SBEnrc Project 2.33

New

Project Management Structures:

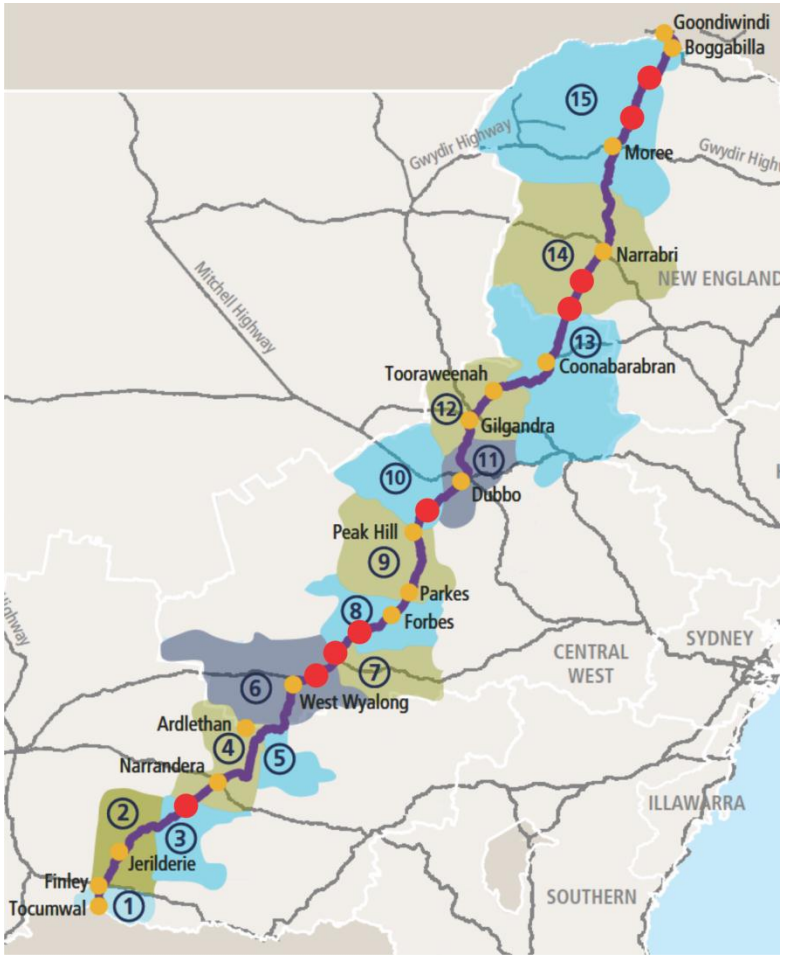
Infrastructure

Modelling (BIM)

and

Location (GIS)

Project Leader: Russell Kenley



SBEnrc 2.33 (Part 2): *from COBie to CONie*

Research Team

- Bill East
- Russell Kenley
- Toby Harfield

NRC (1983) A Report from the 1983 Workshop on Advanced Technology For Building Design and Engineering, National Academy Press, Washington, DC. **1984**

"much valuable data associated with the design, construction and operation of a facility are lost during its life span"

Open systems, standards, specifications development or problem solving

- A number of international organisations, that include industry, academia & government, use consensus during the development of globally accepted open standards and specifications
- This method of development is based on a long time-frame:
    - International Standards Organisation
    - buildingSMART
    - Open Geospatial Consortium
- To solve a problem: use a short time-frame approach
- Look to historical developments

History:
How do we provide the information needed for facilities operations?

- What short time-frame approach solved this problem?
- Develop a specific tool for a specific purpose:
  -handover information that facilities operations can use
- *Construction to Building Operations information exchange* - COBie
- Open source v1 developed in 18 months
- Software developers at COBie launch 2007
- Currently 30 asset management systems use COBie

Lyle has a problem: these are the different media used to handover building construction information

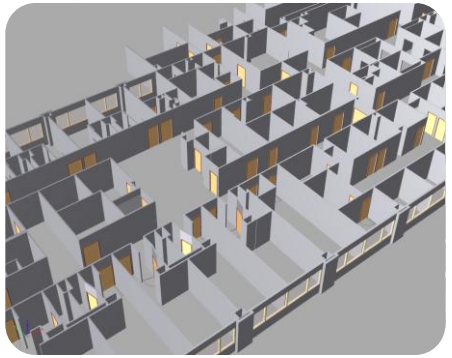
Lyle's problems multiply over time: different types of building information is in different formats & stored in different places

obsolete: remember floppy dics?

a neat & tidy library, but these manuals not available on-site

inaccessible because it is locked in away

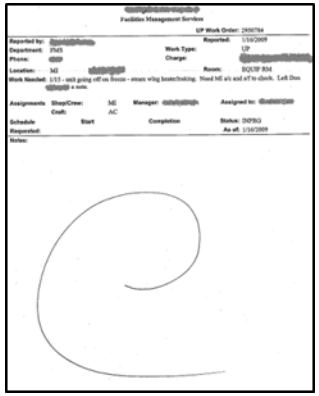
duplicate systems for data: different data recorded by different people for different purposes; but for the same location in a building



There is no end to Lyle's woes: when he finds the document, it is not labelled or searchable or has a number of different specs so he can't easily find what he needs

