bulk items that may be reported by the contractor such as valves, switches, and dampers may need to be drawn out from notes and symbols on design drawings. Often, contractors are required to install brass tags on bulk items such as valves. Some facility managers require these tags or bar codes on all managed equipment. These tags or codes are also recorded in the Component.TagNumber and Component.BarCode fields.

To provide specific services to building occupants, equipment is organized into systems. Figure 5.3 provides a brief example of the organization of equipment in COBie. At the top left of the Figure 5.3 is the facility in which the equipment operates. The next layer of information about equipment is that of equipment Type. Equipment or product type reflects the organization of the designer’s equipment and product schedules. These schedules strive to reuse the same specific type of equipment in a given facility where appropriate. This reduces the cost of the purchase of equipment on the project and reduces the cost for the construction and commissioning process. The example shown in Figure 5.3 illustrates part of the list of types for the “Medical Clinic” facility. Shown is door type A, since there will be more than a single type of door in a given building, each of the other door types will be similarly listed. The example also shows that there will be different types of pumps, a single type of air handling unit (AHU), and multiple types of windows. A real building would, of course, have many more types of equipment, so Figure 5.3 provides only a small subset. Under each equipment type are the specific instances of that equipment. As shown, there are two pumps of type A and two AHUs.
Equipment in a facility does not exist as a separate entity but is part of a system of components, connectors (such as pipes, ducts, and wiring), and controllers that provide a service (such as heating, cooling, fire suppression, etc.) The engineering consultants designing these systems, during the process of design, organize these services into different systems and subsystems to ensure that proper
services can be delivered. To reflect that organization COBie allows these designers to identify the systems to which each component belongs. In Figure 5.3, for example, one of the pumps is used for the HVAC system and one of the pumps is used for the fire suppression system. Both AHUs are used for the heating and cooling system. The COBie Guide provides recommendations about the types of systems that should be captured to support facility maintenance activities, and helpful ways to categorize and name these systems to allow information to be more easily accessed (East 2012b).

Once the designer delivers COBie data at the end of the design, then the contractor’s job is to augment the design data with information captured from construction. If the data provided from the designer is accurate, then to identify the make and model of a particular type of equipment, the contractor can use the information from the approved product submittals and update the designer’s COBie data. Once the equipment is installed, the contractor needs only to document the installation date and serial number. Clearly, capturing such information when it is first available is a departure from paper-based processes. The benefit is that the contractor does not have to capture and possibly lose the information several times during the course of the project.

As building systems are commissioned, the contractor or commissioning agent collects the manufacturer’s recommended maintenance and parts schedules as well as the system O&M information. Warranty and spare and consumable parts are also captured. It is up to the contractor or commissioning agent to complete the identification of that information in the COBie Jobs, Resources, and Spares worksheets.

**IN WHAT FORMATS IS COBIE DELIVERED?**

The ease with which we take for granted existing information standards hides the effort required to create and implement these standards. Those facility managers who began their careers with mainframe computers will recall difficulties in moving programs and documents from one manufacturer’s computers to another’s. One of the tools to resolve this issue was the development of the American Standard Code for Information Interchange, or ASCII, standard. Today, ASCII allows us to share written documents among a wide variety of devices.

At this time of transition between paper-based and information-based exchanges, facility managers need to have some understanding of the formats in which COBie can be exchanged. This knowledge will assist the facility manager in keeping track of claims and counterclaims made by the proponent of one format versus
another. Those considering the use of COBie need to be aware that the information needed by the facility manager can be delivered in several different formats. As long as the information contained in the file reflects the requirements identified by the facility manager, is organized according to the COBie data model, and can be produced and consumed by the required software, that format is adequate for the transmission of COBie data. When conversations about COBie focus on the format of the file, this will reduce the time spent to ensure the quality of the result. As ASCII allows the transparent exchange of written documents, COBie and the related family of standards will allow the transmission of facility information across software and devices.

Today, there are three data formats that can be used to exchange COBie data. The first is called the Standard for the Exchange of Product, or STEP, which is an international standard found in the ISO 10303 specification. STEP files are widely used in product and industrial manufacturing and have been adapted through the additional schema requirements identified in the IFC Mode, ISO 16739. The second standard that may be used is called ifcXML. This format provides an Extensible Markup Language version of the STEP file. While these formats provide concise statements of COBie data, the formats themselves are oriented toward computer-to-computer interactions. Another of the available formats, SpreadsheetML, provides COBie information in a spreadsheet format.

Most users of COBie in the United States and the United Kingdom are familiar with the Excel spreadsheet version of COBie. This format provides a human-accessible view of facility information. Therefore, this chapter will focus on the spreadsheet version of the COBie file, knowing that other formats will be acceptable, provided that they contain the required information and can be consumed by the software needed at the FM office.

**HOW IS THE SPREADSHEET FORMAT ORGANIZED?**

The organization of COBie information, in spreadsheet form, occurs through a series of related worksheets. Together, these worksheets create a database of the facility describing that facilities set of managed assets. There has been extensive technical documentation on the COBie standard already published through the COBie web site (East 2008); therefore, the following descriptions provide only an introduction to the topic.

