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Invited Professional Development Seminar - BIM - a Tool to Optimize Building Construction

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**Centre for Computer-assisted Construction
Technology**

BIM – A Tool to Optimize Building Construction

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15 March 2011



National Research
Council Canada

Conseil national
de recherches Canada

Canada

National Research Council

- National organization, federal government agency
- Over 4,200 full-time employees; over 1,446 guest workers
- Labs and facilities across Canada
- Dissemination of S&T information to industry and scientific community
- Provides essential elements of national S&T infrastructure



Institute for Research in Construction

The NRC Centre for Computer-assisted Construction Technologies



Part of NRC Institute for Research in Construction

Research and development driven by four issues in construction industry:

- the need to improve productivity
- growing complexity of built environments
- sustainable development
- changing workforce demographics

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NRC-CCCT

Increasing **productivity** of the construction life-cycle through **applied technology**

- **Computational** tools to aid design, implementation & management of built resources
- **Decision support** tools
- **Digital knowledge** & information management
- Tools and practices to improve the **efficiency** of the construction supply-chain

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Presentation Outline

What is BIM?

- Why care?
- Intent or promise
- Definition
- Game Changer

BIM @ work

- In use
- Organisations
- Standards

Relevance to Wood

- Products & Systems
- BIM Capabilities
 - Near-term
 - Longer-term

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What is BIM?

Why care?

BIM Intent or Promise

Defining BIM

Game Changer

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Why Care? Lost Money



2004 NIST report

(Cost Analysis of Inadequate Interoperability in the U.S. Capital Facilities Industry)

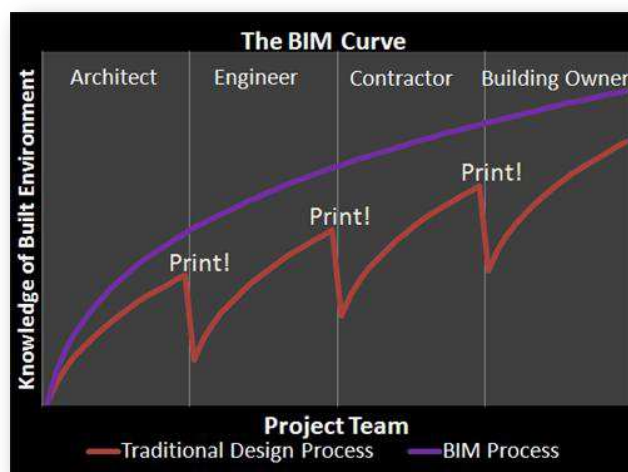
- \$15.8B/y lost due to poor interoperability
 - 1-2% industry's revenue
- 2/3 during operations and maintenance phase

<http://www.bfrl.nist.gov/oa/publications/gcrs/04867.pdf>

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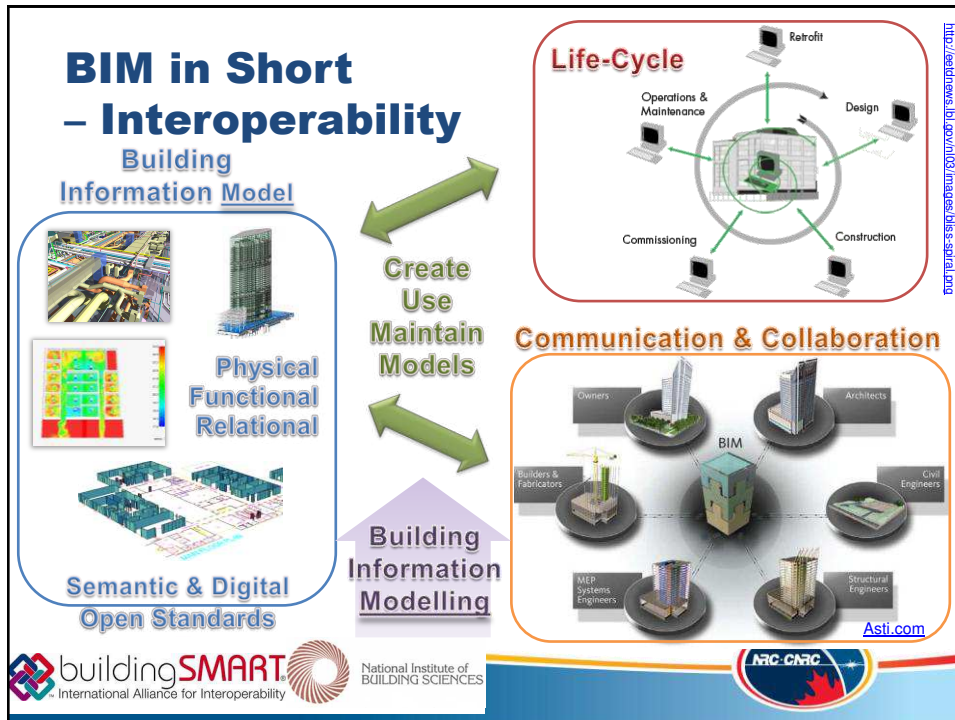
The Promise: Interoperability

