

A low-angle photograph of the Petronas Towers in Kuala Lumpur, Malaysia, showing their iconic twin towers and connecting skybridge against a cloudy sky.

IDM Building Information Modelling

Jeffrey Wix

Building Information Modeling ...

- ... is the creation and use of coordinated, consistent, computable information about a building project in design, in construction and in building operation and management.

coordinated

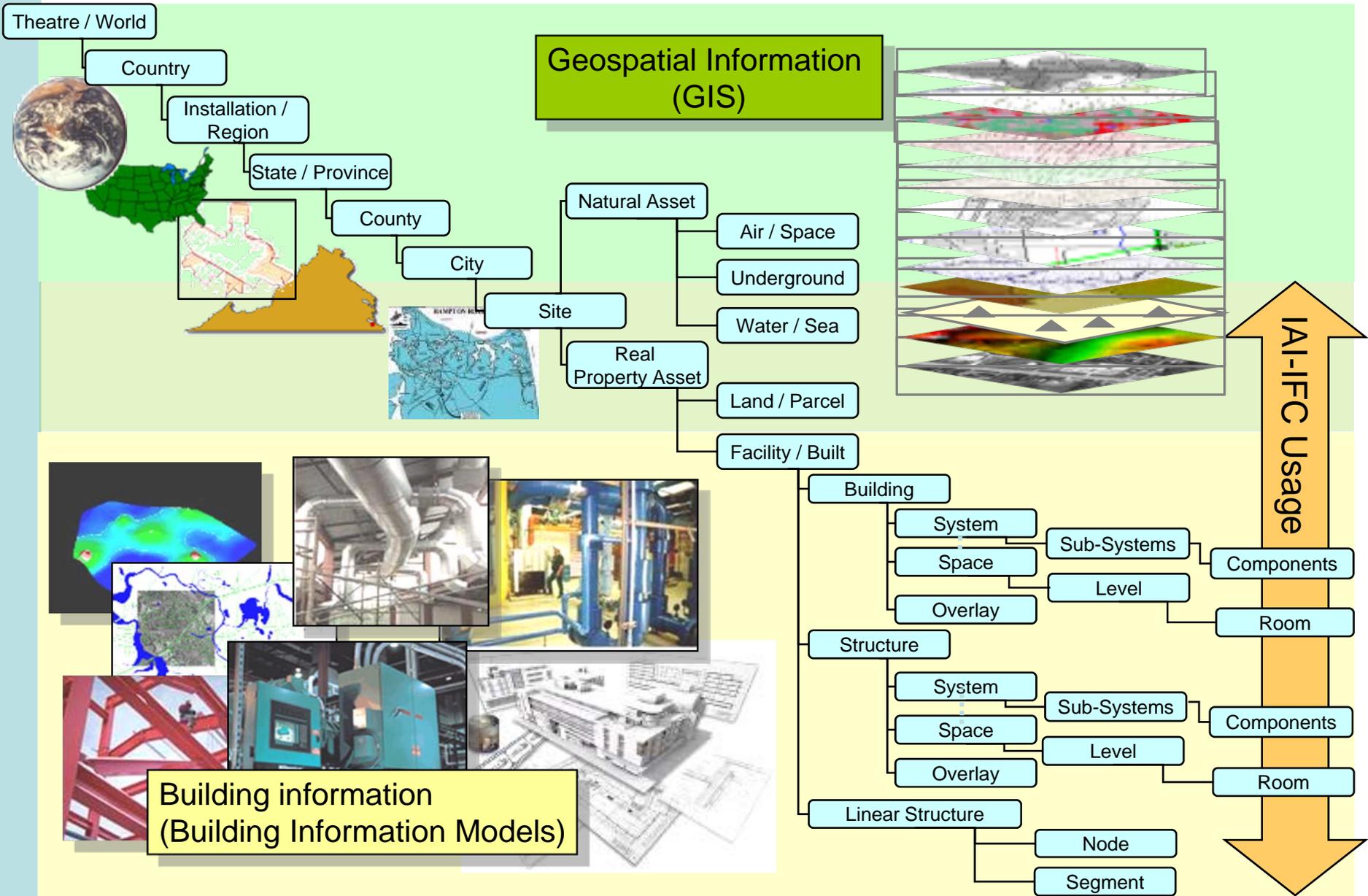
consistent

computable

information

adapted from - <http://usa.autodesk.com/adsk/servlet/item?siteID=123112&id=8127972>

Hierarchical Information Relationships



BIM software applications

- BIM software applications have been developed using ‘object oriented’ methods.
- An object represents an instance of ‘things’ used in building construction, that can include:
 - physical components (e.g. doors, windows, pipes, valves, beams, light fittings etc.),
 - spaces (including rooms, building storeys, buildings, sites and other external spaces),
 - processes undertaken during design, construction and operation/maintenance,
 - people and organizations involved,
 - relationships that exist between objects.

