

# Life Cycle information exchange (LCie): System Layout

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## BACKGROUND

Building systems and their connections are necessarily engineered to the design and specifications requirements. Despite the customized nature of such efforts all such systems have a core-set of common properties that may be represented through the System Layout information exchanges. These core set of common properties are (a) components, (b) assemblies, and (c) connections.

## BUSINESS CASE

The three phases of an engineered building system are (1) design phase, (2) shop drawing phase, (3) erection phase. During operations this information is critical for the facility manager to optimize building performance and maintain services required to meet functional requirements. Current paper-based processes for the exchange of such information require the recreation of information, as opposed to the re-use of the common, shared information, each time the information is required. As an example of such recreation of information, owners with large campuses frequently have full time CAD operators who transcribe equipment layout drawings sketched by maintenance workers since no one at the facility management office has system layout drawings.

## EXAMPLE CONTRACT CLAUSE

Language as follows should be included in the submittal procedures related to shop drawings. Construction contractors shall submit both paper drawings of all system layouts as well as a data file describing the components, assemblies, and connections contained in the system. The data file shall conform to the requirements specified by the LCie System layout Specification.

## ORGANIZATION

The buildingSMART international Information Delivery Manual process identifies information exchanges according to the table shown below. Use this table to determine if this information exchange applies to your area of responsibility for a given project.

Code	Phase	Used
0	Portfolio requirements	
1	Conception of need	
2	Outline feasibility	
3	Substantive feasibility	
4	Outline conceptual design	
5	Full conceptual design	
6	Coordinated design and procurement	✓
7	Production information	
8	Construction	
9	Operation and maintenance	
10	Disposal	

The buildingSMART alliance classifies information exchanges according to a number of different classification tables, called OmniClass, provided by the Construction Specification Institute. In addition to OmniClass references

to the subject exchange, the buildingSMART alliance provides an overall business activity diagram node referenced in the table below.

LCie Worksheet	OmniClass Table 31 Phase	OmniClass Table 34 Actors	OmniClass Table 32 Services	Activity Node Tree
Shop drawings	31-40 20 27 Submittal Processing Phase	34-35 14 00 Contractor	32-21 00 00 Execution Services	4.11 Develop Construction Plan

## EXCHANGES

The sections below describe the inputs required to apply this information exchange. The processing that is accomplished to process these inputs, and the resulting outputs that should be expected as a result of performing this information exchange. This information exchange can be characterized as a “transactional” update of the as-built construction building model. A general description of the requirements for transactional exchanges is found in the LCie Overview (URL).

### Inputs

System Layout requires the user authentication and project authorization wrappers described in the LCie Overview (URL). In addition, the information below is the minimum data set that will be processed; however, additional worksheets may be provided by the creator of the COBie file. Please note that additional worksheets may be needed to produce a proper ifc file.

- Component Worksheet
  - The following required COBie fields must be present in this file:
    - Component name
    - Type component belongs to
    - Space component is located in
    - Description of component
    - Who created the entry and when
  - The following required COBie fields may not be present in this file:
    - Serial number
    - Installation date
    - Warranty start date
    - Tag number
    - Bar code
    - Asset identifier
- System worksheet.
- Attribute worksheet.
- Coordinate worksheet.
- Connection worksheet.

The following table summarizes the expected content in the COBie file. Referenced rows are for informational purposes and should not be changed. New rows require the addition of new row items to the designated worksheet. Updated rows require the addition of information to an existing row item. It may also be appropriate to add a new row item to a worksheet as part of an update. Optional rows are not required but will be processed if provided.

Key: Referenced Rows= Y or – (not reqd.)

New Rows= Y or – (not reqd.)  
 Updated Rows = Y or – (not reqd.)  
 Optional Rows = Y or – (not reqd.)

Worksheet	Referenced Rows	New Rows	Updated Rows	Optional Rows
Facility	Y	-	-	-
Floor	Y	-	-	-
Space	Y	-	-	-
Zone	-	-	-	-
Type	Y	-	-	-
Component	-	-	Y	-
System	-	-	Y	-
Spare	-	-	-	-
Resource	-	-	-	-
Job	-	-	-	-
Document	-	-	-	-
Attribute	-	-	Y	-
Connection	-	-	Y	-
Coordinate	-	-	Y	-
Issue	-	-	-	-

### Processing

The capture of this transactional information may be seen as a type of building information survey where the appropriate portion of the building information is requested to generate a data entry form, the user completes that form, and the information is returned to update the building information.