Along with each of the descriptions is an indication of the ability of commercial software to produce and/or consume that specific type of COBie information today. This information is provided to allow the facility manager to see what can
be accomplished with COBie and what is possible, provided commercial soft-
ware manufacturers upgrade their products, to deliver using COBie. There are
several root causes to the gap between the practical and possible. These causes
will be discussed in the later section discussing software testing as part of COBie
Challenge events.

Common Worksheet Conventions
To simplify the organization of building information model into a spreadsheet,
certain conventions were developed for COBie worksheets. These conventions,
which include worksheet and field naming, field ordering, and color-coding,
assist COBie users to reduce the complexity of what had not been possible
before COBie. These conventions are described in the following paragraphs and
documented fully in the COBie Guide (East 2012b). Examples of COBie files at
different stages of project development may be found on the Common Building
Information Model Files (East 2012d).

Worksheet Layout
COBie worksheets are organized to begin with the unique data element for that
worksheet (the primary key) in the first column. Typically, the column is labeled
“Name.” Thus, the Type.Name refers to the Type worksheet, name column. The
name column will always show up in the first column. The values for the rows in
the name column are required to be unique.

The next set of columns contains information author history, specifically the
CreatedBy and CreatedOn values. These values identify the person or company
that created the data found in the COBie worksheet row. This person could be
the person who was developing the COBie model, or simply the person who
created the COBie file. Either way is fine as long as there is a way to get back to
the person who created the information, in case there is a question.

The fourth column is typically the category of the information found in the row of
data. For many of the categories of information found in a COBie file the facility
manager may already have a standard set of values. Such values can be pro-
vided in the facility manager’s COBie contract language and enforced through
the delivery process. Having consistent categorization ensures that information
about one facility can be compared with that of another facility.

The next set of columns allows information in the current worksheet, if needed,
to reference information in previous COBie worksheets. Such information is
very important in worksheets such as the Document and Attribute worksheets.
These worksheets provide information either external files, in the case of the Document worksheet, or specific properties, in the case of the Attribute worksheet, about COBie.Spaces, COBie.Types, and so on. Within the “reference” worksheets, the name of the previous COBie worksheet and the specific row to which the document or property refer are listed. In database terms, these can be considered to be foreign key values.

The next set of information is required fields to be provided for every record. Often, a “Description” field is required, as is the case in the Space and Type worksheets. Another example of required information, needed at a construction handover, is the model number of each specific approved type of equipment.

The next set of COBie information allows automated systems to document the specific location from which the information in the COBie file was created. Specifically, three columns are required to document the external system name, the name of the related field, and the specific identification number from which the current COBie data was drawn. While COBie data are meant to be delivered automatically from a software system, hand-created COBie models will always leave these columns blank.

Following the external information is the set of information that is identified as “as-specified.” Such information is common to all the expected rows of the COBie worksheet but should be explicitly specified to ensure that the information will be used, if time is taken to record the information. An example of such a column in the Type worksheet is “Code.Compliance.” This text field allows a product manufacturer or contractor to document the code compliance of the product that is installed in the facility.

**Color Scheme**

To reinforce the conventions described earlier, example COBie models include color-coding, reflecting the type of information found in each of the worksheets and specific data columns. Figure 5.4 shows the color-coding of an example Space worksheet. The yellow-colored columns contain required text input. The salmon-colored columns contain required values to be selected from other parts of the COBie file. For example, the Space.CreatedBy column values must be found in the Contact.Email column. The Space.Category column data is found in the Pick-List worksheet under the PickList.Facility-Category column. The Space.FloorName must be found in the Floor.Name column.

The information in the three purple columns reflects the origin of each row of data from the originating software system used to create the data. Green columns to
the right identify “as-specified” columns that, in this case have been filled out with information from the design building information model. Worksheet tabs are also identified by color-code using the yellow color for required, green for as-specified, and black for not used. Notice that, in the file provided, the Assembly worksheet is one of several worksheets that have been identified as not containing any information.

The reader may notice that values for the Space.RoomTag, Column J in Figure 5.4, are set to “n/a.” In COBie, the “n/a” means “not available” or “not applicable”; this designation is equivalent to a NIL in an XML or database table. Since Figure 5.4 represents the design deliverable, the final room signage that would be found in the RoomTag column is not known. As a result, Space.RoomTag set to “n/a” reflects that the signage for the space has not yet been assigned.

**Extensions**

The names of each worksheet and the column headings for COBie may not be changed. The order of these headings is also fixed. That is the basis for...
the COBie standard. Changing the existing worksheets and columns results in nonstandard use of COBie and may result in commercial software’s not being able to produce or consume data in such customized formats. While the set of specified COBie information is fixed, there are three ways to extend COBie allowed in the COBie specification. The first way is by changing the default classification tables found in COBie example files. The OmniClass (Construction Specification Institute 2008) classification tables are used, by default, in the COBie specification and in example files. If another classification scheme is required, then the values simply can be swapped for the current set.

