

IFC BIM-Based Building Management Framework for Energy Efficient Building Operation



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1. Introduction
2. Key concepts
3. Methodology
4. Demonstration
5. Conclusion
6. Future Work



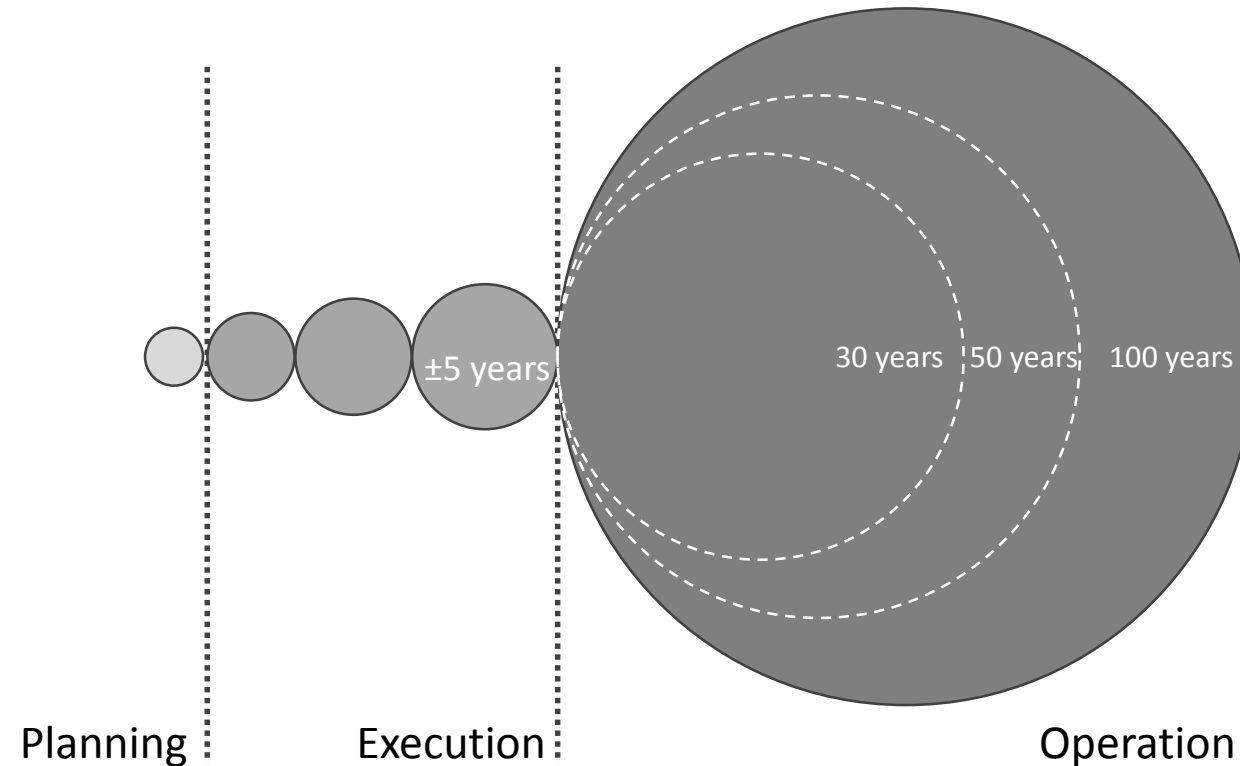
» Planning

» Execution

- Design
- Construction
- Commissioning

