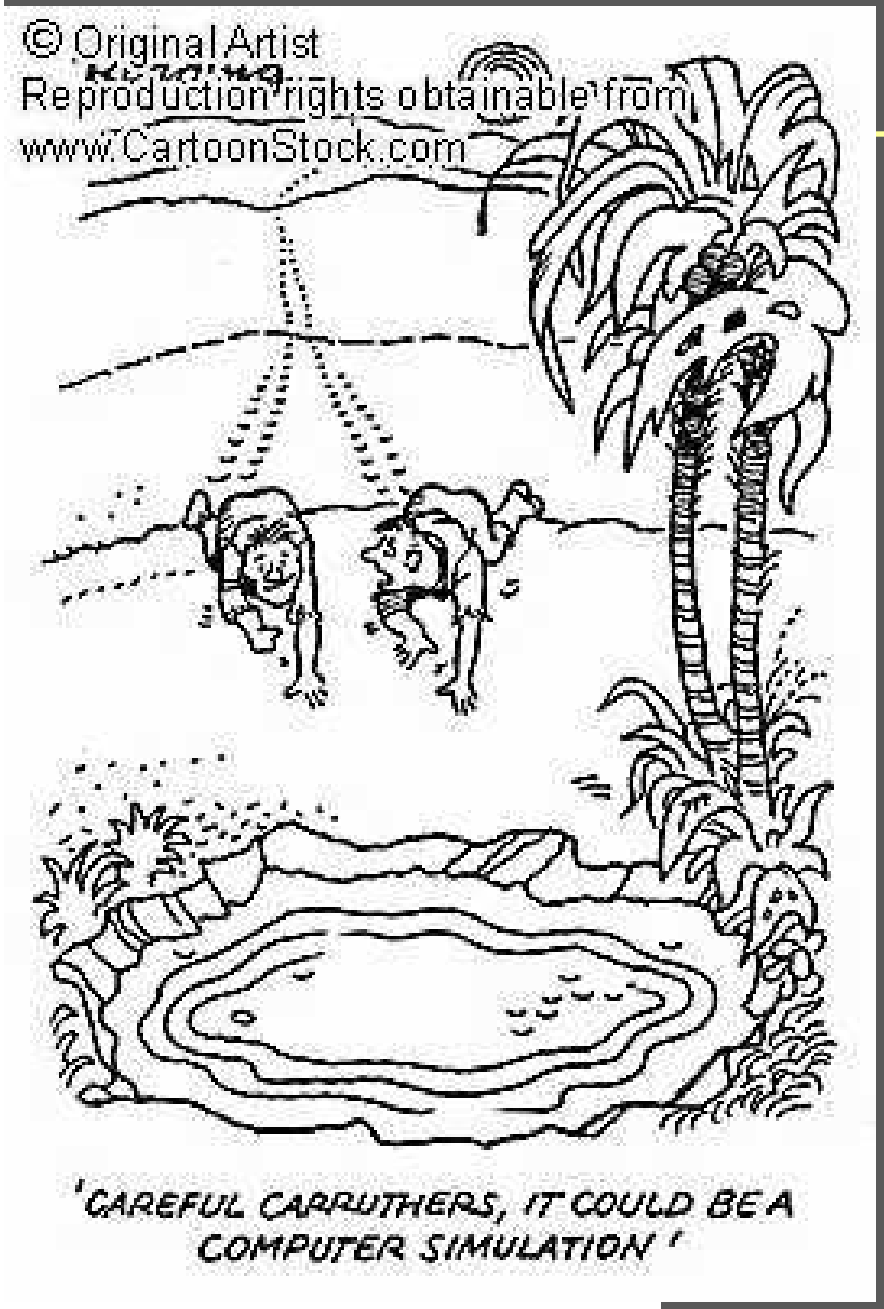
© Original Artist
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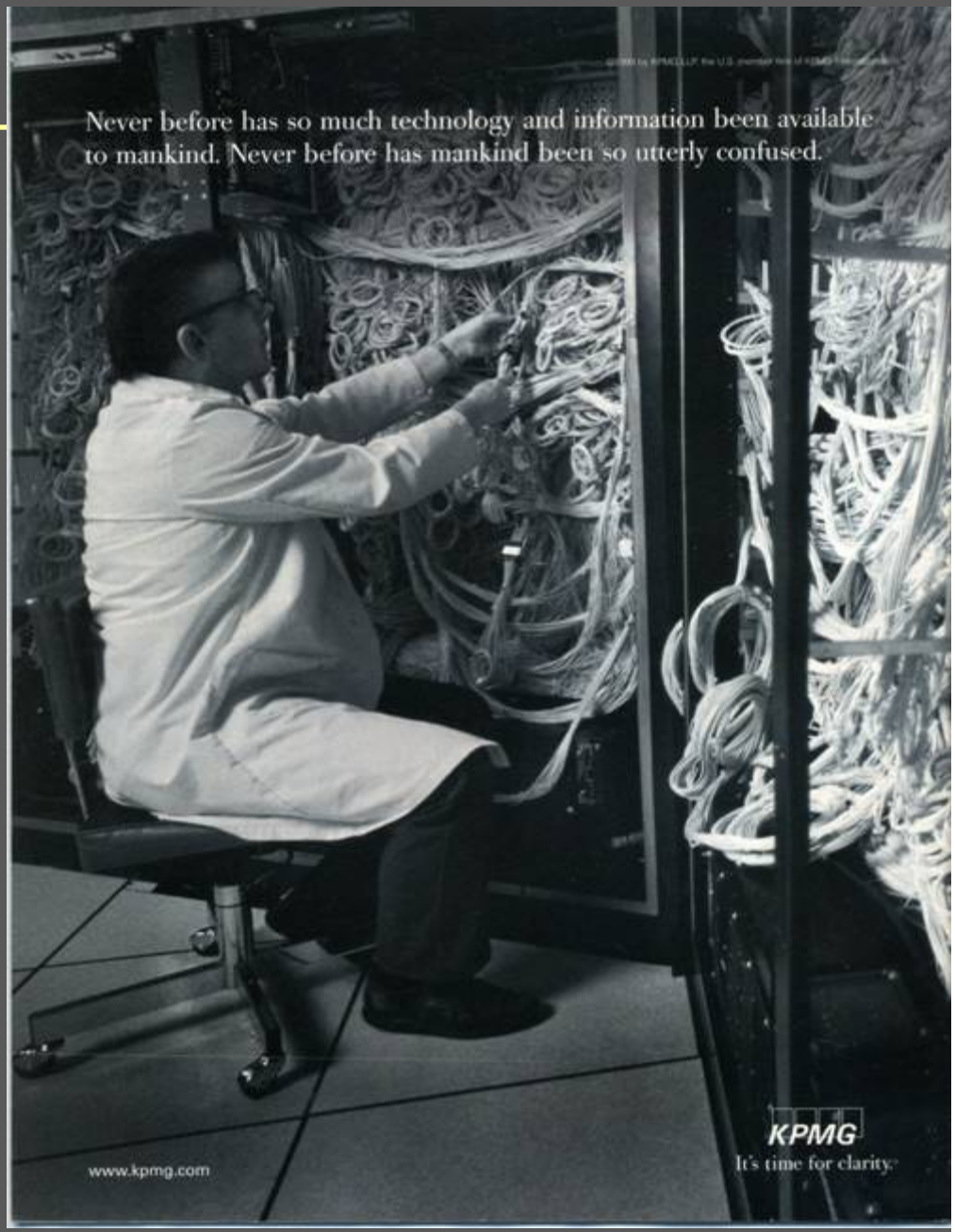
www.CartoonStock.com
'CAREFUL CARRUTHERS, IT COULD BE A COMPUTER SIMULATION'