Object connections

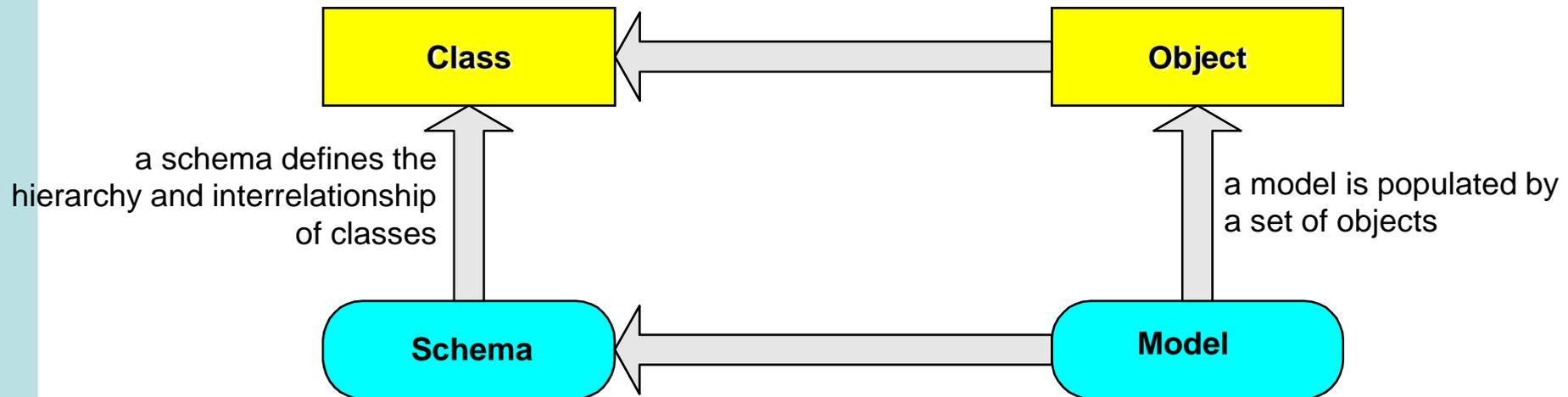
Templates

- attributes

Things

- values
- identity
- behaviour

an object is an occurrence of a pattern defined by a class



a schema defines the hierarchy and interrelationship of classes

a model is populated by a set of objects

a model is the set of information about a building according to the schema

Specifications

- templates needed
- relationships

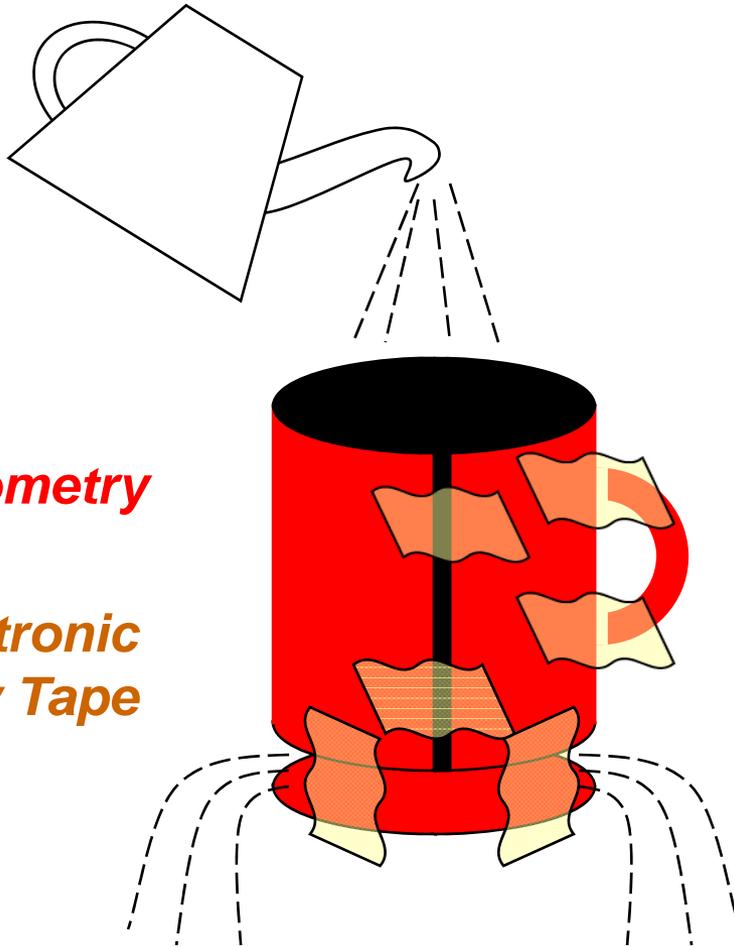
Designs

- population

Where did it come from?

- Before BIM, there was CAD
- CAD originally meant Computer Aided Drafting
 - i.e. drawing things but getting a computer to help
 - consistent line styles
 - consistent and easy to read text fonts
 - better cross hatching
 - faster printing
- CAD means Computer Aided Design
 - i.e. getting a computer to help with the design of something
 - 3d geometric models
 - surface colours and textures
 - link to visualisation systems