» Operation

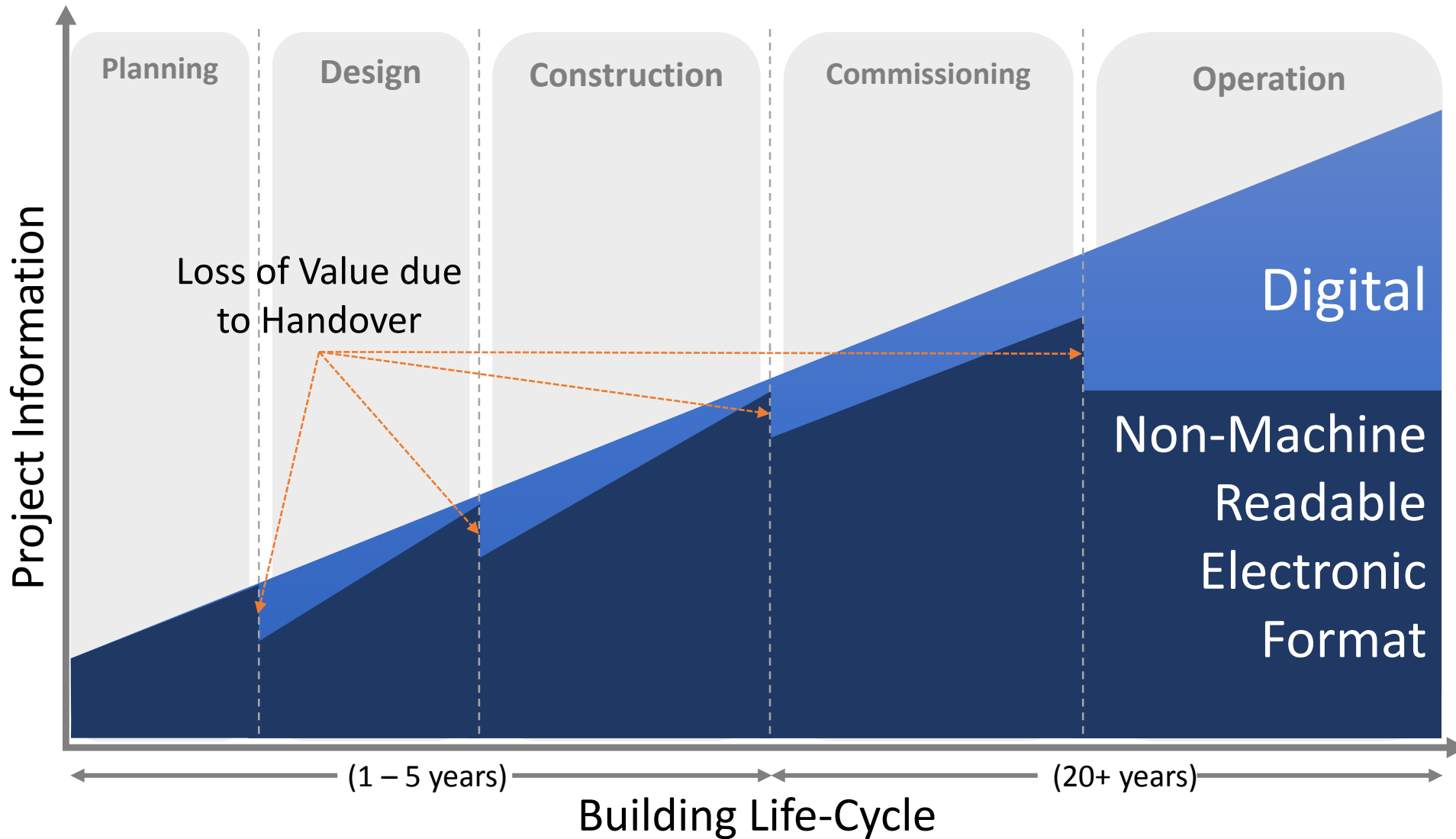
» Demolition



“It is common to find **well-designed** buildings operating **badly** due to poor management.

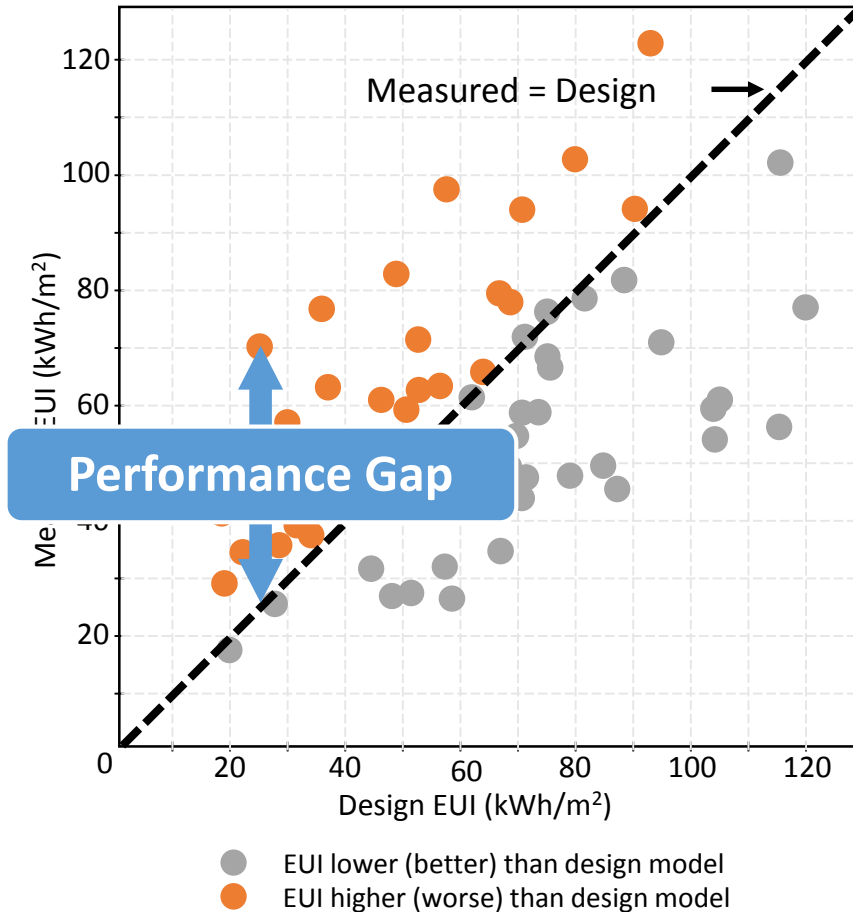
Conversely, **poorly designed** buildings can be improved to a great extent through **good management practices**” (CIBSE Guide F, 2012).