The second way to extend the contents of COBie information is through the specification of required attribute values for specific classes of space, type, or component entities. Through this means the properties that are important for the local O&M of these assets can be identified and delivered. The third way is to include additional columns of information to the right of any existing COBie worksheet. Thus, if a new property were to be identified with every row in a worksheet, the new column could be added to the right of all the existing COBie columns. An example of such a property on the Space worksheet might be “Perimeter.” This new column would allow the capture and possibly the consumption of this new column automatically. If the facility manager wanted to color-code these columns, then the COBie suggests that color-coding for extended properties for an entire worksheet be blue.

**COBie Worksheet Descriptions**

Figure 5.1 identifies each of the worksheets in the spreadsheet version of the COBie data standard. The following paragraphs briefly describe each of these worksheets. For complete technical documentation of COBie, the reader should review the previously referenced COBie-related web sites and COBie Guide. To compare the information that follows with an example of a COBie file, the reader may wish to review the material in conjunction with one of the many COBie sample files (East 2012d).

**COBie.Instruction**

COBie.Instruction is the first spreadsheet in a COBie workbook. It contains only template information but can be used to give a concise overview of the contents of a given COBie submission. The version of the COBie file and the worksheets included are listed at the top of this page. A legend at the bottom of the instruction worksheet provides the color-coding used in the remainder of the file. Color-coding is provided for hand-created COBie files published by buildingSMART alliance, but is technically not needed. As previously described, the
color-coding does help people to more easily conduct a manual review the content of the file.

In many commercial software implementations of COBie, the Instructions worksheet simply reflects the default COBie workbook instructions and is not automatically customized for the specific deliverable. In some cases, the Instructions worksheet is left blank.

**COBie.Contact**

COBie.Contact contains the list of individuals and companies referenced during the life of the project. During design, the values relate to those people or companies creating or producing COBie data files. During construction, the information is supplemented with those entering or updating COBie data. At handover, the information is supplemented with manufacturer, supplier, and warranty guarantor information.

Contact information is generally well represented in construction software, which is where it is most important to identify manufacturer and supplier contact information.

**COBie.Facility**

COBie.Facility contains information about the facility being exchanged during a given COBie deliverable. Since COBie deliverables may be exchanged during planning, design, construction, handover, or operation phases, there may be differences in facility designations. Creating a standard naming convention is something that project owner should do. COBie can only reflect the identifiers that are currently used by the owner. COBie files should only contain a single facility. The COBie.Attribute worksheet can be used to provide the longitude, latitude, and rotation of the facility on the site to coordinate geospatial information with information within the facility.

All tested software is able to produce and/or consume some portion of the overall facility information.

**COBie.Floor**

COBie.Floor contains information about the vertical levels of the facility. Levels of traditional buildings will include the floors of the building as well as foundation and roof levels. For horizontal facilities, the levels will include regions of space outside the facility or across a campus.
All tested software is able to produce and/or consume some portion of the overall facility information.

**COBie.Space**

COBie.Space contains information about the horizontal organization of space within a given vertical, or floor level. Typically, but not always, spaces refer to the physical rooms within the facility as defined by the designer. Spaces have a slightly different definition within COBie to ensure that the different types of spaces, even if they are in the same room, can be captured. COBie splits large rooms into spaces if the activities or tenant has subdivided into several spaces representing different departmental waiting areas. Signage added by the contractor during construction is added to the space data after it has been installed.

All tested software is able to produce and/or use some portion of the overall facility information.

**COBie.Zone**

COBie.Zone contains information about the grouping of spaces organized into relevant categories that support various design or operational functions of the facility. To have a consistent result, zoning must be defined by the owner’s requirements while planning the project. The COBie Guide provides a recommended set of zones and conventions for zone naming (East 2012b). In large, complex facilities, there are many zones and subzones. In COBie, these groups of rooms may be nested through the use of naming conventions applied by the designer, contractor, and commissioning agent as the project proceeds. Zoning refers not only to groups of spaces that share building services, but also to the functional or occupancy aspects of spaces.

Despite the clear requirement by the FM community to identify spatial zones, as documented in the COBie design requirements since 2008, not all tested software is able to produce and/or consume zoning information. This inability can be directly tied to the lack of underlying data structures that contain zoning information in tested software.

**COBie.Type**

COBie.Type contains information about the types of managed assets in the facility. These assets are identified during the design process and appear in design drawing schedules. Types are organized to concisely provide related lists of components, properties, and needed O&M information. The types of products to be installed during construction are defined during the design stage. Early in the
design stage, the types of architectural elements to be included in the facility are documented. Later in design, the types of products required for mechanical, electrical, plumbing, and other systems are defined. During the construction submittal process, the contractor provides information about each of these equipment types. Later, testing results and O&M manuals are provided. All such information is linked to specific manufacture and model information (i.e., COBie.Types).

All tested software is able to produce and/or consume some portion of the type information. A major problem with producing software is the inability to translate the type information found on design drawings into type information found in COBie. This is often the result of problems related to design workflow, where designers often paste tabular data into design drawings for purposes of printing drawings, in lieu of ensuring that the information in the model is correct.