Over the life of the facility, as technology continues to rapidly advance, eventually much information cannot be accessed

un-labelled documents



un-searchable scanned pdfs

inconsistent processes

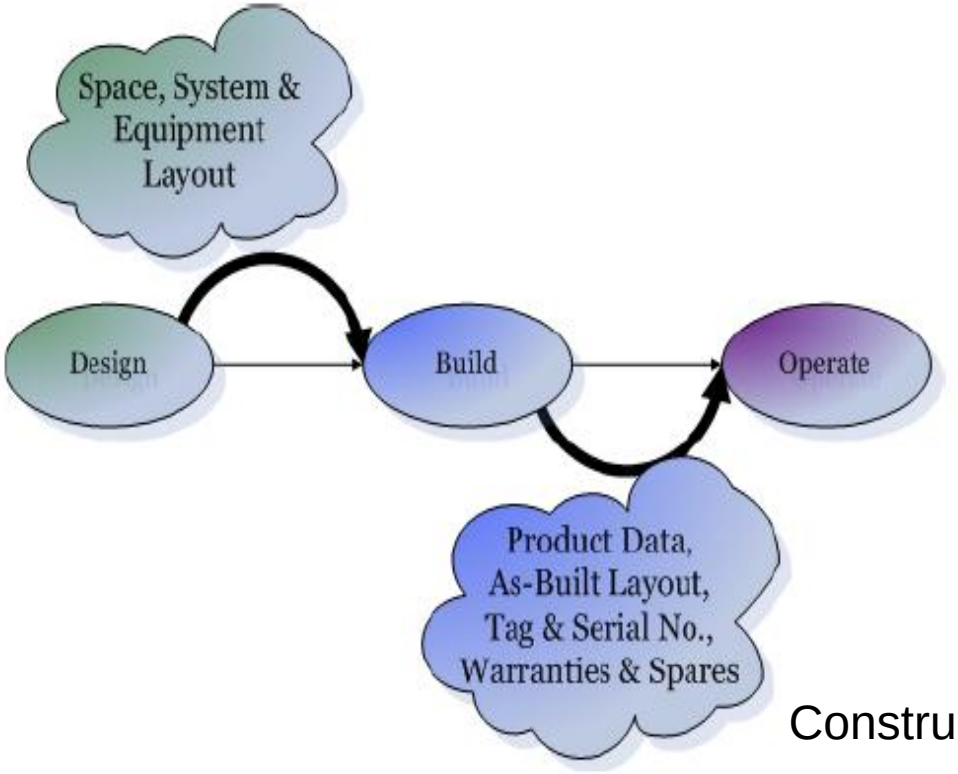
You use inches: I use centimetres

BIM (ISO 16379) is not the answer for most facilities managers: too much data generated for most buildings

- important to define which piece of that information is important
- is information linked to the intended purpose
- sub-set of data is a model view
- buildingSMART working on how to manage all types of building information

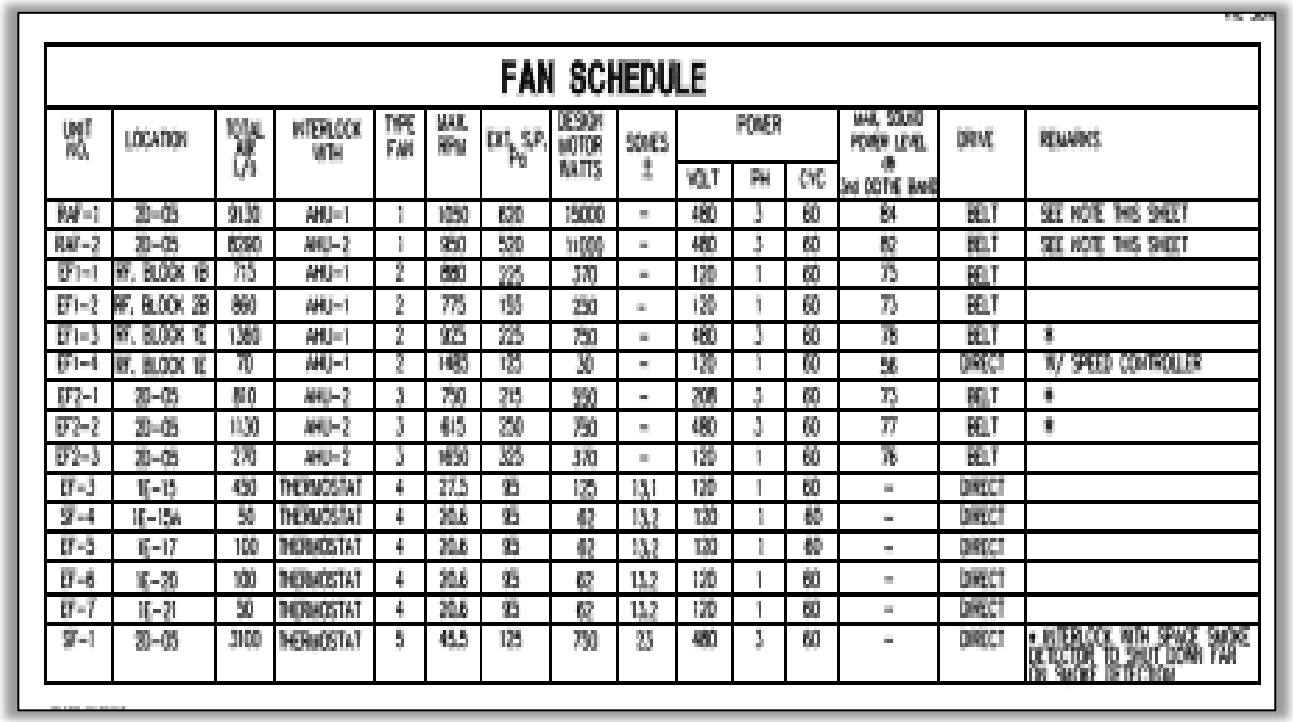
Who creates the building information? Where does it come from?