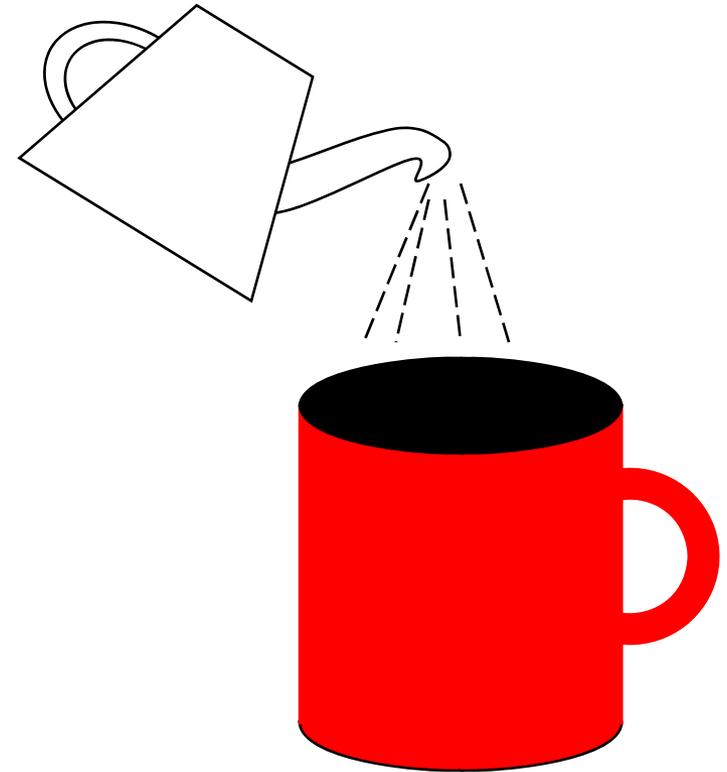
Blocks and Objects



Geometry

*Electronic
Sticky Tape*

Block: Doesn't hold water



Object: Holds water

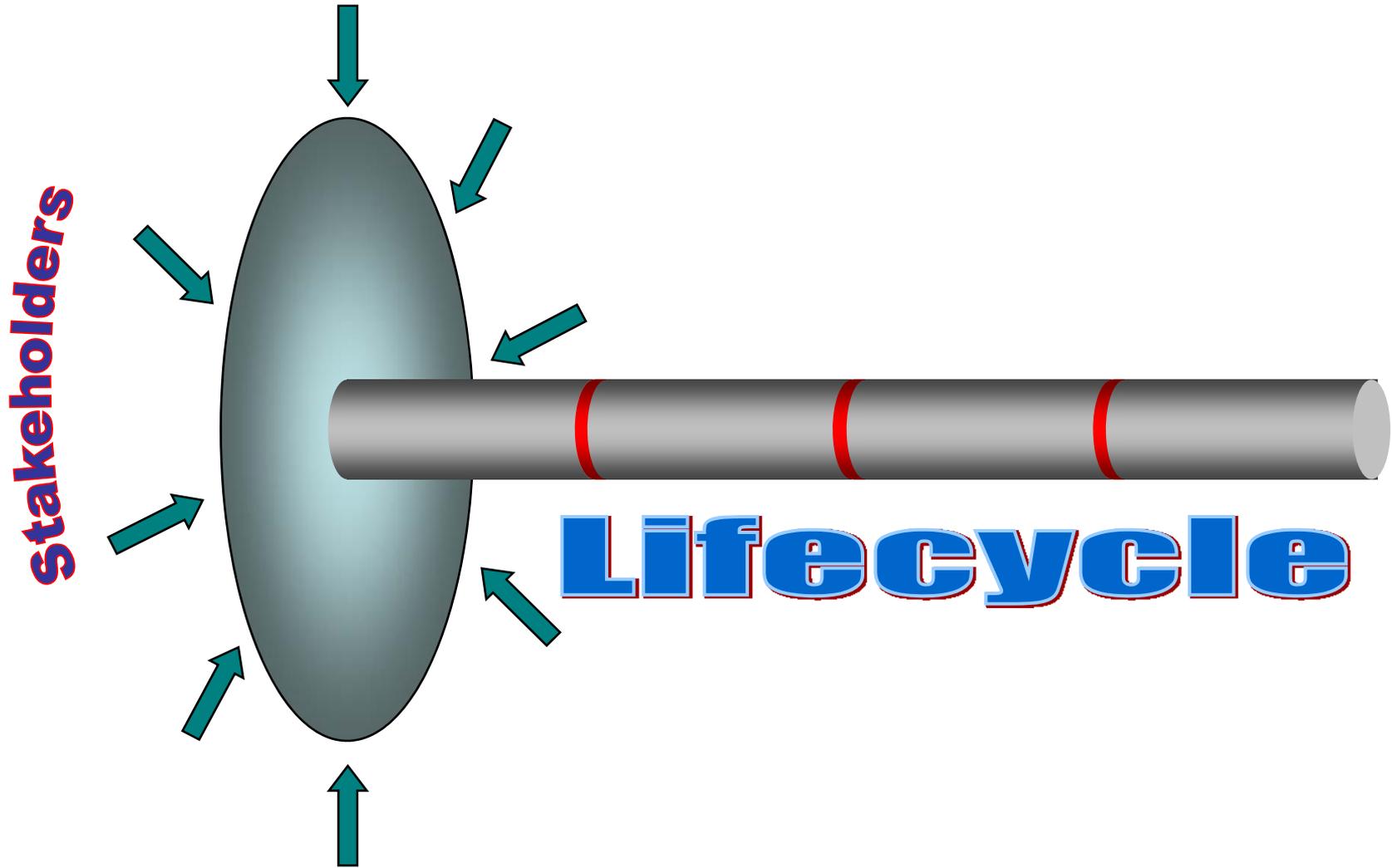
What does it means

- BIM means Building Information Modeling
 - Modelling the information about a building
 - All of the information, not just the shape
 - The process of creating a Building Information Model
- BIM also means Building Information Model
 - The result of the Building Information Modeling development process
- BIM provides a digital representation of physical and functional characteristics of a facility.

Collaboration

- A BIM serves as a **shared** knowledge resource for information about a facility forming a reliable basis for decisions through its life-cycle.
- A basic premise of BIM is **collaboration**
 - by different stakeholders
 - at different phases of the life cycle of a facility
 - to insert, extract, update or modify information in the BIM
 - to support and reflect the roles of that stakeholder.
- A BIM is a shared digital representation founded on **open standards for interoperability**.

Collaboration



Open standards

- When we say 'open standard', what does this mean?
- First, it means sharing using the IFC *standard*
 - The full 'de facto' standard is available through the International Alliance for Interoperability (IAI) (www.iai-international.org)
 - The core of IFC is defined as ISO/PAS16739
 - IAI are committed to making ISO 16739 a full standard
- But, it can also mean (from the IDM viewpoint)
 - gbXML
 - CityGML
 - landXML
 - CIMsteel
 - ...