**COBie.Component**

COBie.Component contains information about the specific instances of each managed asset. The majority of such information is identified, during design, in design drawing schedules. During construction, such items require the documentation of installation dates and serial numbers. Information about bulk assets, important to O&M, are also identified by construction contractors using brass tags, bar codes, or other designations. These components are also included in the COBie.Component worksheet.

All tested software is able to produce and/or use some portion of the type information. A key problem with delivering both type and component information is that owners have been unwilling to spend the time to determine the list of mandatory types and components to be included in a COBie file. The **COBie Guide** provides a recommended set of types and components, with associated naming conventions (East 2012b).

**COBie.System**

COBie.System contains information to describe how groups of components are organized into relevant categories that deliver specific building services to the facility. COBie.Spaces are to COBie.Zones as COBie.Components are to COBie.Systems. While some system and zoning information will typically overlap, it is not always the case in COBie—systems of components and zones of spaces are both maintained.

Despite the clear requirement to identify component systems by the FM community, as documented in the COBie design requirements since 2008, not all tested software is able to produce and/or use system information. This inability can be
HOW IS THE SPREADSHEET FORMAT ORGANIZED?

directly tied to lack of underlying data structures that contain system information in tested software.

**COBie.Assembly**
COBie.Assembly contains information to describe the way in which products, which are themselves composed of other managed products, can be captured. In some types of assemblies this is critical, since internal components of these assemblies have different maintenance plans. An example of such an assembly is an AHU. For other types of assemblies, the subcomponents each have attributes that must be known, for example, an electrical distribution board where each internal breaker serves a specific circuit.

No software tested as of July 2012 has been demonstrated to produce assembly information.

**COBie.Connection**
COBie.Connection contains information about the logic connections between components. Such information is important to assist facility management staff to determine the upstream or downstream impact of their decisions when flipping a breaker or closing a valve.

No software tested as of July 2012 has been demonstrated to produce connection information.

**COBie.Spare**
COBie.Spare provides a mechanism through which spare parts, replacement parts, and consumable parts required for the O&M of each type of managed asset may be identified. Spare information may be provided in one row, in which case a COBie.Document record should also be found. Spare information may also be identified part by part in the Spare worksheet.

Some of the maintenance management systems have been demonstrated to consume information about spare and replacement parts and consumables.

**COBie.Resource**
COBie.Resource provides a mechanism through which the material, equipment, and training required for maintenance activities may be communicated.

Some of the maintenance management systems have been demonstrated to consume information about the material, equipment, and training required for job plans.
**COBie.Job**

COBie.Job provides a mechanism through which information about preventative maintenance, safety, testing, operational, and emergency procedures may be communicated. COBie.Job may contain a general description of a series of operations or tasks. COBie.Job may also be used to create small critical path method projects where project teams want to explicitly link resources to specific operations within a job.

The majority of maintenance management systems have been demonstrated to consume information about job plans. Few of these tools have been able to consume multistep job schedules, preferring to import large blocks of text instead.

**COBie.Impact**

COBie.Impact provides a mechanism through which the types of impacts that the facility has on the environment and the tenants of the facility may be captured.

No software tested as of July 2012 has been demonstrated to produce assembly information.

**COBie.Document**

COBie.Document provides a mechanism through which the many types of external documents may be indexed and their information may be captured.

The majority of construction and maintenance management systems have been demonstrated to capture and consume some of the information in documents related to product types.

**COBie.Attribute**

COBie.Attribute provides a mechanism through which the many types of attributes may be captured. Those specifying the delivery of COBie data may require specific attributes. A minimum standard for the required set of attributes to be included based on the headers of design schedule tables. The COBie Guide provides a minimum set of attributes that can be specified for commonly encountered product types (East 2012b).

All software has been demonstrated to produce and/or consume attribute information. Much of the attribute information currently provided from design software pertains to information needed to be sent to plotters. Given that facility managers have not specified the required attributes, the attributes that are provided are often irrelevant for FM and may not even match the attributes found on design drawing schedules.
**COBie.Coordinate**

COBie.Coordinate provides a mechanism through which a minimal set of point, line, and box geometry may be specified for the referenced object.

Design software has been demonstrated to produce coordinate information for space objects.

**COBie.Issue**

COBie.Issue provides a mechanism through which text descriptions of issues and decisions made during the related phase of the project may be captured. Issues may pertain to a single asset previously identified in the COBie file, or they may pertain to the some aspect of two assets.

No commercial software tested as of July 2012 has been demonstrated to produce issue information. Model server technologies have, however, demonstrated the production of issues such as punch lists and integrated these within COBie exchanges.

**COBie.PickList**

COBie.PickList contains, for hand-developed files, the columns of values used in category and other selection lists in COBie worksheets. COBie files produced via software output often will not have any content in the COBie.PickList worksheet, or the sheet may be omitted completely.

The identification of the pick lists pertaining to facility, space, zone, component, and systems should be of primary importance to the facility manager when developing local requirements for that specific agency or facility campus.