Designers of all detailed drawings



Constructors, suppliers

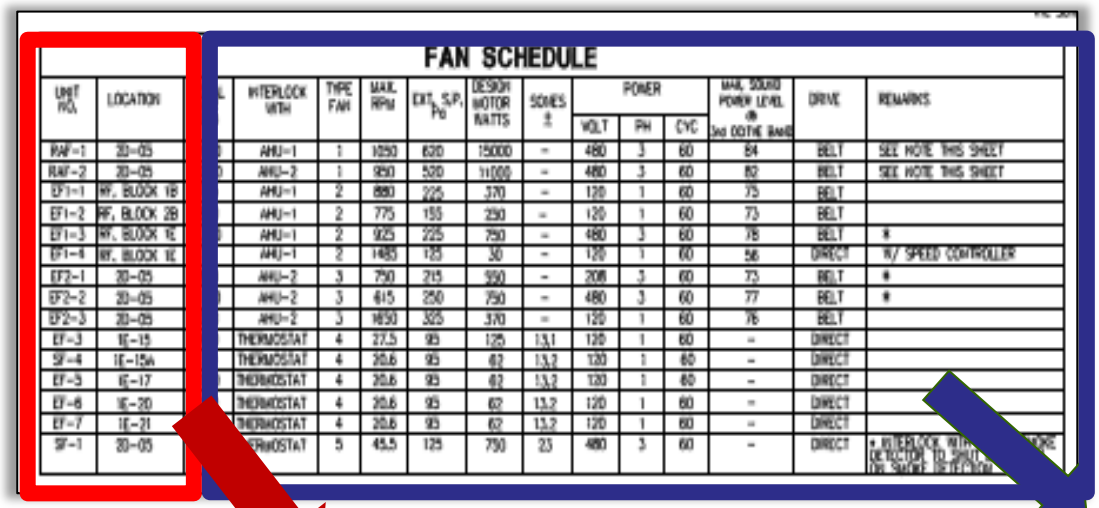
Example of information/data for Fan



FAN SCHEDULE

UNIT NO.	LOCATION	TOTAL AIR L/s	INTERLOCK WITH	TYPE FAN	MAX. RPM	EXT. S.P. Pa	DESIGN MOTOR WATTS	SONES #	POWER VOLT	PH	CYC	MAX. SOUND POWER LEVEL dB 3rd OCTAVE BAND	DRIVE	REMARKS
RAF-1	20-05	9130	AHU-1	1	1050	820	15000	-	480	3	60	84	BELT	SEE NOTE THIS SHEET
RAF-2	20-05	8080	AHU-2	1	950	520	11000	-	480	3	60	82	BELT	SEE NOTE THIS SHEET
EF1-1	MF, BLOCK 1B	715	AHU-1	2	880	225	370	-	120	1	60	75	BELT	
EF1-2	MF, BLOCK 2B	860	AHU-1	2	775	155	250	-	120	1	60	73	BELT	
EF1-3	MF, BLOCK 1E	1,380	AHU-1	2	1025	225	750	-	480	3	60	78	BELT	#
EF1-4	MF, BLOCK 1E	70	AHU-1	2	1480	125	30	-	120	1	60	58	DIRECT	W/ SPEED CONTROLLER
EF2-1	20-05	860	AHU-2	3	750	215	550	-	208	3	60	73	BELT	#
EF2-2	20-05	1130	AHU-2	3	815	250	750	-	480	3	60	77	BELT	#
EF2-3	20-05	270	AHU-2	3	1650	325	370	-	120	1	60	76	BELT	
EF-3	1E-15	450	THERMOSTAT	4	27.5	125	125	13.1	120	1	60	-	DIRECT	
SF-4	1E-15A	50	THERMOSTAT	4	30.6	125	62	13.2	120	1	60	-	DIRECT	
EF-5	1E-17	100	THERMOSTAT	4	30.6	125	62	13.2	120	1	60	-	DIRECT	
EF-6	1E-20	100	THERMOSTAT	4	30.6	125	62	13.2	120	1	60	-	DIRECT	
EF-7	1E-21	50	THERMOSTAT	4	30.6	125	62	13.2	120	1	60	-	DIRECT	
SF-1	20-05	3100	THERMOSTAT	5	45.5	125	750	23	480	3	60	-	DIRECT	# INTERLOCK WITH SPACE SMOKE DETECTOR TO SHUT DOWN FAN ON SMOKE DETECTION

Example of information/data to be decomposed



FAN SCHEDULE

UNIT NO.	LOCATION	INTERLOCK WITH	TYPE FAN	MAX. RPM	EXT. S.P. Pa	DESIGN MOTOR WATTS	SONES ±	POWER VOLT	POWER PH	POWER CYC	MAX. SOUND POWER LEVEL @ 3rd OCTAVE BAND	DRIVE	REMARKS
RAF-1	2D-05	AHU-1	1	1050	620	15000	-	480	3	60	84	BELT	SEE NOTE THIS SHEET
RAF-2	2D-05	AHU-2	1	950	500	11000	-	480	3	60	82	BELT	SEE NOTE THIS SHEET
EF1-1	RF, BLOCK 1B	AHU-1	2	880	225	370	-	120	1	60	75	BELT	
EF1-2	RF, BLOCK 2B	AHU-1	2	775	155	250	-	120	1	60	73	BELT	
EF1-3	RF, BLOCK 1E	AHU-1	2	925	225	750	-	480	3	60	78	BELT	*
EF1-4	RF, BLOCK 1E	AHU-1	2	1480	125	30	-	120	1	60	56	DIRECT	W/ SPEED CONTROLLER
EF2-1	2D-05	AHU-2	3	750	215	550	-	208	3	60	75	BELT	*
EF2-2	2D-05	AHU-2	3	615	250	750	-	480	3	60	77	BELT	*
EF2-3	2D-05	AHU-2	3	1650	325	370	-	120	1	60	76	BELT	
EF-3	1E-15	THERMOSTAT	4	27.5	95	125	13.1	120	1	60	-	DIRECT	
SF-4	1E-15A	THERMOSTAT	4	20.6	95	62	13.2	120	1	60	-	DIRECT	
EF-5	1E-17	THERMOSTAT	4	20.6	95	62	13.2	120	1	60	-	DIRECT	
EF-6	1E-20	THERMOSTAT	4	20.6	95	62	13.2	120	1	60	-	DIRECT	
EF-7	1E-21	THERMOSTAT	4	20.6	95	62	13.2	120	1	60	-	DIRECT	
SF-1	2D-05	THERMOSTAT	5	45.5	125	750	23	480	3	60	-	DIRECT	* INTERLOCK WITH DETECTION TO SHUT DOWN ON SMOKE DETECTION