?? DGN
?? DWF
?? DWG

What BIM is not ...

- A 3D model alone does not give you a BIM
 - There is no added intelligence to give you any “data” about the project
 - the person using the model must interpret the geometry to determine what it *‘represents’*
- A BIM does not have to use 3D shape representation
 - It is the information that matters, not the representation
 - A 2D shape representation can also be used with a BIM
- BIM is not a single application
 - A building information model is typically the result of many applications working together

(Mis)understanding BIM, Nigel Davies, http://www.eatyourcad.com/article.php?incat_id=1494

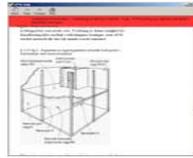
Types of BIM application

- It's not just about 'geometric' software applications
 - Applications like Autodesk Architecture, Revit, ArchiCAD, Microstation etc. describe themselves now as BIM applications
- BIM applications can also be 'downstream'
 - Requirements
 - Code checking, health and safety, specifications ...
 - Engineering design, analysis, modeling and simulation
 - Structural, HVAC, piping, electrical, energy, acoustics, lighting ...
 - Sustainability
 - Service life, environmental impact, whole life costing ...
 - Construction planning and management
 - Estimating, planning, managing, accounting, QA, risk ...
 - Operations and maintenance
 - Asset management, work orders, condition assessment, helpdesk ...
 - Dismantling, demolition and disposal

BIM Applications

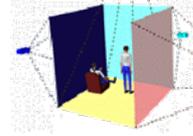
Laws and regulations

- Building regulations
- Building specifications

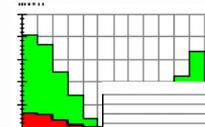


CAD software

- Drawings, calculations
- Architect, engineer,...



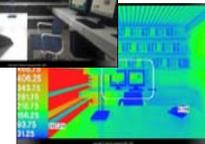
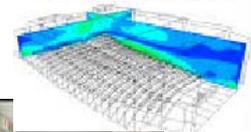
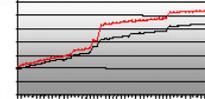
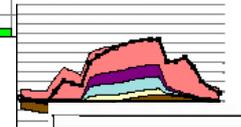
VRMI



, 3D models

Simulations

- Comfort
- Ventilation, heat
- Life cycle cost
- Light, sound
- Insulation
- Fire, usage
- Environment
- Life time prediction



Knowledge databases

- Best practise knowledge
- Own practice



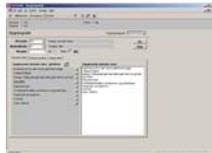
Briefing

- Functional req.
- Estimates
- Conditions
- Requirements



Demolition, refurbishment

- Rebuild
- Demolition
- Restoration



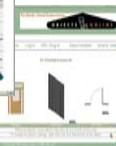
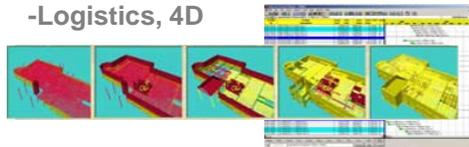
Facility management

- Letting, sale, operations
- Maintenance
- Guaranties



Construction management

- Scheduling
- Logistics, 4D



Specifications

- Specification sheets
- Classification standards
- Estimates, accounting

Procurement

- Product databases
- Price databases

Good practice

- BIM software applications allow users to continue to use good practices from existing CAD use.
- Conventions that are equally relevant to BIM as to CAD:
 - file naming
 - layer naming
 - presentation styles
 - Annotation
 - Linework

Using BIM

- Methods of working that can be tolerated in CAD are not acceptable in BIM
 - **WHY?**
 - Human beings can interpret the geometry in CAD as real world objects. In BIM, computers cannot manage such interpretation.
- Building Information Modelling is an assembly process and not a drawing process
 - Simulates the real world
 - Need for comprehensive object libraries
- Accuracy is critical
 - Downstream applications must be able to rely on the accuracy of work in upstream applications
 - ***This is the fundamental reason for IDM***

Consequences and Challenges

- Information only need to be entered once
 - not 7 times .. which is today's average)
- Consequences can be tested when information is changed
 - checking or calculation
- Structure and type of information can be captured in open standard formats (like IFC)
- Potentially more efficient processes with higher quality
- Freedom to use specialist software on various “vendor platforms” when needed in projects
- Focus on machine readable information
- Low friction information flow through the building lifecycle
- Cost savings can be documented as massive !

Examples

Air systems for evacuation of buildings

Project Tree (Left Panel):

- Supply air-diffusor circular w. re
- 16 Room Vol=0.0 m³ Calc F=0.0 m³/h Sum
- 17 Room Vol=0.0 m³ Calc F=0.0 m³/h Sum
- 18 Room Vol=0.0 m³ Calc F=0.0 m³/h Sum
- 20 Room Vol=0.0 m³ Calc F=0.0 m³/h Sum
- Supply air-diffusor circular w. re
- Supply air-diffusor circular w. re
- 21 Room Vol=0.0 m³ Calc F=0.0 m³/h Sum
- 22 Room Vol=0.0 m³ Calc F=0.0 m³/h Sum
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- Supply air-diffusor circular w. re
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- 34 Room Vol=0.0 m³ Calc F=0.0 m³/h Sum
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- Supply air-diffusor circular w. re
- 46 Room Vol=0.0 m³ Calc F=0.0 m³/h Sum
- Supply air-diffusor circular w. re
- 47 Room Vol=0.0 m³ Calc F=0.0 m³/h Sum
- Supply air-diffusor circular w. re
- 48 Room Vol=0.0 m³ Calc F=0.0 m³/h Sum
- 49 Room Vol=0.0 m³ Calc F=0.0 m³/h Sum
- Supply air-diffusor circular w. re
- 50 Room Vol=0.0 m³ Calc F=0.0 m³/h Sum