**HOW IS COBIE DELIVERED?**

COBie is organized to efficiently deliver that information about managed assets during several stages during a facility life cycle. Starting with the planning of a new building and ending with the current operating condition of a facility, there are six major milestones where COBie data can be captured. The complete set of exchanges of all or partial COBie data is described in the Life-Cycle information exchange (East 2010).

**As-Planned**

Prior to the decision to design and construct a facility, planners and tenants develop the requirements for each new facility. For buildings, the planning process
produces as one its key artifacts a “room data sheet.” The room data sheet contains the list of required spaces in the facility and the characteristics and services that the space needs to provide to meet the tenant’s requirements. Many large owners have well-developed space management criteria. In the case of the U.S. Department of Defense, for example, a series of unified facility criteria documents identifies each type of typical space and the furniture and equipment needed in that space (www.wbdg.org/ccb/browse_cat.php?o=29&c=4). The compilation of the set of spaces that compose a given planned building is called the space program. The compilation of the set of equipment needed for those spaces is called the equipment program.

Since COBie contains space and equipment assets, the delivery of COBie data at the as-planned stage of a project is the perfect place to start. In fact, the delivery of the as-planned COBie model as part of the design or design/build contract helps jump-start the designer to delivery COBie data in a way that is compatible with local FM practice. This is because the names of each type of space and equipment, developed from standard criteria, can be reused by the designer. The alternative is for the designer to take the room data sheets and manually transcribe some of the information into architectural floor plans. This transcription is error prone, and the information lost from planning to design is never recovered. For most projects the facility manager is never able to see the original requirements for each of the spaces because the original space and equipment program data are not transferred from planning to design.

As-Designed

During design, an early architectural COBie model and a full construction documents stage design model should be specified. The purpose of the architectural model is to verify that the space program requirements are met. Comparing the space programming COBie file and the early architectural COBie model will allow the facility manager and funding organizations to determine if the design that has been presented meets the requirements stated in relevant contract documents.

The construction documents stage design model should fully reflect the information found in the contract construction documents. Of primary interest is that the COBie file match the information found on the drawings in design schedules and related notes. These schedules would include room schedules, equipment schedules, and product schedules.

Given that different designers develop asset schedules and associated notes based on industry convention and the personal preference of the designer,
additional discipline will be required by designers to provide a consistent set of shared, structured information about building assets. The first step in ensuring this consistency is to define the minimum information that should be present in the design schedules of critical managed assets. Without defining the requirement, the design and construction teams will provide customary information, which may or may not meet the needs of the facility management office.

The COBie Guide identifies the minimum set of fixed assets that should be included in the deliverable file and outlines the required properties for each type of asset (East 2012b). Furthermore, the COBie Guide lists COBie required managed assets in relative order of importance, from an O&M point of view. With each type of asset is the minimum set of properties that should be identified by the designer, and later by the contractor in COBie format. Ideally, these properties would also be used by the designers as the headings in design schedules found on contract drawings and as-builts.

**As-Constructed**

During the construction phase the construction manager, contractor, subcontractors, and commissioning agent will be working toward completing the facility. As this takes place, they should be capturing COBie data as they go. The construction manager, if using an electronic submittal register, automatically captures product data on all approved products in the facility. The construction contractor, or subs, can capture the serial number and installation date of installed equipment. During commissioning, information about installed equipment can be checked, and O&M information can also be provided.

An important reason for the facility manager to obtain a high-quality COBie model following the installation of all major equipment is that COBie information can assist maintenance staff to plan their expected personnel requirements. During construction there are, essentially, three different approaches to delivering COBie files. The FM office should determine which of these approaches would provide the most useful information given the size and scope of the facility to be built. This assessment can be made during the design review process, and the approach taken must be reflected in the construction contract to ensure that retainage can be held for failure to deliver the required information.

The first approach is a monthly submission of COBie files for equipment-heavy or industrial facilities. On such projects, contractors often have a substantial investment in on-site, but not installed, equipment to increase the contractor’s cash flow. The COBie file can be used by the construction management agent to justify
payment for such on-site equipment and provide a copy of that COBie file so that the facility manager can determine if any specialized training or equipment will need to be purchased for O&M of such an equipment-intensive project.

For traditional facilities that have commonly used equipment, a facility manager is primarily interested in the quantity of the equipment and the complexity of the control systems that must be operated and maintained. To assess such considerations, a COBie file for all major equipment is required from the contractor following the approval of submittals.

For commonly constructed facilities with which the FM office has significant experience, the minimum set of COBie deliverables can be provided. These deliverables would occur at the beneficial occupancy stage and the fiscal completion of construction stage.

As-Oppcupied

Upon being given responsibility to occupy a building prior to the completion of the project, the facility manager becomes responsible to begin O&M of that portion of the facility. The as-occupied COBie deliverable should be provided with (or before) the keys to the facility are given to the FM office. COBie information at this phase should include warranty, parts, consumables, maintenance, and operations information.

Before doing anything, the facility manager should place a copy of the COBie file and associated documents in a backup location. Once the information has been stored for future reference, the operational use of COBie data by the FM office should begin. If the FM office uses a CMMS, then the COBie file should be imported into that system. Importing COBie.Type, COBie.Component, COBie.Job, and related information will immediately allow the continuation of appropriate maintenance and operations activities.