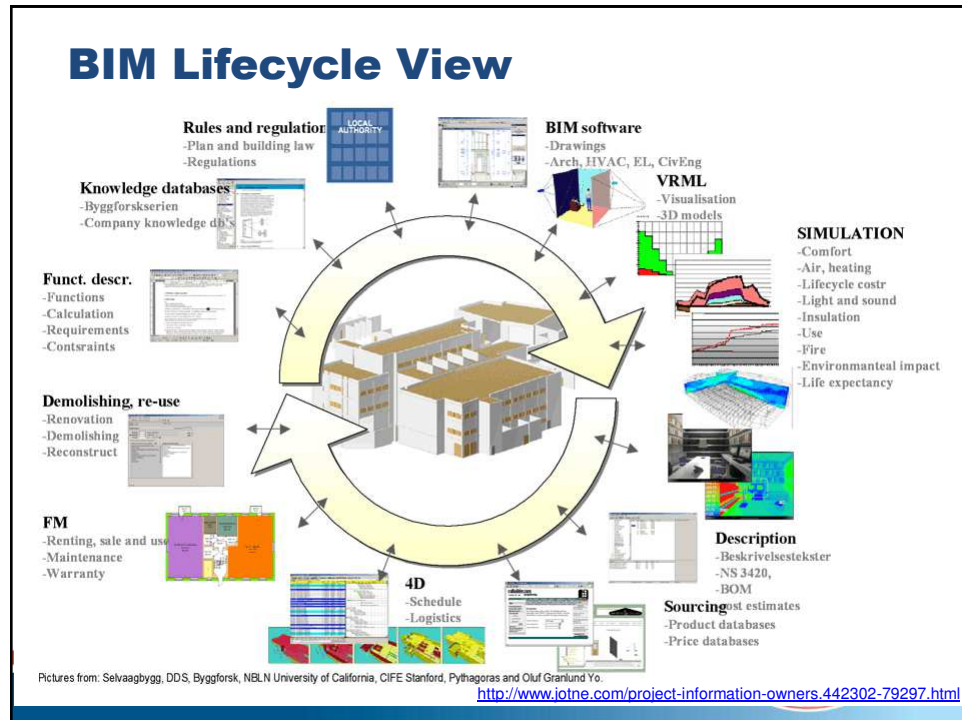


http://inside-the-system.typepad.com/my_weblog/bim_discussions/

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CAD vs. BIM

- | | |
|---|--|
| <ul style="list-style-type: none"> • 2D or 3D • Lines • Layers if done properly • Robust exchange standards • No standard way of adding contextual | <ul style="list-style-type: none"> • 3D or more • Physical & functional elements • Well-defined collection of facility data • Machine interpretable • Traceability, ownership 4D – Time 5D – Cost |
|---|--|