COBie
Component: location in the building

	A	D	E	F
1	Name	TypeName	Space	Description
524	Fan- EF1-1	Fan- Roof Mounted Type 1	2R02	Centrifugal Fan- Roof Mounted
525	Fan- EF1-2	Fan- Roof Mounted Type 2	3R01	Centrifugal Fan- Roof Mounted
526	Fan- EF1-3	Fan- Roof Mounted Type 3	2R02	Centrifugal Fan- Roof Mounted
527	Fan- EF1-4	Fan- Roof Mounted Type 4	2R02	Centrifugal Fan- Roof Mounted
528	Fan- EF2-1	Fan- In Line Type 1	2D05	Centrifugal Fan- In Line
529	Fan- EF2-2	Fan- In Line Type 2	2D05	Centrifugal Fan- In Line
530	Fan- EF2-3	Fan- In Line Type 3	2D05	Centrifugal Fan- In Line
531	Fan EF-3	Fan- Sidewall Type 2	1E15	Exhaust Fan
532	Fan EF-5	Fan- Sidewall Type 3	1E17	Exhaust Fan
533	Fan EF-6	Fan- Sidewall Type 3	1E20	Exhaust Fan
534	Fan EF-7	Fan- Sidewall Type 3	1E21	Exhaust Fan
535	Fan SF-1	Fan- Sidewall Type 1	2D05	Supply Fan
536	Fan SF-4	Fan- Sidewall Type 3	1E15A	Exhaust Fan

COBie
Attribute: off the drawing that is usable

	A	D	E	F	G	H
1	Name	Category	SheetName	RowName	Value	Unit
6772	Design Motor	Requireme	Componen	Fan- EF1-1	370	Watts
6773	Drive	Requireme	Componen	Fan- EF1-1	Belt	n/a
6774	Ext. S.P.	Requireme	Componen	Fan- EF1-1	225	Pa
6775	Frequency	Requireme	Componen	Fan- EF1-1	60	Hertz
6776	Interlock With	Requireme	Componen	Fan- EF1-1	AHU-1	n/a
6777	Max Speed	Requireme	Componen	Fan- EF1-1	880	RPM
6778	Max. Sound Power Level	Requireme	Componen	Fan- EF1-1	75	db
6779	Phase	Requireme	Componen	Fan- EF1-1	1	n/a
6780	Remarks	Requireme	Componen	Fan- EF1-1	n/a	n/a
6781	SONES	Requireme	Componen	Fan- EF1-1	n/a	n/a
6782	Total Air	Requireme	Componen	Fan- EF1-1	715	L/s
6783	Voltage	Requireme	Componen	Fan- EF1-1	120	Volts

Key designations to the related area depicted on the contract drawings

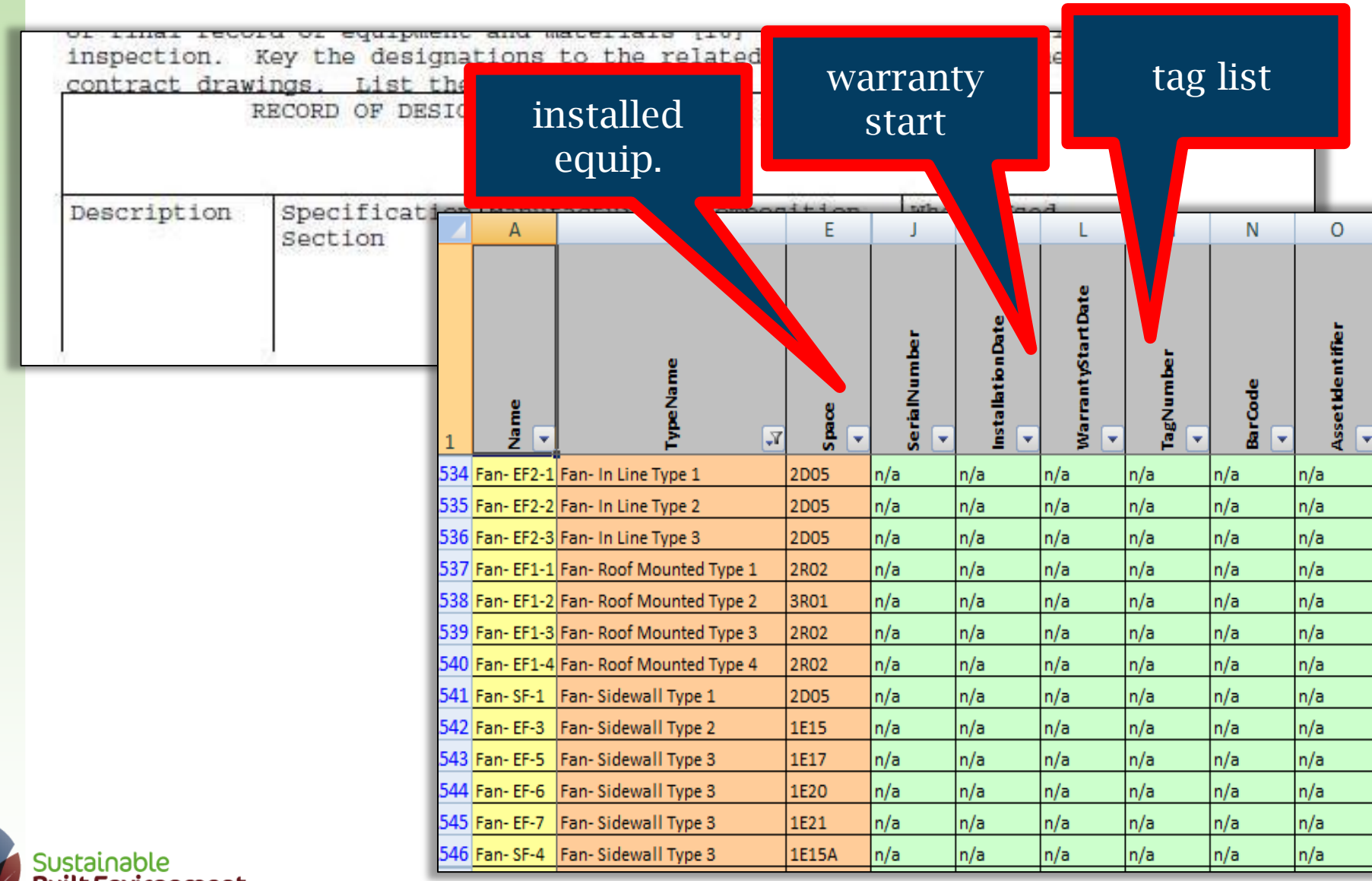
- Necessary information to construct the building
- Basic information provided by the contractor
- Useful for handover for facilities operations