In addition to scheduling the required jobs, the facility management staff will also want access to COBie data as they complete these tasks. COBie can be delivered to the staff in the following ways: paper, network, cloud-based, or integrated system. The following paragraphs describe the first of these three options; the integrated system is described in a later section.

The format for the information can be different for each maintenance shop depending on the facility staff's level of expertise with computers and the security posture of the facility. Sections of the COBie data and documents can be printed for those technicians or shops that demand it. For offices whose facility information should not be placed on computer networks outside the control of
HOW IS COBIE DELIVERED?

the facilities’ information management networks, a shared network drive can be configured for each building and the COBie data placed there. Such drives should be configured to provide read-only access so that product data sheets, shop drawings, and so on can be read but not changed by authorized users.

Commercial or not-for-profit cloud-based platforms that have verified compliance with relevant security accreditation requirements, can be evaluated and selected to host COBie information and related files. While the enforcement of security controls over cloud-based applications provides a layer of complexity to the facility management process over simply creating a read-only network drive, the aggregation of COBie data across an entire campus may raise issues related to facility security.

Another use of the information delivered through COBie is for computerized-aided facility management (CAFM). Typically, such systems support the allocation of space to tenants. COBie delivers to such systems the complete list of all spaces and space area measures. In addition to the list of spaces, the characteristics of spaces are also provided through COBie. Such information provides a powerful tool to assist facility asset managers to determine where required tenant activities may be supported within a given facility.

As-Built

The as-delivered COBie model is provided at the fiscal conclusion of the construction process. This is typically months, if not years, following the actual occupancy of the facility. The delay is required to include the complete set of changes into the project and resolve any remaining punch-list items. This COBie model should only have minor deviations to the as-occupied COBie model and from the point of view of the list of spaces and managed assets; there should be little deviation from the occupancy and fiscal completion model.

As-Maintained

For COBie to ultimately be successful, it is critical that the delivery of COBie information at beneficial occupancy be the starting point and not the ending point for the use of COBie data by the facility manager. Today, there are many different processes that impact the ongoing status of COBie data. Work orders may result in use of spare parts or consumables. Service orders could require the removal of equipment and installation of replacement equipment. Renovations may demolish, move, and add new equipment. To truly determine how the COBie will change, the facility management staff must first map and understand the information flows among the variety of information systems that are currently in place.
Since decisions about information systems are complex, it is often the case that facility management offices will either be directed to use specific products or select whatever current product appears to be most able to address some individual aspect of the COBie information management life cycle. Such decisions may give the appearance of forward progress but may also result in expensive data translation and transformation efforts due to lack of adoption of open standards across all products.

SOFTWARE SUPPORTING COBIE

There is no COBie-specific software. COBie is an information exchange standard format. COBie is meant to be used by software to help the project team capture, exchange, and ultimately deliver COBie data to the facility management office. While COBie data can be captured by hand using commonly available spreadsheets, COBie has also been incorporated directly into over 20 different software products. The COBie Means and Methods web site is the national repository that describes the ability of each of these products to produce or consume COBie data, depending on the nature of the specific product (East 2012c).

Starting with the first release of COBie in July 2008, my team has directly tested software for its ability to produce COBie data. There are two types of quality testing conducted. For those products that produce COBie data files, there is a quality control test performed. For those products that consume COBie data files, there is a quality assurance test performed.

Quality control testing has two components. The first is to ensure that the format for the information produced is correct. COBie data may be provided in one of three formats: IFC, ifcXML, or SpreadsheetML. Since software developers are easily able to provide data in a specified format, there has been little difficulty obtaining compliance with data formats. Rather, problems have been the direct result of poor implementation of the COBie model, shown in Figure 5.1, within that software.

The 11 COBie Challenge events held between July 2008 and December 2011 have shown improvements in the ability of commercial software to produce the required content of the COBie model. Nevertheless, there is still work to be done. It is worth noting that COBie did not become a U.S. national BIM standard until 2012. This delay was caused by the fact that the internal configuration of design software remains, even today, oriented toward the production of paper documents. An example of the lack of compliance of existing commercial tools to the COBie format was documented in a recent COBie case studies presentation.
(Carrasquillo and Love 2011). The current list of issues identified in this case study is representative of problems that will be encountered by virtually all project teams during design and construction.

For software that consumes (imports) COBie data, a quality control test cannot be accomplished without looking directly at the proprietary data formats and programming within commercial software systems. As a result, consuming COBie applications are subjected to a quality assurance test where a sample COBie file (with changes known only to the testing team) is required to be imported. The results of that import are investigated through a question-and-answer session that ensures the proper importation of the COBie data, within the scope of work accomplished by the consuming application. Examples of these checklists can be found in many of the previous COBie Challenge events available from the main COBie web site (East 2008).