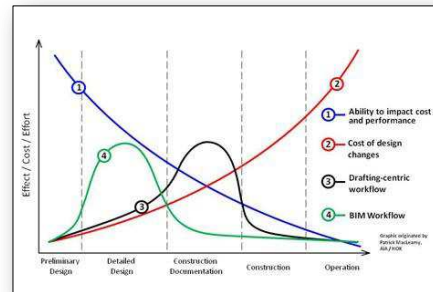
Potential for Game Changer

- Full/Better solutions up-front
 - Mutual understanding, consensus
 - multi-disciplinary approaches



- Avoid late changes
 - Miss-understandings
 - Unforeseen consequences
 - Less errors/clashes
- Correct materials/tools/people at correct time,
- Offsite work, prefab assemblies

Communication Collaboration Coordination



http://www.cenews.com/magazine-article-cenews.com-october-2008-what_does_bim_mean_for_civil_engineers_-6098.html

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BIM @ Work

BIM In Use
Organisations Backing/Using BIM
Standards

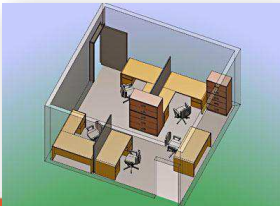
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Design Visualisation

- Architects
- Industrial Designers
- Functional Analysis
- Real Estate
- Commercial Property Managers
- Interior Decorators

http://discount.bineadefurniture.com/2010_07_01_archive.html



<http://my.opera.com/kientucvn/album/s/homepic.dn?album=24012&picture=973862>

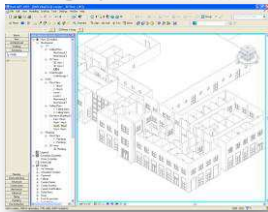


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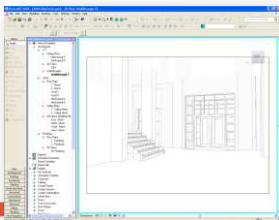
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Facility Appearance - Visualisation

Geographical Rendering and Neighbourhood Impact



Interior Rendering and Walk through



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Walkthrough Example



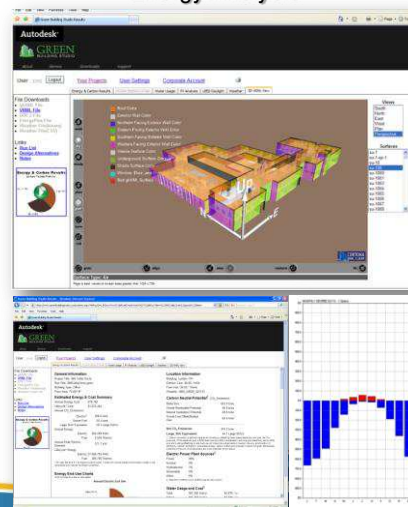
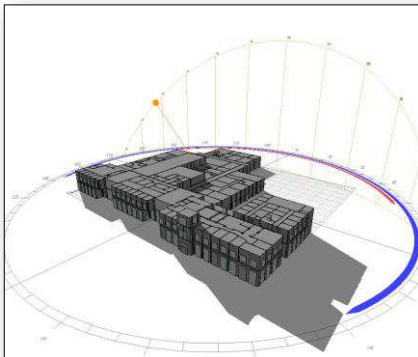
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Engineer – Architect Collaboration - Green/LEED/Sustainable