The consequences of information loss to the construction industry are enormous





Measured versus Design Energy Use Intensity (EUI)



Source: Turner, C., & Frankel, M. (2008)

Reference	Findings
Norford et al. (1994)	Energy consumption 2.5 times higher than predicted
Bordass et al. (2001)	Energy consumption twice as much as predicted
Torcellini et al. (2004)	Studied 6 sustainable buildings and all performed worse than predicted
Bordass et al. (2004)	Performance gap arises because of assumptions are not well informed
Diamond et al. (2006)	Average energy consumption deviates 46% from simulations
Newsham et al. (2009)	Compared 100 LEED buildings and found out that 35% are performing worse than their counterpart
Carbon Trust (2012)	Energy consumption can be as much as 5 times higher than predicted
De Wilde (2014)	Identified the performance gap as a function of time and external conditions



Key Concepts

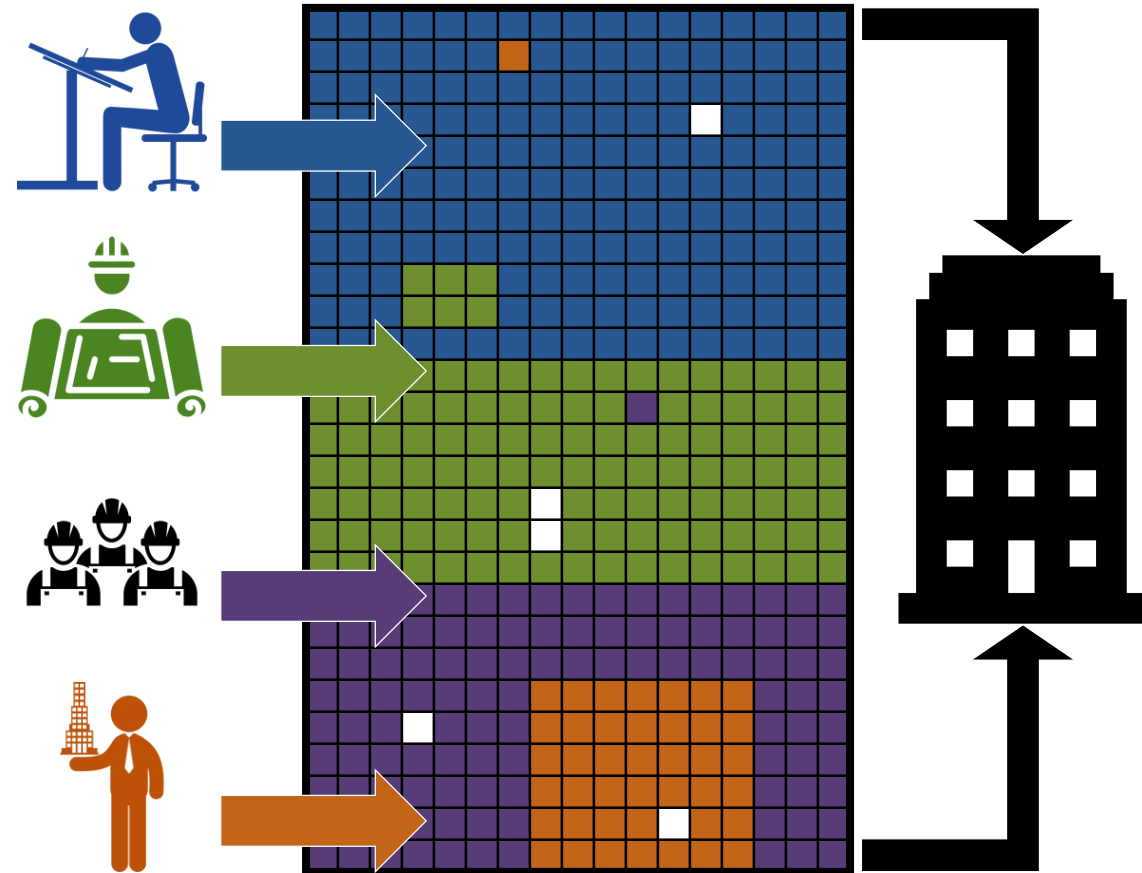


» As a noun: Building Information Model

- An **instance** of a **populated** data model of buildings that contains **multi-disciplinary** data specific to a particular building which they describe **unambiguously**

» As a verb: Building Information Modelling

- The **act/process** of **creating** a Building Information Model (BIM – a noun)