**INTERNAL SOFTWARE TESTING**

For the facility manager, the ability of maintenance and management software to consume COBie data is of paramount importance. Since the specific software used at a given FM office is unlikely to be the exact same product and configuration as those products tested during a COBie Challenge event, it is recommended that each facility manager take the time to perform an internal COBie Challenge, using the smallest of the three standard BIM files used by my testing teams, that of the Duplex Apartment Building. The test can be as simple as creating a new building in the software being tested and using the same software to import the small Duplex model. Following the importation of the model, a side-by-side comparison of the Duplex model data with the screens generated by the software will show precisely what information was, and was not, imported. Until such tests are conducted and the reports provided back to software vendors, it is unlikely that a fully satisfactory result will be obtained by the facility manager. If, however, the test is conducted and the software vendor is responsive about correcting the import of any missing data, then the facility manager may be assured that the software will work as needed.

**LEGAL IMPLICATIONS OF COBIE**

Any discussion of building information modeling data, such as that found in COBie, inevitably requires addressing legal issues. Many of these discussions pertain to collaborative design processes that could result in the modification of authoritative
sources. Requirements for COBie do not pertain to any such collaborative processes. The delivery of COBie data mirrors directly the contracted deliverable requirements that currently exist in design and construction contracts. Designers produce room schedules and equipment and product schedules in their existing design deliverables today. The COBie information provided by designers is intended to exactly match that information. Contractors are currently required in the general provisions of virtually all contracts to delivery operations and maintenance information. COBie simply transforms the format of that information, from paper to structured information and attached electronic documents.

The major legal issue to be resolved is that a proper specification of the quality requirements for COBie deliverables needs to be provided. Without such a quality standard, whatever data is provided in COBie-formatted files must be accepted. The specification of the contents of COBie, as is proposed in the COBie Guide, provides a contractible quality standard for the objective evaluation of design and construction deliverables.

Given that COBie deliverables map precisely to existing contract deliverables and define the quality of such deliverables, no legal issues have been identified regarding the requirement, delivery, or use of COBie information.

**HOW TO IMPLEMENT COBIE**

The best way to start using COBie for the first time is to jump in and use it to get some immediate feedback. One starting point is following the design and construction of capital projects. The second is to capture information about ongoing facility management office work orders and the like. The following checklists provide a starting point for the FM COBie team to consider when embarking on the use of COBie for the first time.

**Conduct a COBie Pilot Project**

- Review the capital program based on scope and project team.
- Conduct introductory meeting stating project goals.
- Identify and review design and construction processes and procedures.
- Review and update existing contracts and specifications.
- Update contracts to deliver COBie data.
- Monitor production of COBie via monthly team meetings.
- Review COBie deliverables.
- Accept COBie deliverables in lieu of paper documents.
- Import COBie data into relevant existing information technology.
Identify Opportunities for Innovation
- Provision of asset information with service orders.
- Provision of form-based data input for work orders.
- Provision of as-maintained building data for renovations and as-operated conditions.
- Consolidated maintenance and asset management functions.

Review Existing Information Technology
- Identify operations and maintenance management software.
- Identify asset management software.
- Determine the extent to which this software can consume COBie data.
- Conduct an internal COBie Challenge to verify COBie compliance.

Review Existing Management Controls
- Identify a common classification system.
- Identify equipment naming conventions.
- Identify mandatory properties for most critical assets.
- Document processes for capture of COBie data during O&M phase.
- Document processes for use authorized use of centralized COBie data warehouse.

While much attention has been paid to the development of COBie data for new facilities, the majority of the buildings in the industrialized world have already been built. At even the most aggressive facility replacement rate, the capture of COBie data for an entire campus may require decades. There has been one published study to date on technologies used for capturing COBie for existing facilities (Rojas 2010). This report demonstrates simple tools that can be used to conduct inexpensive surveys, on the average of one dollar per square foot, to capture as-built COBie data for spaces and major building assets.

Following the completion of processes for the delivery of COBie on all capital facilities, facility managers should also consider that information about assets can be captured on a daily basis as part of each service order, work order, or renovation project. The modification of contracts, procedures, and current software to have technicians document existing or changed assets should be seen as a high-value opportunity for leveraging existing maintenance personnel. Since most major equipment must be maintained on an annual basis, slight changes to include COBie documentation in all service orders could result in a complete COBie inventory within a single year.
CONCLUSIONS

COBie is a structured set of information about managed facility assets. COBie information may be exchanged in one of three open standard formats: IFC, ifcXML, and SpreadsheetML. The spreadsheet version of COBie has begun to be widely accepted since the information is clearly presented, easily understood, and can be produced and consumed by over twenty commercially developed software systems.

The need for COBie was first recognized by the National Research Council in 1983 (NRC 1983). Their findings indicated that a significant amount of information is lost between design, construction, and facility operations. Since much of the information that is lost pertains to information about managed assets, COBie can eliminate a significant amount of that information loss. The automated production of COBie during planning, design, and construction can also reduce or eliminate the need for expensive paper documentation that is so often simply discarded.

While the development of COBie reflects a decade of work, the development of the COBie information model and data formats is the easiest part of this effort. The difficult work is ahead of each facility manager as they determine how and when to conduct COBie pilot projects and organize their back office services to support not only the consumption of COBie at the end of capital projects, but the real-time delivery of as-operated facilities through the use of this same COBie standard.