Air Terminal Dialog Box:

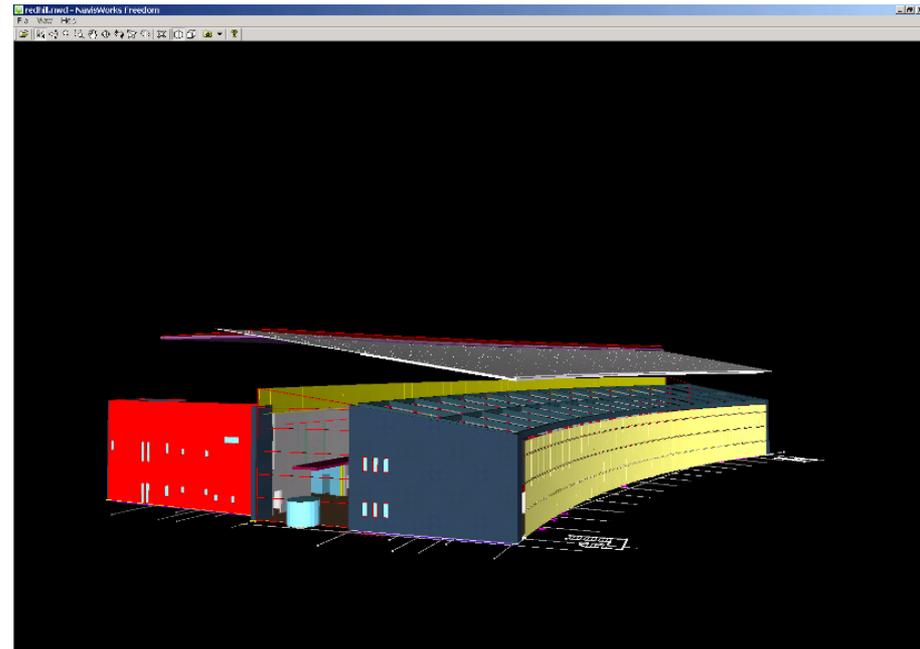
Calculation data	Zeta calculator
Position: 1	Air flow: 180.00 m ³ /h
<input checked="" type="checkbox"/> Automatically regulate	Air flow: 50.00 l/s
Air flow: 180.00 m ³ /h	Velocity: 1.59 m/s
Velocity: 1.59 m/s	Width/Radius: 200 mm
Pa loss: 6 Pa	Height: 0 mm
Zeta: 3.89 Z	Pa loss: 6 Pa
	Zeta: 3.89 Z

Damper Dialog Box:

Calculation data	Zeta calculator
Position: 1	Air flow: 1620.00 m ³ /h
<input checked="" type="checkbox"/> Automatically regulate	Air flow: 450.00 l/s
Air flow: 1620.00 m ³ /h	Velocity: 3.00 m/s
Velocity: 3.00 m/s	Width/Radius: 500 mm
Pa loss: 1 Pa	Height: 300 mm
Zeta: 0.17 Z	Pa loss: 1 Pa
	Zeta: 0.17 Z

Environmental assessment

- Environmental impact of building proposals
- Applies the BRE EcoPoints methodology
- Assessment of Whole Life Costing
- Using an IFC database to hold:
 - proposed designs
 - library of construction properties.
 - library of material properties.
- Allows designers to:
 - assess their buildings
 - modify the materials selected.



Material File Library

© Jeffrey Wix Consulting Ltd 2004/06/17 N.Nisbet

Introduction

Material File

Content	
Introduction	
Identification of Project	
Table of Constructions	
Table of Materials	

Delivered as part of the Avanti / Atkins / IAI UK IFC model-based WLC, Sustainability and Cost Appraisal project from a query on an IAI IFC2X_FINAL model held on EPM Jotne Express Data Manager 4.5.033.

Partners

Links	
Atkins Plc	
International Alliance for Interoperability - UK Chapter	
Epm Jotne AS, Norway	
Jeffrey Wix Consulting Ltd	

Identification of Project

Name	Description
Library	Atkins Library of Constructions and Materials

Table of Constructions

Table for Construction: Approved Wall Type 1 A: Solid Plastered Brick

Construction: Approved Wall Type 1 A: Solid Plastered Brick		Value
Approved Wall Type 1 A: Solid Plastered Brick		241.0mm
Plaster		13.0mm
Brick		215.0mm
Plaster		13.0mm

Table for Construction: Approved Wall Type 1 B: Solid Plastered Block

Construction: Approved Wall Type 1 B: Solid Plastered Block		Value
Approved Wall Type 1 B: Solid Plastered Block		241.0mm
Plaster		13.0mm



The new hospital

116.000 m2 new building
 565 beds
 22 operating theatres

Start excavations 1. mars 2004
 Construction finished December 2007
 Full operation October 2008

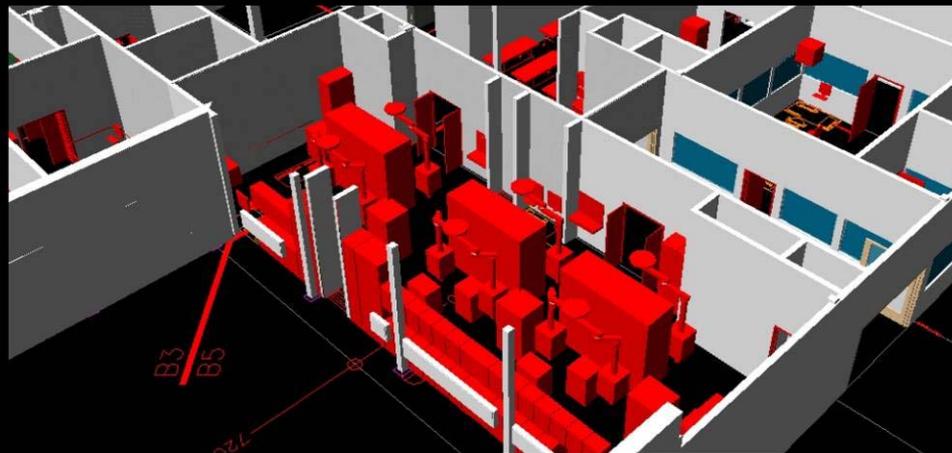
20.000 m2 renovation of existing buildings.