Never before has so much technology and information been available to mankind. Never before has mankind been so utterly confused.
www.kpmg.com
KPMG
It's time for clarity.

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ZEN and the Art of Building Information Modeling

BIM@CMU

禅

Khee Poh Lam PhD, RIBA
Professor of Architecture
Center for Building Performance & Diagnostics
School of Architecture
Carnegie Mellon University

National Institute of Building Sciences

Carnegie Mellon

International Alliance for Interoperability

Wikipedia

- **Zen** (禪 or 禅) is a school of Mahāyāna Buddhism notable for its emphasis on *practice* and *experiential wisdom* — particularly as realized in the form of *meditation* known as *zazen*—in the attainment of *awakening*. As such, it de-emphasizes both *theoretical knowledge* and the study of *religious texts* in favor of direct individual experience of one's own *true nature*.

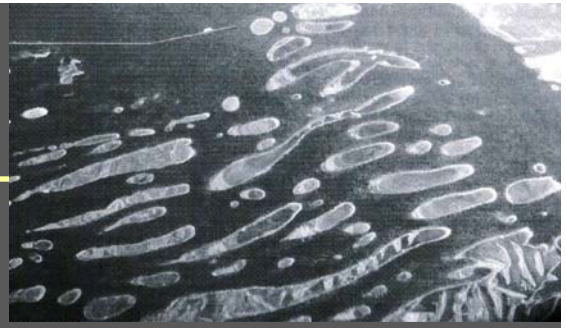
Maluan Bay, Xiamen, China (Yang, 2007)

Ecological Design – City Scale

Ecology: the scientific study of systems of living organisms and the interactions among organisms and between the organisms and their environment.