inspection. Key the designations to the related area depicted on the contract drawings. List the following data:

RECORD OF DESIGNATED EQUIPMENT AND MATERIALS DATA

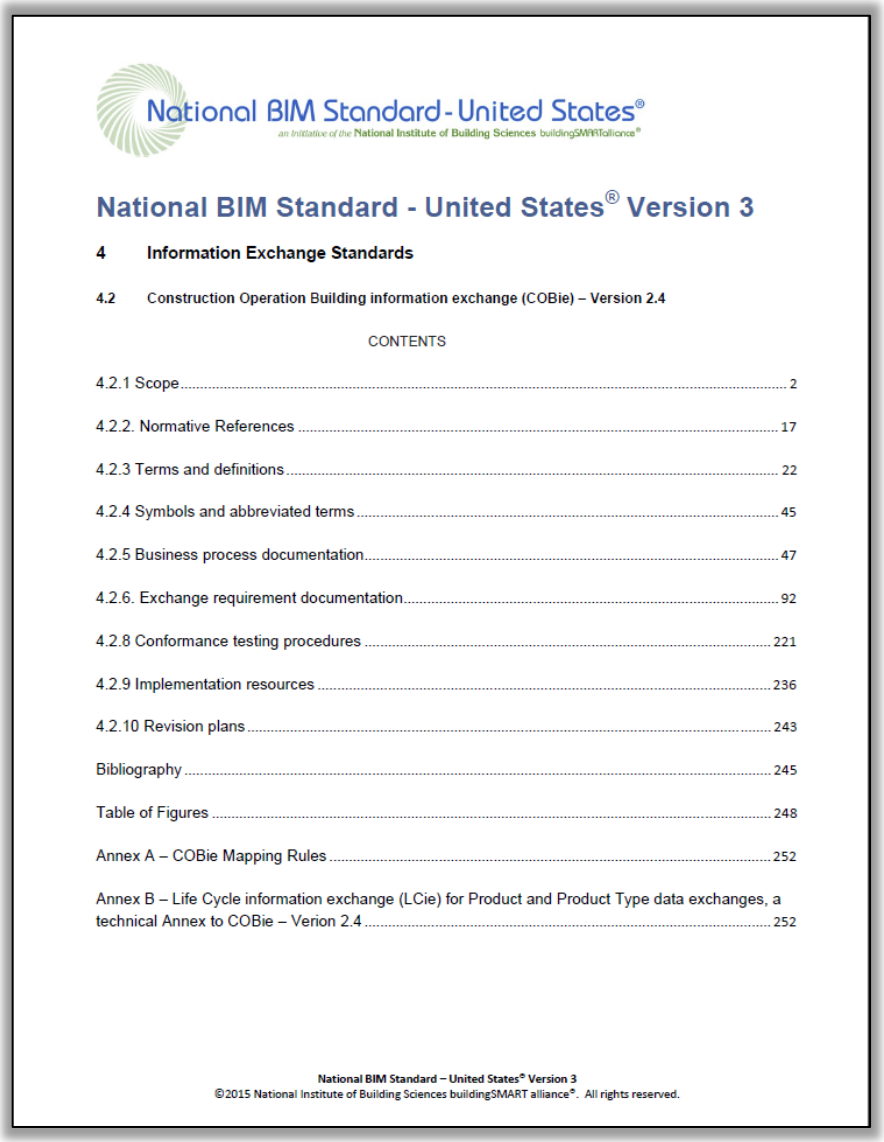
Description	Specification Section	Manufacturer and Catalog, Model, and Serial Number	Composition and Size	Where Used

1. 3D modelling data not necessary
2. installed equipment, warranty start, lag list:on the paper drawings
3. spreadsheet universally integrated