It is recommended that every facility manager interested in knowing the current status of the assets for which they are responsible begin by identifying those organizational elements that should participate in the COBie transformation. Within these divisions, branches, and organizations, the facility manager must develop champions who will guide the transformation of the business practice of each of these offices.

One of the first activities that should be completed is the identification of waste associated with the loss and recreation of COBie data. The resulting estimates can be developed and presented in the amount of additional capacity that could be achieved by utilizing shared and structured information. With the projection of the expected result, pilot projects should be initiated. Comparing the actual versus the expected performance using COBie will allow the facility manager to develop the business case for organization-wide transformation that can be achieved with COBie.
FUTURE DEVELOPMENTS

While the basic skeleton of COBie and requirements for the delivery of managed assets has been completed, the hard job, implementation within the design, construction, and FM office is just beginning. There are several COBie-related projects that may help to streamline the use of COBie.

The first of these projects, called the COBieCutSheet, is aimed at transforming manufacturer’s document-centric PDF product data sheets into lightweight data models. If this were accomplished information about equipment within a building could flow through the supply chain, streamlining the entire process. Before the COBieCutSheet is realized, however, data standards about the specific properties required for each type of asset must be established (attributes, units of measures, etc.). The SPie project aims to deliver such standard product templates.

A key problem when implementing COBie for those “in the trenches” is the request from upper management that a “business case” be developed. The COBieCalculator, a project whose results will be published in January 2013, will show the differences between a current document-centric business process and that which can be put in place with COBie information. Developed with simple flowcharts in Excel, the calculator can be adjusted to reflect per-project and portfolio-based savings.

A problem for implementers of heavy weight STEP and even SpreadsheetML specifications is that such specifications to not easily support the rapid software prototyping that has driven substantial technical innovation over the last decade. The COBieLite specification will be an XML specification for the delivery of COBie data. Developed using the Content Assembly Mechanism standard developed under the Organization for the Advancement of Structured Information Standards (OASIS), the COBie development team will open building information to a variety of different computer programmers and begin to unlock the potential for securely sharing building information with clients, tenants, regulators, and building occupants via any number of smart sensors and platforms.

The delivery of COBie data described in this chapter is based on the delivery of COBie data in full data sets at prescribed contractual phases. When developing COBie, the parties to these contracts should not be waiting until shortly before the required deliverable to produce the full data sets. The delivery of asset information during the life of the project can be achieved through the careful assignment of specific parties who are currently required to deliver portions of that information as part of their subcontracts or quality control processes. The specification for
FUTURE DEVELOPMENTS

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The first of these projects, called the COBieCutSheet, is aimed at transforming manufacturer’s document-centric PDF product data sheets into lightweight data models. If this were accomplished information about equipment within a building could flow through the supply chain, streamlining the entire process. Before the COBieCutSheet is realized, however, data standards about the specific properties required for each type of asset must be established (attributes, units of measures, etc.). The SPie project aims to deliver such standard product templates.

A key problem when implementing COBie for those “in the trenches” is the request from upper management that a “business case” be developed. The COBieCalculator, a project whose results will be published in January 2013, will show the differences between a current document-centric business process and that which can be put in place with COBie information. Developed with simple flowcharts in Excel, the calculator can be adjusted to reflect per-project and portfolio-based savings.

A problem for implementers of heavy weight STEP and even SpreadsheetML specifications is that such specifications to not easily support the rapid software prototyping that has driven substantial technical innovation over the last decade. The COBieLite specification will be an XML specification for the delivery of COBie data. Developed using the Content Assembly Mechanism standard developed under the Organization for the Advancement of Structured Information Standards (OASIS), the COBie development team will open building information to a variety of different computer programmers and begin to unlock the potential for securely sharing building information with clients, tenants, regulators, and building occupants via any number of smart sensors and platforms.

The delivery of COBie data described in this chapter is based on the delivery of COBie data in full data sets at prescribed contractual phases. When developing COBie, the parties to these contracts should not be waiting until shortly before the required deliverable to produce the full data sets. The delivery of asset information during the life of the project can be achieved through the careful assignment of specific parties who are currently required to deliver portions of that information as part of their subcontracts or quality control processes. The specification for
the life-cycle delivery of asset information is found in the Life-Cycle information exchange (LCie) project (East 2010). It is this LCie project that can help planners, designers, builders, and commissioning agents to streamline their business practices to both eliminate waste in their process and deliver a higher-quality handover data set to the facility manager.

The handover of design and construction information to the facility manager at the conclusion of a construction project is one of many different types of exchanges that take place every day across our industry. The most valuable resource to develop standards that allow our industry to move beyond the current document-based exchanges to create information-based exchanges is subject matter expertise engagement. COBie was successful as a direct result of subject matter engagement with the problem. Since the ultimate object of projects like COBie is to have them recognized as national standards, as part of the United States National Building Information Model standard, those interested in working in solving other problems should contact the buildingSMART alliance.

REFERENCES