Finished 2011/2012

Budget NOK 7 billions

The primary item is object/model oriented planning, not 3D Building Information Model (BIM)

Walls, curtain walls, windows, window assemblies, doors, furniture, fixture, equipment
 Also slabs and columns as the structural engineer doesn't supply it



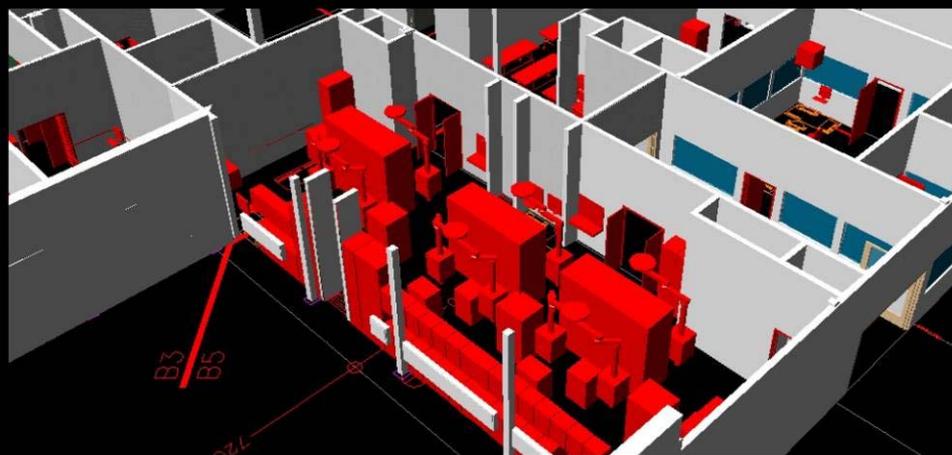
Example of model contents

New Ahus

Akershus Hospital (Oslo, Norway)

Object libraries

Building elements, furniture, fixture, equipment
 3D object with real height, volumes and to some degree photo quality
 Objects contains information about object type, dimensions, materials, producer etc.