Energy Analysis

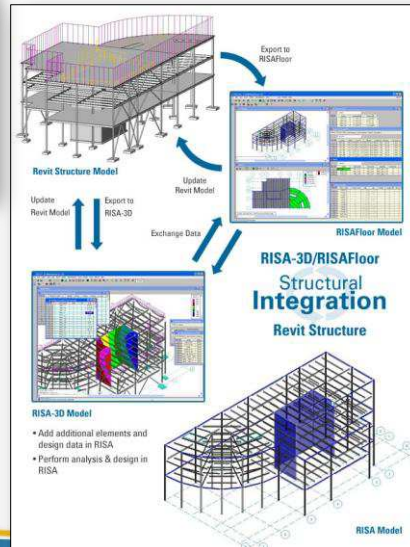
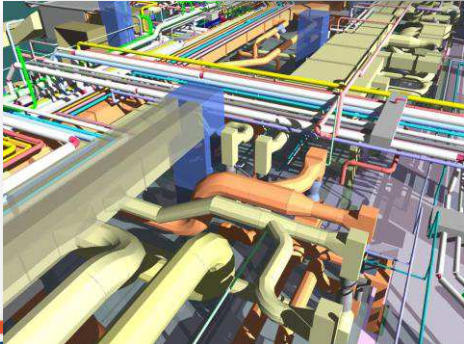
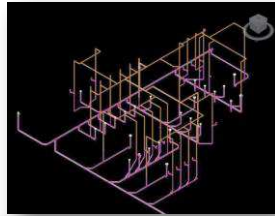
Orientation Optimization



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Engineering - Systems & Structure

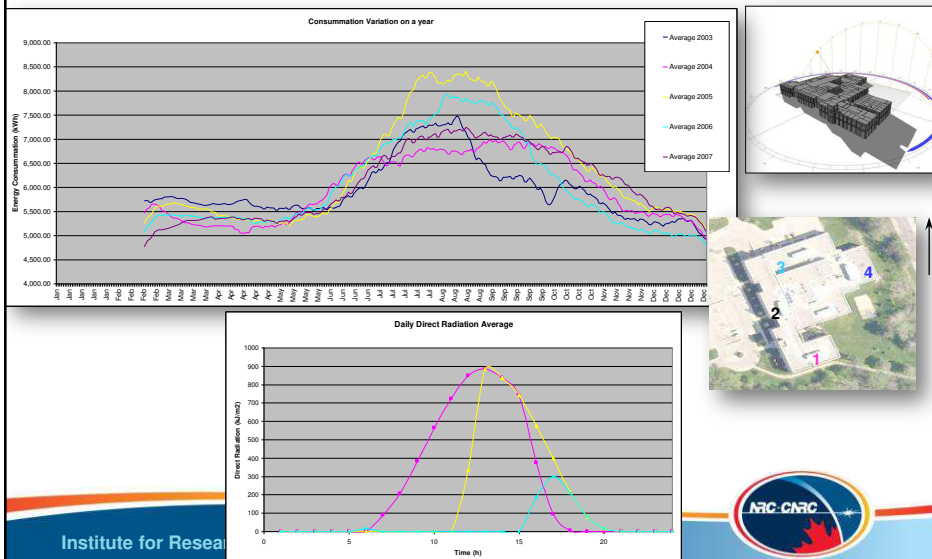
http://www.pnengineer.com/Articles/Cover_Story/2009/02/01/The-Benefits-of-BIM-in-Plumbing-Design



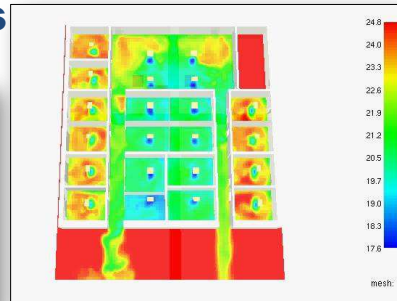
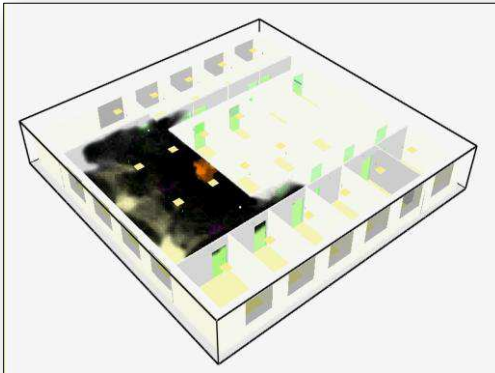
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Facility Performance – Owners/Ops