1	A Name	TypeName	E Space	J SerialNumber	InstallationDate	L WarrantyStartDate	TagNumber	N BarCode	O AssetIdentifier
534	Fan- EF2-1	Fan- In Line Type 1	2D05	n/a	n/a	n/a	n/a	n/a	n/a
535	Fan- EF2-2	Fan- In Line Type 2	2D05	n/a	n/a	n/a	n/a	n/a	n/a
536	Fan- EF2-3	Fan- In Line Type 3	2D05	n/a	n/a	n/a	n/a	n/a	n/a
537	Fan- EF1-1	Fan- Roof Mounted Type 1	2R02	n/a	n/a	n/a	n/a	n/a	n/a
538	Fan- EF1-2	Fan- Roof Mounted Type 2	3R01	n/a	n/a	n/a	n/a	n/a	n/a
539	Fan- EF1-3	Fan- Roof Mounted Type 3	2R02	n/a	n/a	n/a	n/a	n/a	n/a
540	Fan- EF1-4	Fan- Roof Mounted Type 4	2R02	n/a	n/a	n/a	n/a	n/a	n/a
541	Fan- SF-1	Fan- Sidewall Type 1	2D05	n/a	n/a	n/a	n/a	n/a	n/a
542	Fan- EF-3	Fan- Sidewall Type 2	1E15	n/a	n/a	n/a	n/a	n/a	n/a
543	Fan- EF-5	Fan- Sidewall Type 3	1E17	n/a	n/a	n/a	n/a	n/a	n/a
544	Fan- EF-6	Fan- Sidewall Type 3	1E20	n/a	n/a	n/a	n/a	n/a	n/a
545	Fan- EF-7	Fan- Sidewall Type 3	1E21	n/a	n/a	n/a	n/a	n/a	n/a
546	Fan- SF-4	Fan- Sidewall Type 3	1E15A	n/a	n/a	n/a	n/a	n/a	n/a

COBie validated 2 years ago
Now published as part of
US Information Exchange Standards



National BIM Standard - United States®
an initiative of the National Institute of Building Sciences buildingSMART alliance®

National BIM Standard - United States® Version 3

4 Information Exchange Standards

4.2 Construction Operation Building information exchange (COBie) – Version 2.4

CONTENTS

What is needed for a specification?

Ask the questions:

- what information is needed for building maintenance?
  - moving parts
- what information **isn't** needed?
  - almost everything else

Extract data that is needed from paper documents:

- put it into a technical information format
- create a specification by
- putting the information into a spreadsheet

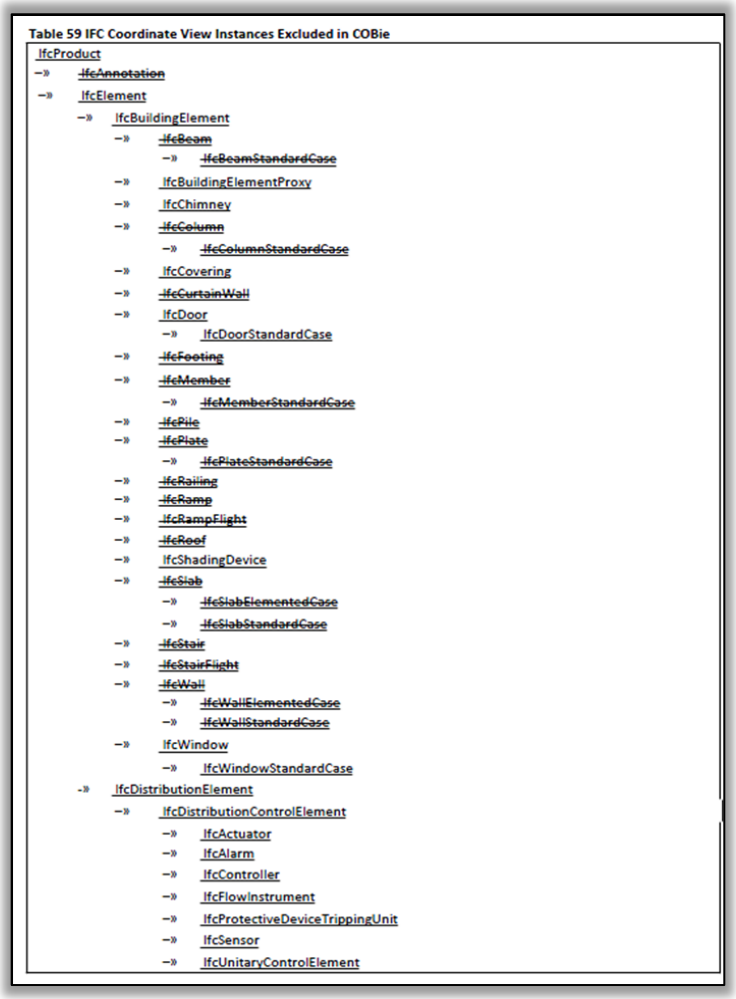


Table 59 IFC Coordinate View Instances Excluded in COBie

IfcProduct
- ~~IfcAnnotation~~
- IfcElement
  - IfcBuildingElement
    - ~~IfcBeam~~
      - ~~IfcBeamStandardCase~~
    - IfcBuildingElementProxy
    - IfcChimney
    - ~~IfcColumn~~
      - ~~IfcColumnStandardCase~~
    - IfcCovering
    - ~~IfcCurtainWall~~
    - IfcDoor
      - IfcDoorStandardCase
    - ~~IfcFooting~~
    - ~~IfcMember~~
      - ~~IfcMemberStandardCase~~
    - ~~IfcPile~~
    - ~~IfcPlate~~
      - ~~IfcPlateStandardCase~~
    - ~~IfcRailing~~
    - ~~IfcRamp~~
    - ~~IfcRampFlight~~
    - ~~IfcRoof~~
    - IfcShadingDevice
    - ~~IfcSlab~~
      - ~~IfcSlabElementedCase~~
      - ~~IfcSlabStandardCase~~
    - ~~IfcStair~~
    - ~~IfcStairFlight~~
    - ~~IfcWall~~
      - ~~IfcWallElementedCase~~
      - ~~IfcWallStandardCase~~
    - IfcWindow
      - IfcWindowStandardCase
  - IfcDistributionElement
    - IfcDistributionControlElement
      - IfcActuator
      - IfcAlarm
      - IfcController
      - IfcFlowInstrument
      - IfcProtectiveDeviceTrippingUnit
      - IfcSensor
      - IfcUnitaryControlElement