Example of model contents

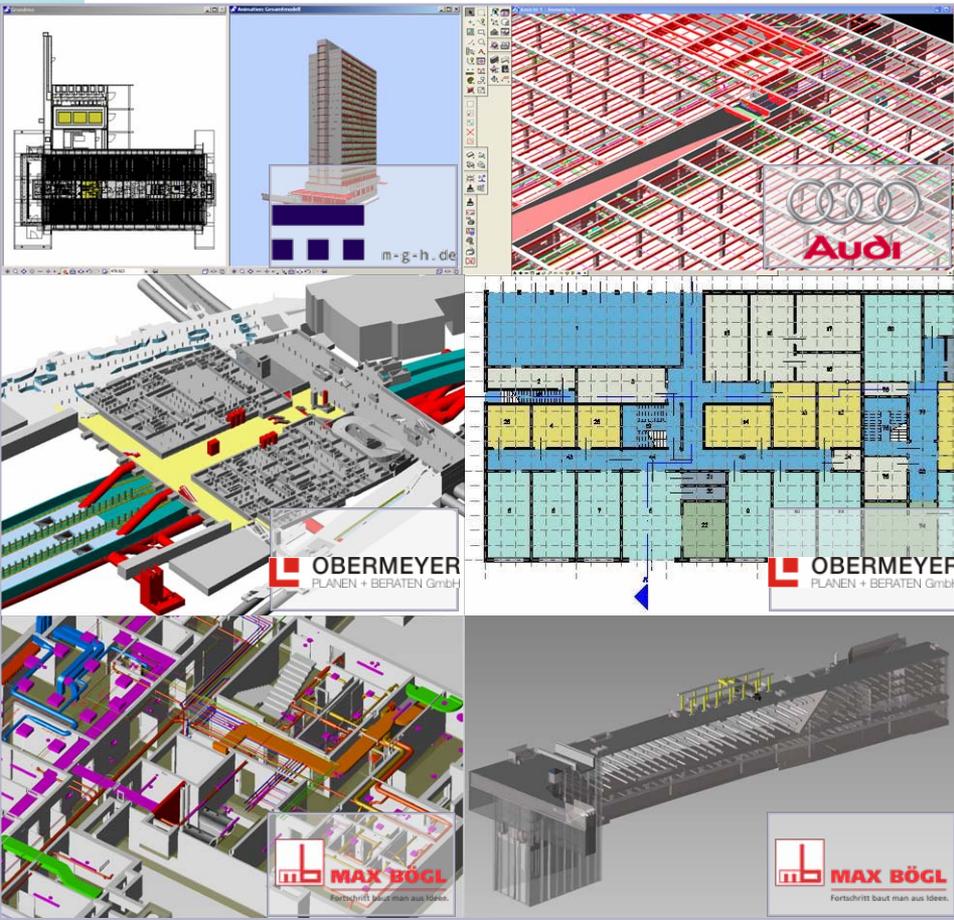
New Ahus

Webcam at 05.09.2006 17:49:00

<http://nyeahuswebcam.netpoweresolutions.no/showplace.asp>



Application in Practice

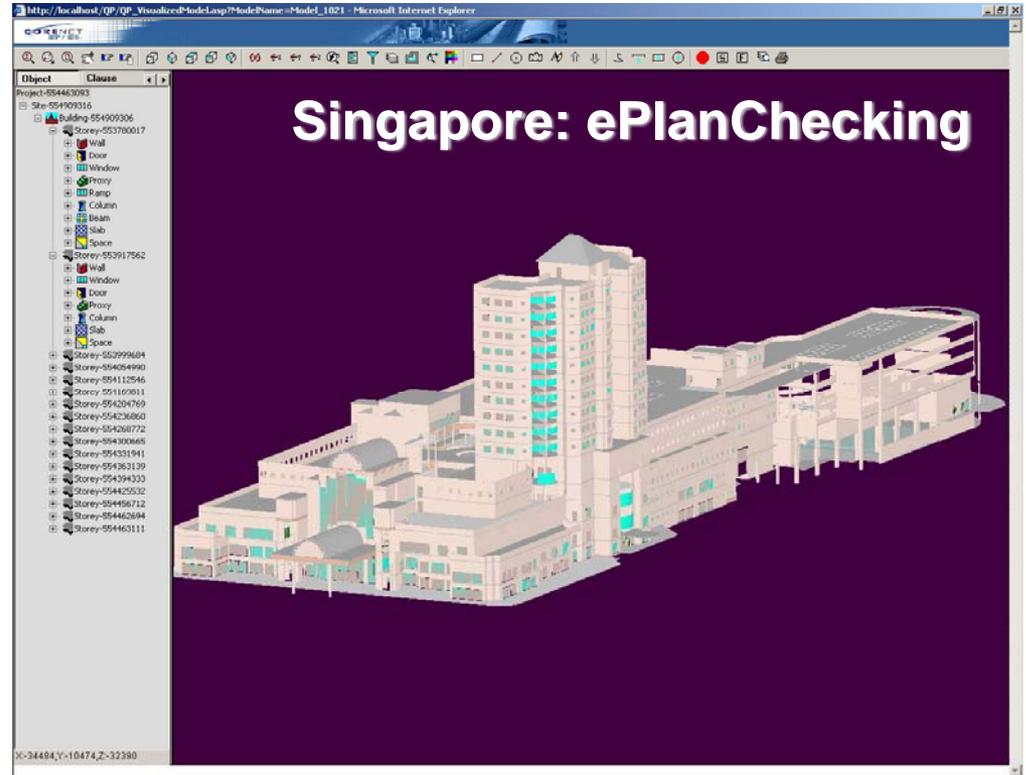
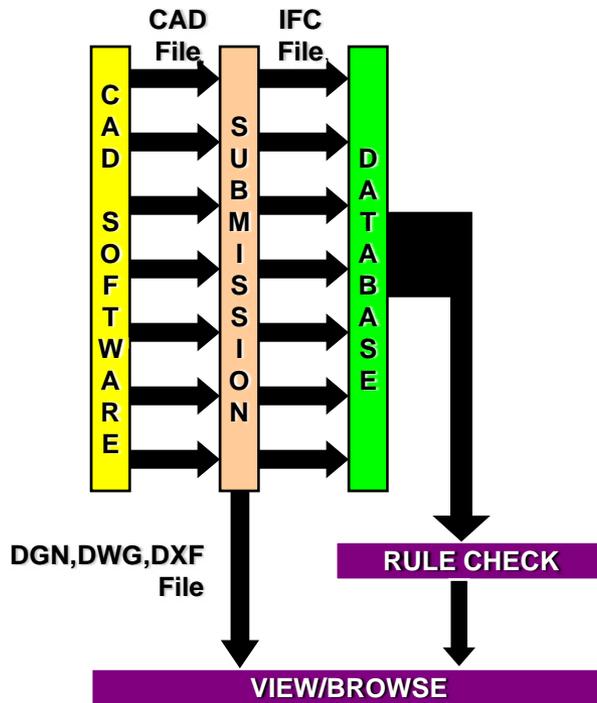