Energy analysis, comfort, controls automation



Analysis Simulations



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General Contractors – VDC

- Constructability – clashes before workers onsite
- Scheduling – planning, slippage
- Reduce # and \$ of RFIs – models vs. drawings
- Bid – 3D-4D visualization of process
- Lower uncertainty → reduced contingency
- Coordination meetings / Progress tracking
- Materials / Supplies
- Off-site fabrication – ease yard management

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Bottom Line

– GC

Partial VDC project vs. Benchmark projects

- 50% RFIs
- Per-RFI cost 1/5th
- Over-runs costs 1/15th typical
- Project completed months ahead schedule
 - Benchmarks months delayed

<http://www.tpm.com/component/content/article/1-latest-news/513-how-bim-is-being-utilized-by-general-contractors-and-its-benefits-a-general-contractor>

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Bottom Line

– Owner

Tendency to:

- Better understand what they are buying
 - Improved upfront design
 - Less requests for changes
- Get better quality
 - built as-planned
 - less problems/ad-hoc solutions/products
- Future
 - Property and Facility Management

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Early Canadian Industry Adopters

EllisDon
HIP Architects
RCNA
Stantec
Halsall Associates
PCL Construction
PFLA Inc
DOWCO Group

... more



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Organisations

American Institute of Architects
Associated General Contractors
General Services Administration
The FIATECH Consortium
Construction Specifications Institute
Canada/US Green Building Council
Canadian Construction Assoc.
Canada BIM Council
Steel Construction Institute
Institute for BIM in Canada



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Regional Adoptions

Scandinavia: Finland, Norway, Denmark

Australia

Singapore

US: GSA, universities, army, NASA

Canada: Alberta, BC, Montreal?

Western European Practitioners: 36% (2010)

USA Practitioners: 48% (2010)

http://images.autodesk.com/adsk/files/business_value_of_bim_in_europe_2010_final_new.pdf

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Interoperability at a glance – IFC

IFC: Industry Foundation Classes (.ifc)

- Objects: spaces, basic building elements, ...
- Certification program
- Model View Definitions – legal subsets of data

Two common IFC2x3 model views:

- Coordination View – design & construction
- Basic FM Hand Over – construction & operator
 - COBie: Construction Operations Building information exchange
 - Spreadsheet based – contractor/supplier editable

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Interoperability CIS/2.1 & gbXML

CIS/2.1: CIMsteel Integration Standards Release 2

- Steel Construction Institute
- Structural steelwork industry
- Detailing, analysis, fabrication, ...



gbXML: green building XML

- Mostly for energy and comfort modelling packages
- Chunks facility into contiguous spaces
- Equipment



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BIM Relevance to Wood



Products and Systems

BIM Capabilities

Near-term

Longer-term

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BIM Capabilities – Near-Term

- Design tools – [Revit](#) (Framing Tool),
- Design and Analysis tools:
 - [Tekla](#) & [Risa](#)
- Parametric **libraries** of wood & composite products → **supply chain**
- Limited code checking or **requirements assessment**
- Link to Fabrication ([Cadwork](#))
 - Still manual CAD and not BIM – joins, cuts, machining



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BIM Capabilities – Far-Term

- **Link to Analysis**
 - Improved Structural
 - Fire (NIST – FDS) Geometry and common properties
 - Acoustic (not soon) – digital guides
- **Design to Fabrication** (need CIS/2 for Wood)
 - **Automation** – First in CAD, later BIM?
 - **Standards** for Stakeholders
 - Analysis, Process, Materials, Parts, Assembly
 - Designer, Engineer, Supplier, Manufacturer, Installer

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Key Points

BIM Interoperability

- Exchange and collaborate with partners
- Avoid re-entry
- Game changer

Significant Penetration

- Design
- Construction
- Analysis – Code, Lighting, Water, Energy, Basic Structure

Future for Wood

- Analysis – Structure, Fire, ...
- Design to Fabrication

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