Performance based specification for information delivery: COBie

We use the tried and true construction process:

- performance testing specification part of COBie
  - similar to testing concrete

- standard data format
  - similar to the standard testing cylinder
- allowable information
  - similar to concrete
- test data to see if it conforms
  - similar to breaking the test sample

Specified data: 1. useable, 2. backward compatible 3. performance testable

people who established information make it available for others

techies transform information into a format that is easily usable

specification is available as an open resource

many people can use the information exchange in a variety of products

Table 11 COBie.Type Worksheet Schema

Column	Column Name	Unique Key		Foreign Key	Required Value			Allowed Values	
		Primary	Compound		Reqd.	System	AsSpecified	Type	Max. Len.
A	Name	X	-	-	X	-	-	AlphaNumeric	255
B	CreatedBy	-	-	Contact.Email	X	-	-	Contact.Email	255
C	CreatedOn	-	-	-	X	-	-	ISO Date	19
D	Category	-	-	PickList.Category-Product	X	-	-	PickList.Category-Product	255
E	Description	-	-	-	X	-	-	AlphaNumeric	255
F	AssetType	-	-	PickList.AssetType	X	-	-	PickList.AssetType	255
G	Manufacturer	-	-	Contact.Email	X	-	-	Contact.Email	255
H	ModelNumber	-	-	-	X	-	-	AlphaNumeric	255
I	WarrantyGuarantorParts	-	-	Contact.Email	X	-	-	Contact.Email	255
J	WarrantyDurationParts	-	-	-	X	-	-	Numeric	Double
K	WarrantyGuarantorLabor	-	-	Contact.Email	X	-	-	Contact.Email	255
L	WarrantyDurationLabor	-	-	-	X	-	-	Numeric	Double
M	WarrantyDurationUnit	-	-	PickList.DurationUnit	X	-	-	PickList.DurationUnit	255
N	ExternalSystem	-	-	Creating System Name	-	X	-	AlphaNumeric	255
O	ExternalObject	-	-	Creating System Object	-	X	-	AlphaNumeric	255
P	ExternalIdentifier	-	-	Creating System ID	-	X	-	AlphaNumeric	255
Q	ReplacementCost	-	-	-	-	-	X	Numeric	Double
R	ExpectedLife	-	-	-	-	-	X	Numeric	Double
S	DurationUnit	-	-	PickList.DurationUnit	-	-	X	PickList.DurationUnit	255
T	WarrantyDescription	-	-	-	-	-	X	AlphaNumeric	255
U	NominalLength	-	-	-	X	-	-	Numeric	Double
V	NominalWidth	-	-	-	X	-	-	Numeric	Double
W	NominalHeight	-	-	-	X	-	-	Numeric	Double
X	ModelReference	-	-	-	-	-	X	AlphaNumeric	255
Y	Shape	-	-	-	-	-	X	AlphaNumeric	255
Z	Size	-	-	-	-	-	X	AlphaNumeric	255
AA	Color	-	-	-	-	-	X	AlphaNumeric	255
AB	Finish	-	-	-	-	-	X	AlphaNumeric	255
AC	Grade	-	-	-	-	-	X	AlphaNumeric	255
AD	Material	-	-	-	-	-	X	AlphaNumeric	255

Construction to Operations Network information exchange
CONie

- Can the lessons learned from COBie be used for SBEnrc project 2.33?
- Research Question:

  Can a “COBie for infrastructure” be created?
- We could call it CONie (*Construction to Operations Network information exchange)*
- What would a CONie look like?
- What specific information and data are needed for road network handover?

General comments about data for road networks

- Without a central authoritative set of infrastructure network information, public and private interests keep multiple, overlapping datasets for Asset Management
- Upkeep of these datasets (maintenance, operations, GIS, BIM, etc.) is typically not tied to project phases
- Over time, information content diverges, leading to higher costs and inability to share needed data
- Ability to extract, use, and share basic asset information often tied directly to specific proprietary software
- Networks focus almost exclusively on format not process or content

Identified information sources for road network asset management and maintenance

Information Sources
Engineering Data
Engineering Geometry
Network Segments
Network Geometry
Network Topology
Easement Information
Segment Condition
Asset Inventory
Work Templates
Safety Conditions
Sensor Feedback
Operational Conditions
External Condition
Political Boundaries

Structuring information for road networks by identified information users

Information Sources	Information Users					
	Project Management	Maintenance Management	Asset Management	Operation Management	Public Use	Policy Research
Engineering Data						
Engineering Geometry						
Network Segments						
Network Geometry						
Network Topology						
Easement Information						
Segment Condition						
Asset Inventory						
Work Templates						
Safety Conditions						
Sensor Feedback						
Operational Conditions						
External Condition						
Political Boundaries						