Real projects using 3D BIM and IFC

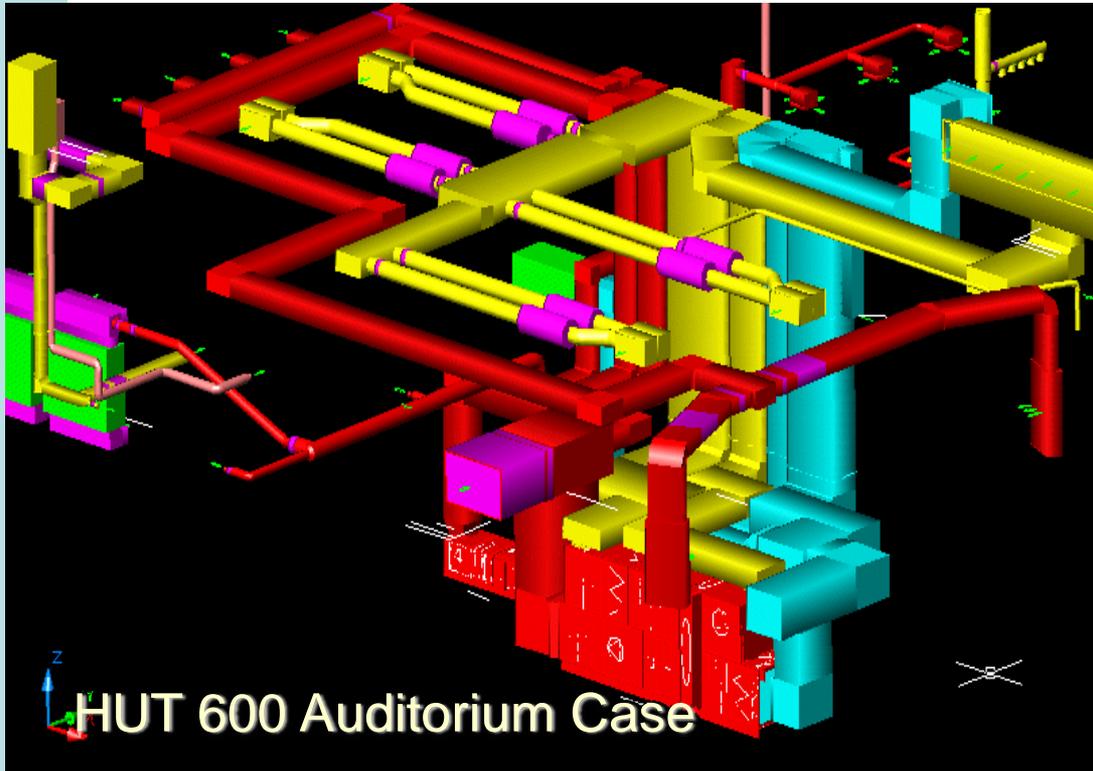
- Reconstruction- Office Bldg
- Construction- Factory
- Design- Central Train Station
- Design- Airport
- Construction - Airport
- Construction - Station
- ...



Regulations



- Automatic building regulation checking proved in Singapore
- Applied for planning regulations in Norway



- Designed by Alvar Aalto
- Senate Properties used this project to set benchmarks for IFC based collaboration.
- Benefits they recorded were
 - shorter design iteration
 - truly reliable budget
 - visualisation fostered early communication amongst the project team

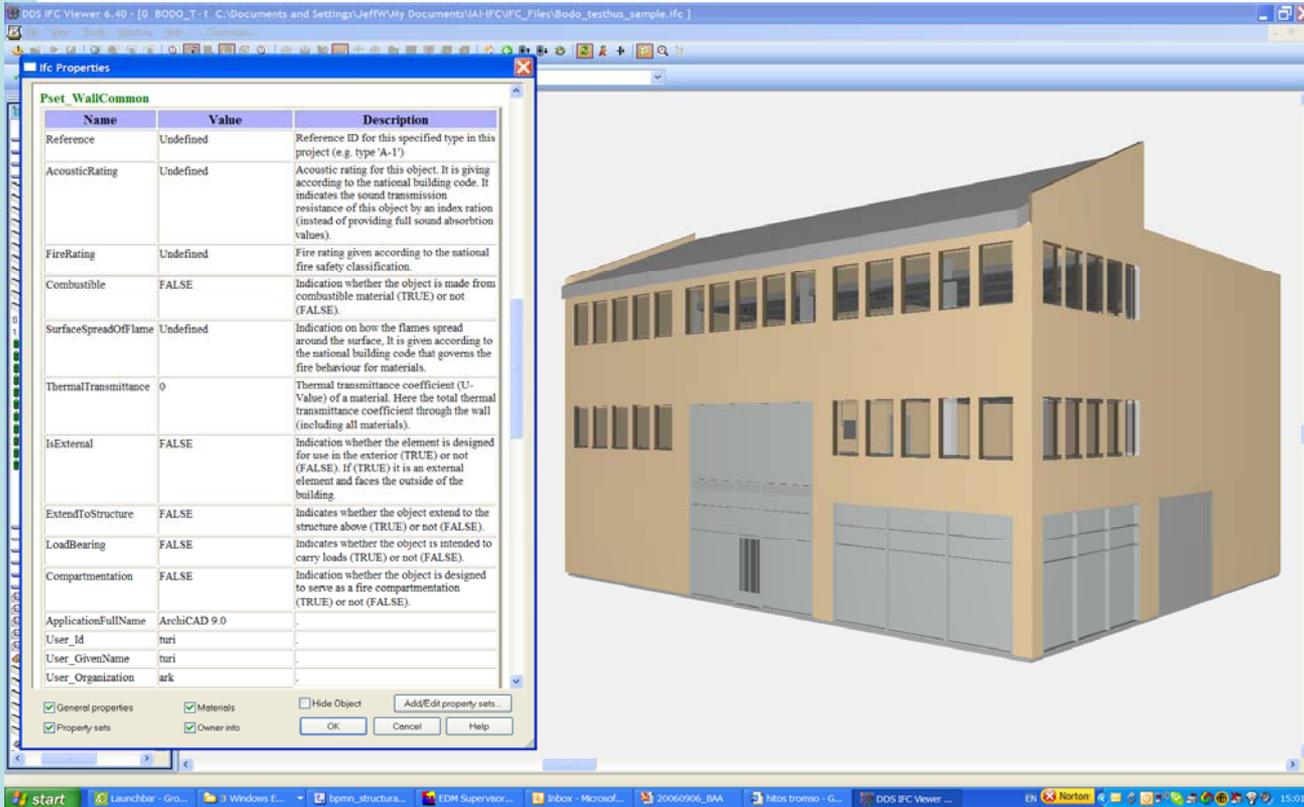
General Services Administration



Using buildingSMART information
to validate correctness of BIM development

- From FY2006, design information must be buildingSMART format.
- By 2008 requirement will start to have an effect on actual buildings.
- Around 2011, the use of buildingSMART will come more fully into operation.
- Initial GSA view of 'Spaces' now

Tromso College



- Tertiary college in North Norway
- Whole building design using buildingSMART principles
- Using documented processes
- Design process being monitored