Courtesy of Vladimir Bazjanac

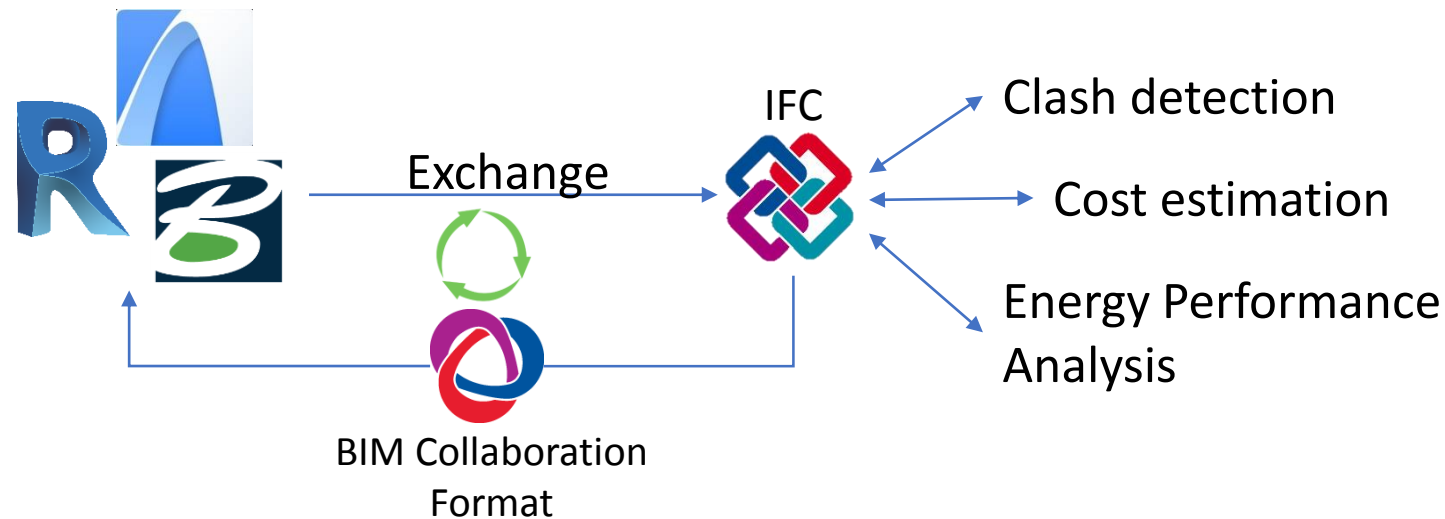
Source: Bazjanac V., (2004)

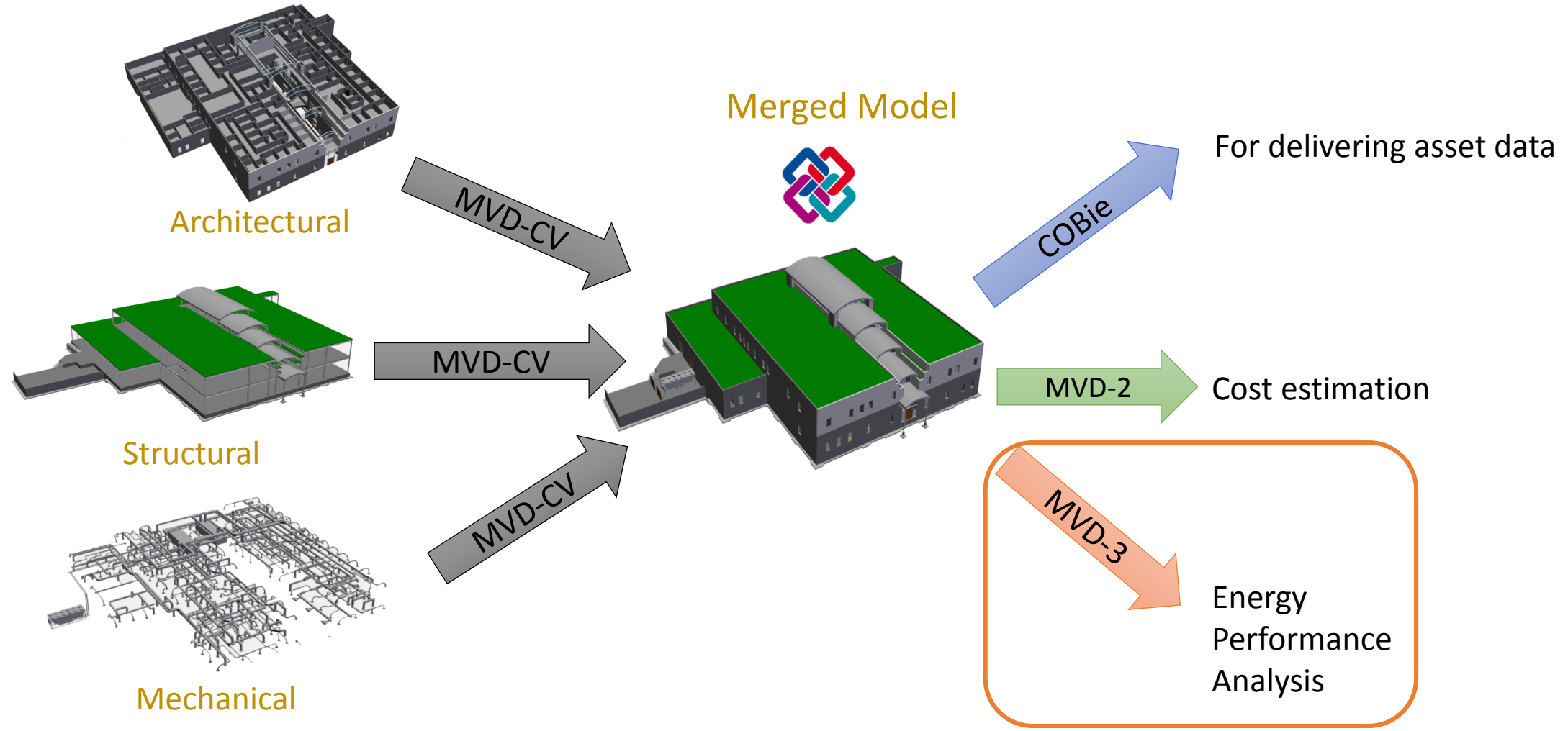


IFC is about exchanging data – it is not an application format

› The importance of IFC:

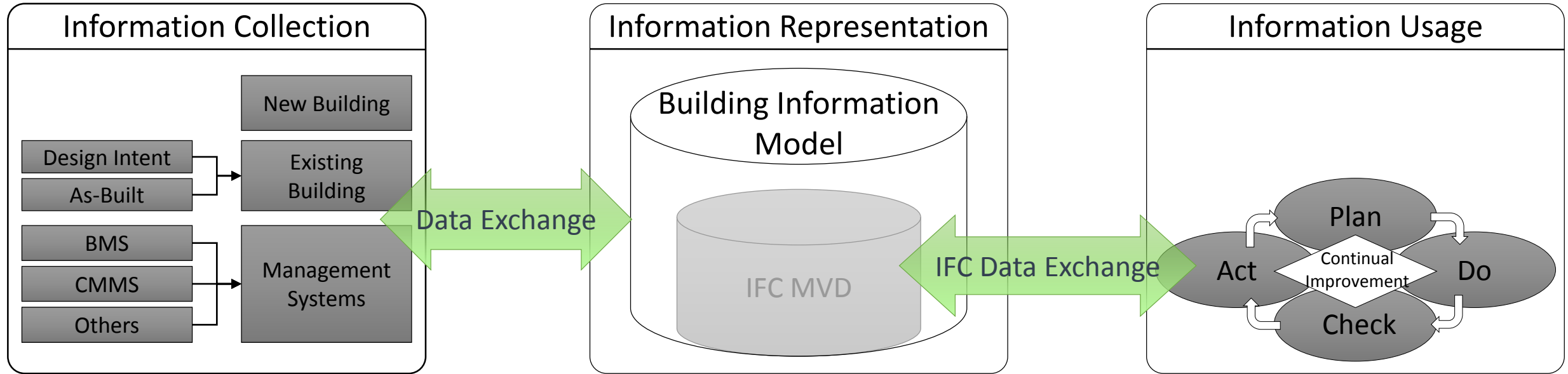
- Open
- Neutral
- Comprehensive
- Customisable
- Extensible
- ISO Standard 16739