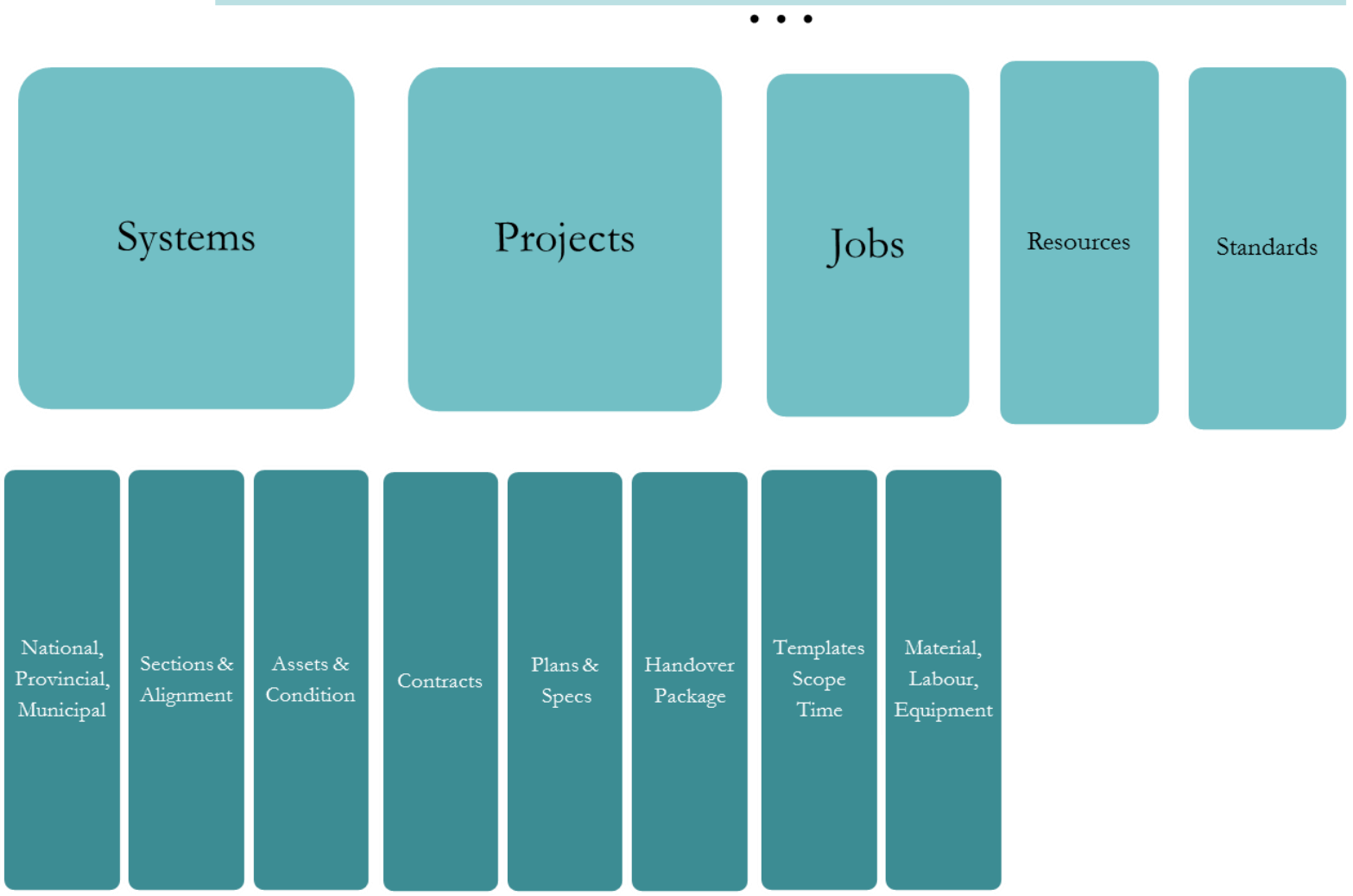
Road network data:
1. how do we get data from the people who create and use it?
2. what is their relationship to this data?

Information Sources	Information Users					
	Project Management	Maintenance Management	Asset Management	Operation Management	Public Use	Policy Research
Engineering Data	Create	Reference	-	-	-	-
Engineering Geometry	Create	Reference	-	-	-	-
Network Segments	Create	Update	Read	Read	Read	Read
Network Geometry	Create	Update	Read	Read	Read	Read
Network Topology	Create	Update	Read	Read	Read	Read
Easement Information	Read	Read	-	Create	-	-
Segment Condition	Create	Update	Read	Update	Read	Read
Asset Inventory	Create	Update	Read	Read	-	-
Work Templates	-	Create	Create	-	-	-
Safety Conditions	Read	Read	-	Create	Read	-
Sensor Feedback	-	-	-	Read	-	-
Operational Conditions	-	Read	-	Create	Read	-
External Condition	Read	Read	-	Read	Read	-
Political Boundaries	Read	-	Read	Read	Read	Read

Appropriate specification standards for CONie

- authoritative highway network information repository
- services based on open engineering standards
- forward-compatible standards that can be adopted today
- open systems for constituents levels of access provided by secure, cloud-based services

Outline for a road network data model



Suggested location system for horizontal infrastructure

- CityGML is an international OGC standard and can be used free of charge
- OGC CityGML is an open data model and XML-based format for the storage and exchange of semantic 3D city models
- an application schema for the Geography Markup Language version 3.1.1 (GML3), the extendible international standard for spatial data exchange issued by the Open Geospatial Consortium (OGC) and the ISO TC211
- aim of CityGML is to reach a common definition of the basic entities, attributes, and relations of a 3D city model

CONie: next steps

1. Look at specified requirements in contracts for specifications in a format that is usable
2. Create samples with real data (spreadsheets)
3. Find software to check the data