### Preparation of building information template

The first stage is the preparation of a template data set from the current building information. Implementation of the template information may be accomplished through specific software solutions using appropriate menus. To create realistic examples, bimServices demonstration scripts automatically create COBie spreadsheets containing the minimum set of information needed to provide the required BIM sub-set.

- Select current project from building information database
- Select specific system from current project
- Generate system layout data entry form
- Provide system layout data entry form

### Building information capture

The second stage is the capture of the required new information in the data entry form. As with step one this would be expected to be accomplished within proprietary software solutions. To provide a realistic example the COBie file provided in the first step may be used to:

- Access system layout data entry form
- Provide required component data
- Provide required attribute data
- Provide required connection data
- Provide required coordinate data

### Building information transmission and processing

The final stage is the transmission and processing of that information by the target information system. For this specific information exchange the following steps are required. To provide a realistic example the completed COBie building information survey form is used as the input artifact that updates the model.

- Access system layout data entry form
- Provide user credential information (if needed)
- Provide required component data
- Provide required attribute data
- Provide required connection data
- Provide required coordinate data
- Send information to the building information server

Processing information sent to the building information server will require the following steps.

- User authentication
- User authorization
- Checking file compliance with COBie
- Checking file compliance with LCie exchange requirements
- Checking the requested transaction with targeted information
- Backing-up prior building information
- Identification of matching system
- Updating mandatory component information
- Updating attribute data
- Updating connection data
- Updating coordinate data
- Completion of the transaction and reporting

## Output

There are two types of outputs created with this transaction. The first is the creation of the system layout form. This output may be shown on a screen as part of an information system or may be produced as a standalone template file, as is accomplished with the bimServices engine.

The second outputs are files that demonstrate proper processing of the submitted information. The following reports would be expected:

- Incoming file compliance with COBie
- Incoming file compliance with information exchange requirements (identification of optional data)
- Verification of mapping to target model
- Results of completing the transactions
- Comparison of prior and current model states.

## Follow On

The following processes are expected to occur after or concurrently with this process:

- Other system layout reports
- Product Installation

## EXAMPLES

The LCie project has two example projects, a duplex apartment and a medical clinic. For the duplex apartment example project, system layout COBie files have been created. The component, system, attribute, connection, and coordinate worksheets in each system layout file have been completed in

accordance with the COBie instruction worksheet. Example system layout files for the duplex apartment example project can be found below.

## Duplex Apartment

- Example 1:
  - Input:
    - Prior building model (DuplexApartment\_SystemLayout\_Flat\_1\_Heating\_before)
    - Exported template for System Layout (URL)
    - Completed template for System Layout (DuplexApartment\_SystemLayout\_Flat\_1\_Heating)
  - Output:
    - Incoming file compliance with COBie
    - Incoming file compliance with exchange requirements (identification of optional data)
    - Verification of mapping to target model
    - Results of completing the transactions
    - Comparison of prior and current model states.
  
- Example 2:
  - Input:
    - Prior building model (DuplexApartment\_SystemLayout\_Flat\_1\_Electrical\_before)
    - Exported template for System Layout (URL)
    - Completed template for System Layout (DuplexApartment\_SystemLayout\_Flat\_1\_Electrical)
  - Output:
    - Incoming file compliance with COBie
    - Incoming file compliance with exchange requirements (identification of optional data)
    - Verification of mapping to target model
    - Results of completing the transactions
    - Comparison of prior and current model states.

## Medical Clinic

- Example 1: There are currently no system layout COBie files for this example project.

## Software Implementation Guidance

### SCRIPTED PROCESS

To recreate the example files identified in this information exchange documentation the bimServices engine was used based on information from two projects a Duplex Apartment building and a Clinic building. The following batch file was used to process the appropriate files through the bimServices engine.

```
echo off
set a0=SystemLayout
rem Replace %1 with MedicalClinic or DuplexApartment
set a1=%1
rem Replace %2 with appropriate system name
set a2=%2

call goCl      %a1% %a0%_%a2%
call goMerge2  %a1% %a0% %a2%
call goC       %a1% %a0%_%a2%

time /t
```

Figure 1 doSystemLayout batch file