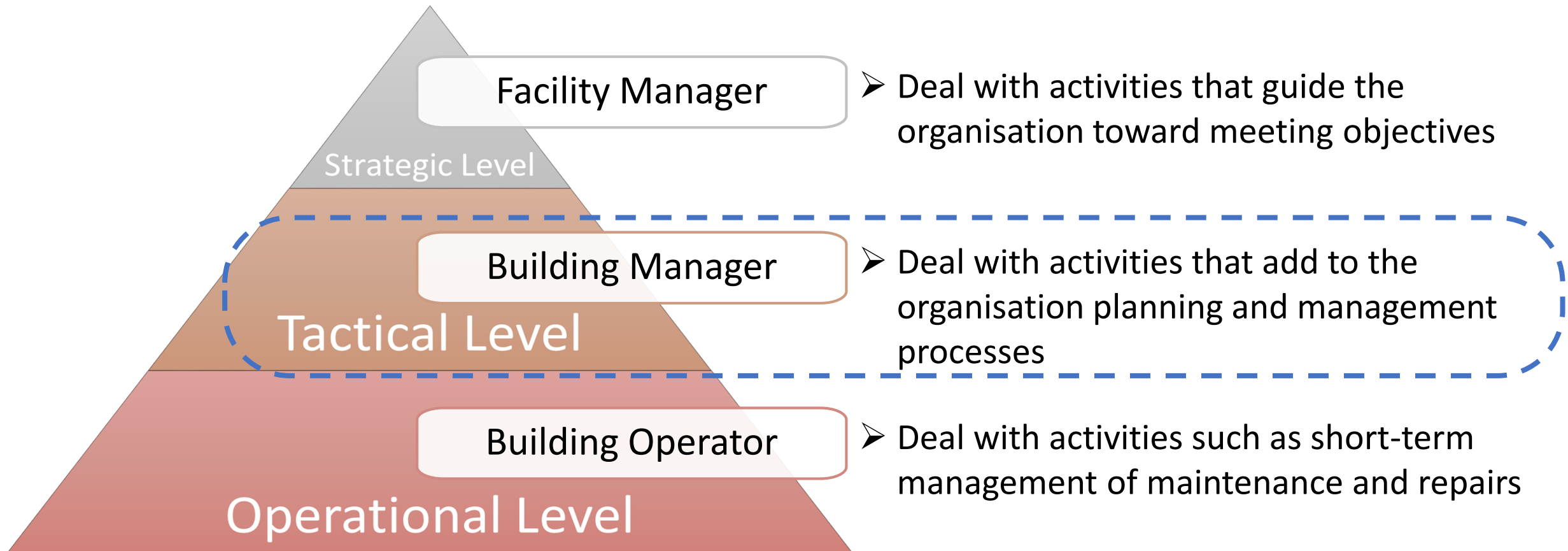
Methodology



Gathering of **useful**
and **valuable**
information

Consolidated
interface for data
representation

Timely informed
decision





» Benchmarking

» Targeting

» Scheduling

» Procurement

» Commissioning

» Metering

» Monitoring

» Maintenance

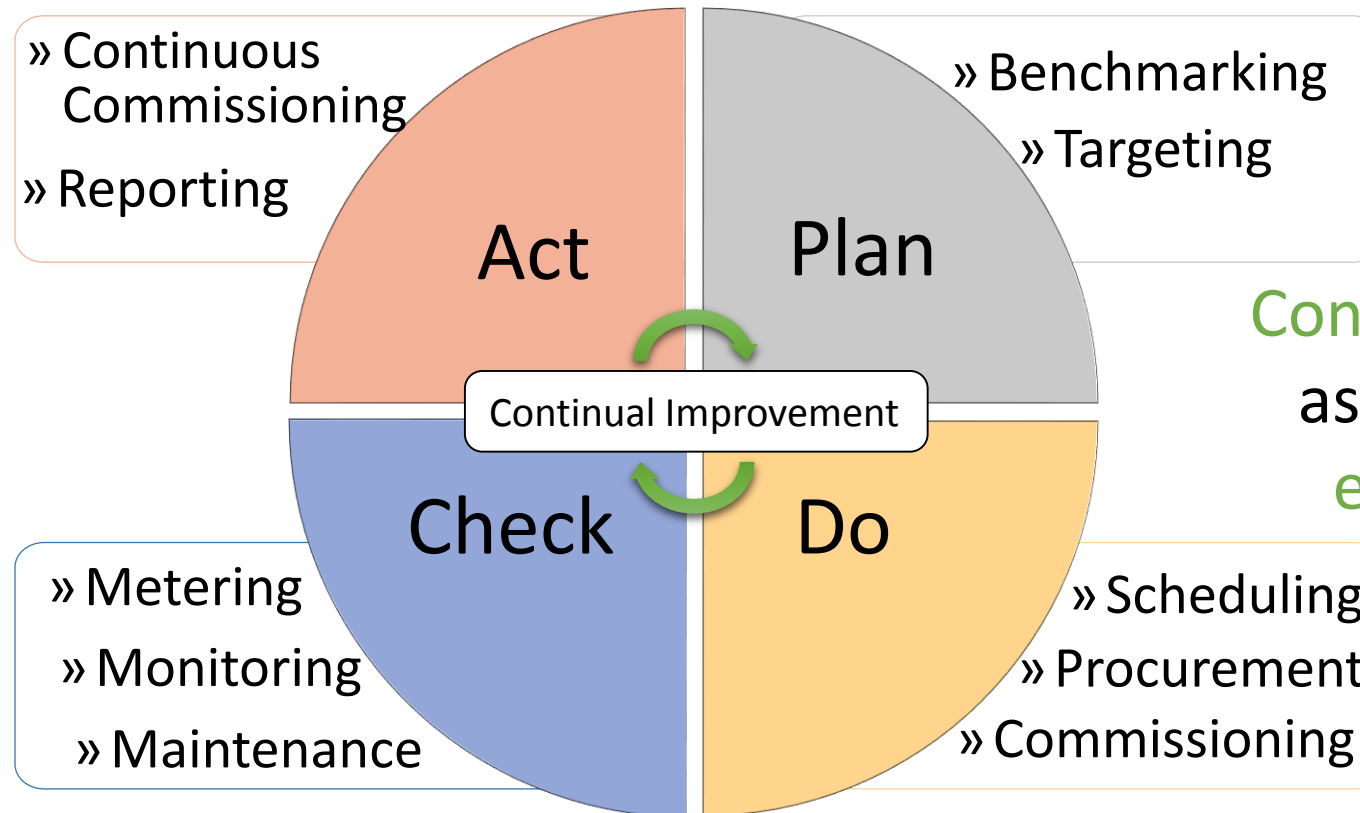
» Continuous
Commissioning

» Reporting

- Energy Benchmark
- Environmental Benchmark
- Metric
- Source
- Others

- Meter Location
- Frequency of Readings
- Location Data Storage
- Calibration Date
- Others

- Report
- Guidelines
- Suggestions



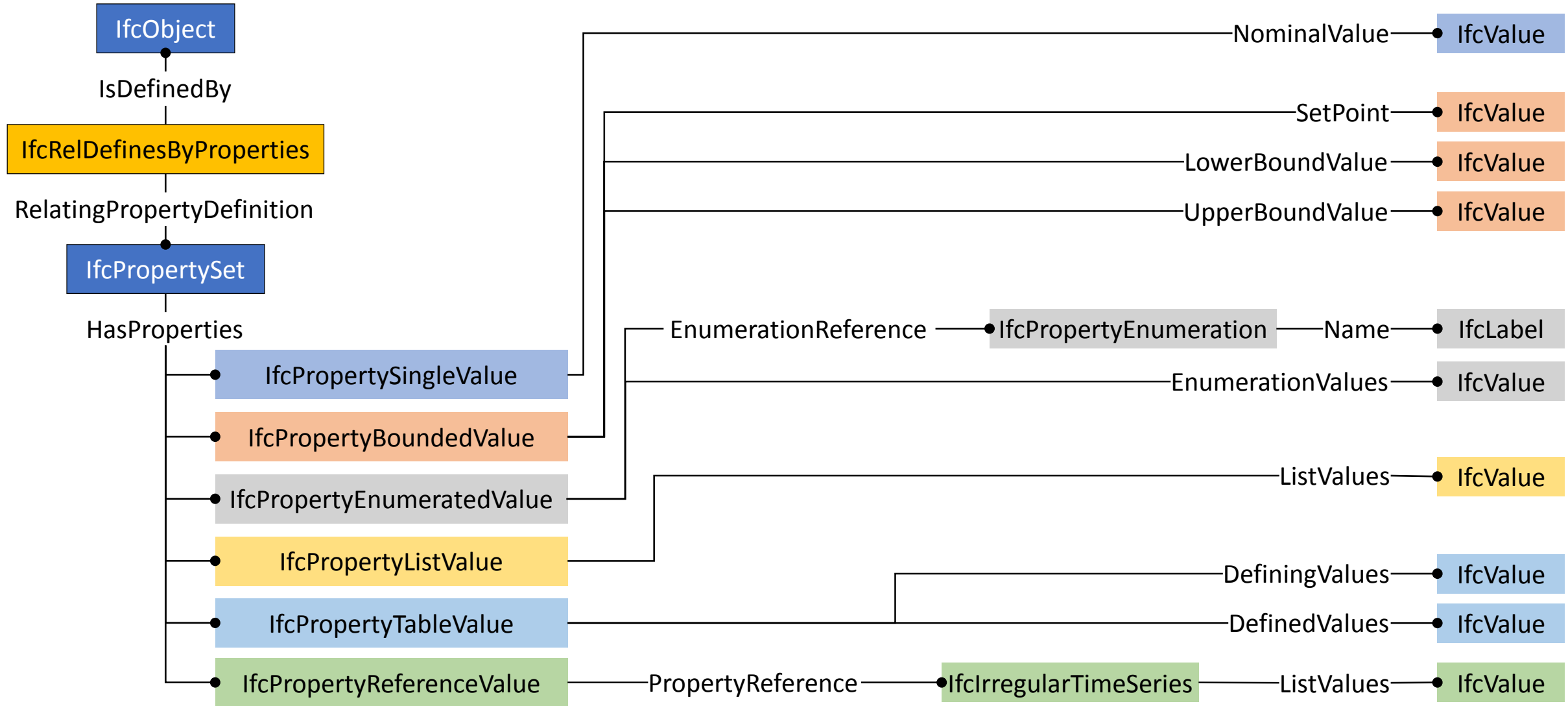
Consistent and Systematic
assessment of building
energy performance

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BIM GATHERING

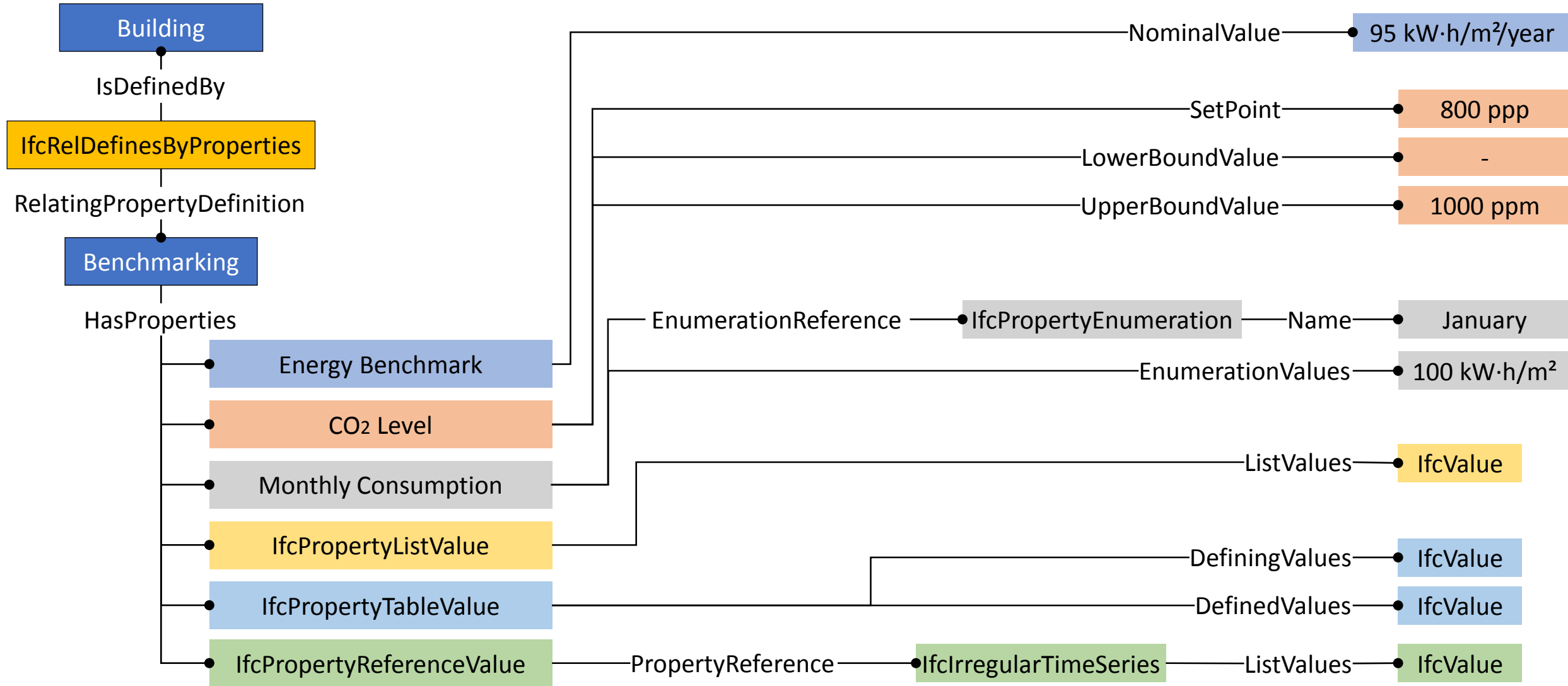


Demonstration

Property Sets for Objects describes how an object occurrence can be related to a single or multiple property sets



Property Sets for Objects describes how an object occurrence can be related to a single or multiple property sets





External Wall

Object	Type	Materials	Properties	Quantities
140 Block Insulated Cavity Plastered				
Brick	[#2314]			103
Air Space	[#2331]			50
Insulation - Plastic Hard	[#2347]			25
Concrete Block - Structural	[#2363]			100
Plaster - Gypsum	[#2364]			12

Object	Type	Materials	Properties	Quantities
Pset_WallCommon				
AcousticRating				25
ThermalTransmittance				1.182
LoadBearing				true
IsExternal				true
User_PerformanceBenchmarking				
Benchmarking				Building Regulations Part L
User_PerformanceTargeting				
TargetingMethod				Building Regulation Part L
Target				Thermal Transmittance
DrivingFactor				-
TargetValue				0.60

```
#2295= IFCWALLSTANDARDCASE('3SgmhkDaP9P8mflQoGJmlp',#12,'Ext.Wall',S,S,#2255,#2291,'DCAB0AEE-3646-4964-8C29-49AC904F04E');
#2299= IFCMATERIAL('Brick');
<
#415= IFCRELCONTAINEDINSPATIALSTRUCTURE('2SA7h_xKiYvnhrijSP2Gc8a',#12,S,S,(#399,#1850,#2103,#2152,#2295,#3136,#3262,#3359,#3372));
#2373= IFCREASSOCIATESMATERIAL('1Q5Im5zzWn_FngtvU3iOI8',#12,S,S,(#2295),#2372);
#2427= IFCRELVOIDSELEMENT('0ZFesg3Vt1vwwDSWGEt0nu',#12,S,S,#2295,#2422);
#2447= IFCRELDEFINESBYPROPERTIES('1GnuQ$rm76WZ1$GUIS0DK8',#12,S,S,(#2295),#2445);
#12= IFCOWNERHISTORY(#7,#11,S,.ADDED.,S,S,S,1500545572);
#2295= IFCWALLSTANDARDCASE('3SgmhkDaP9P8mflQoGJmlp',#12,'Ext.Wall',S,S,#2255,#2291,'DCAB0AEE-3646-4964-8C29-49AC904F04E');
#2445= IFCPROPERTYSET('3mHz7IQENiTkbeu6kVoVy_',#12,'User_PerformanceTargeting',S,(#2440,#2441,#2442,#2443,#2444));
#12= IFCOWNERHISTORY(#7,#11,S,.ADDED.,S,S,S,1500545572);
#2440= IFCPROPERTYSET('TargetingMethod',S,IFCLABEL('Building Regulation Part L'),S);
#2441= IFCPROPERTYSET('Target',S,IFCLABEL('Thermal Transmittance'),S);
#2442= IFCPROPERTYSET('DrivingFactor',S,IFCLABEL('-'),S);
#2443= IFCPROPERTYSET('TargetValue',S,IFCLABEL('0.60'),S);
#2444= IFCPROPERTYSET('Targeting',S,IFCLABEL('Building Regulation Part L'),S);
```



Conclusion & Future Work



- » The **widespread adoption** of BIM and the use of a comprehensive digital model is a step towards the **elimination of interoperability** issues.
- » It is of **paramount importance** that building managers are involved in the **earlier stages** of the BLC so they can **request the correct information** from all disciplines.
- » The proposed **IFC BIM-based framework** contributes to the **reduction of time, cost, and effort** associated with **gathering information** from different sources.



- » Completion of the MVD to include all the identified information.
- » Definition of the business rules and agreements necessary to assist the implementation of import and export functions by BIM applications.
- » Submission of an MVD proposal to buildingSMART for further review by the community as well as to extend the IFC scope to cover all relevant objects.

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Thank you

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