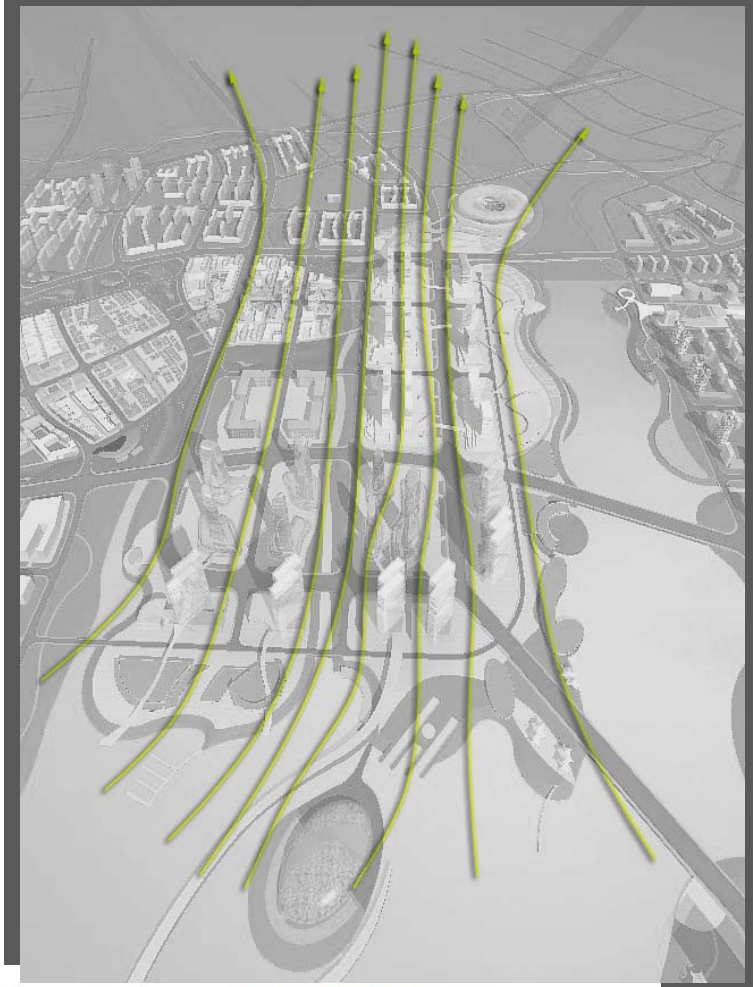
Eco-flows and Patterns

Maluan Bay, Xiamen, China (Yang, 2007)

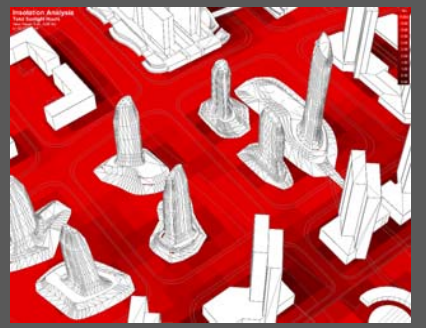


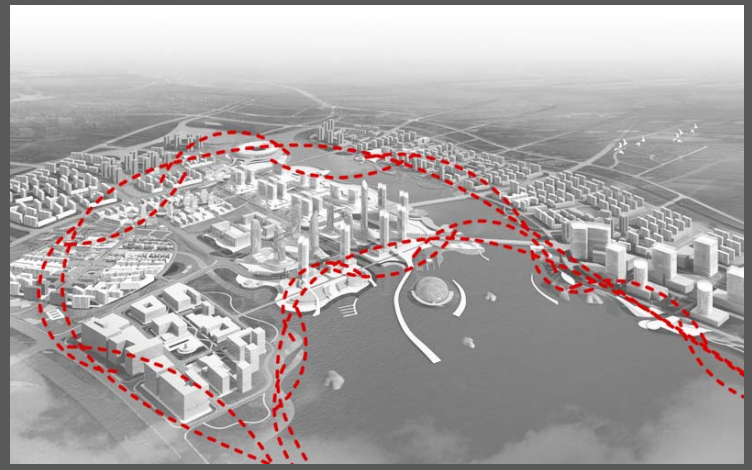
Patch elongation driven by natural forces, (Forman, 1995)

Air Flows

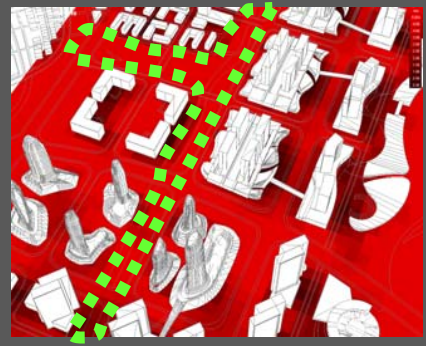


Water flows





Wildlife Flows



Solar Availability

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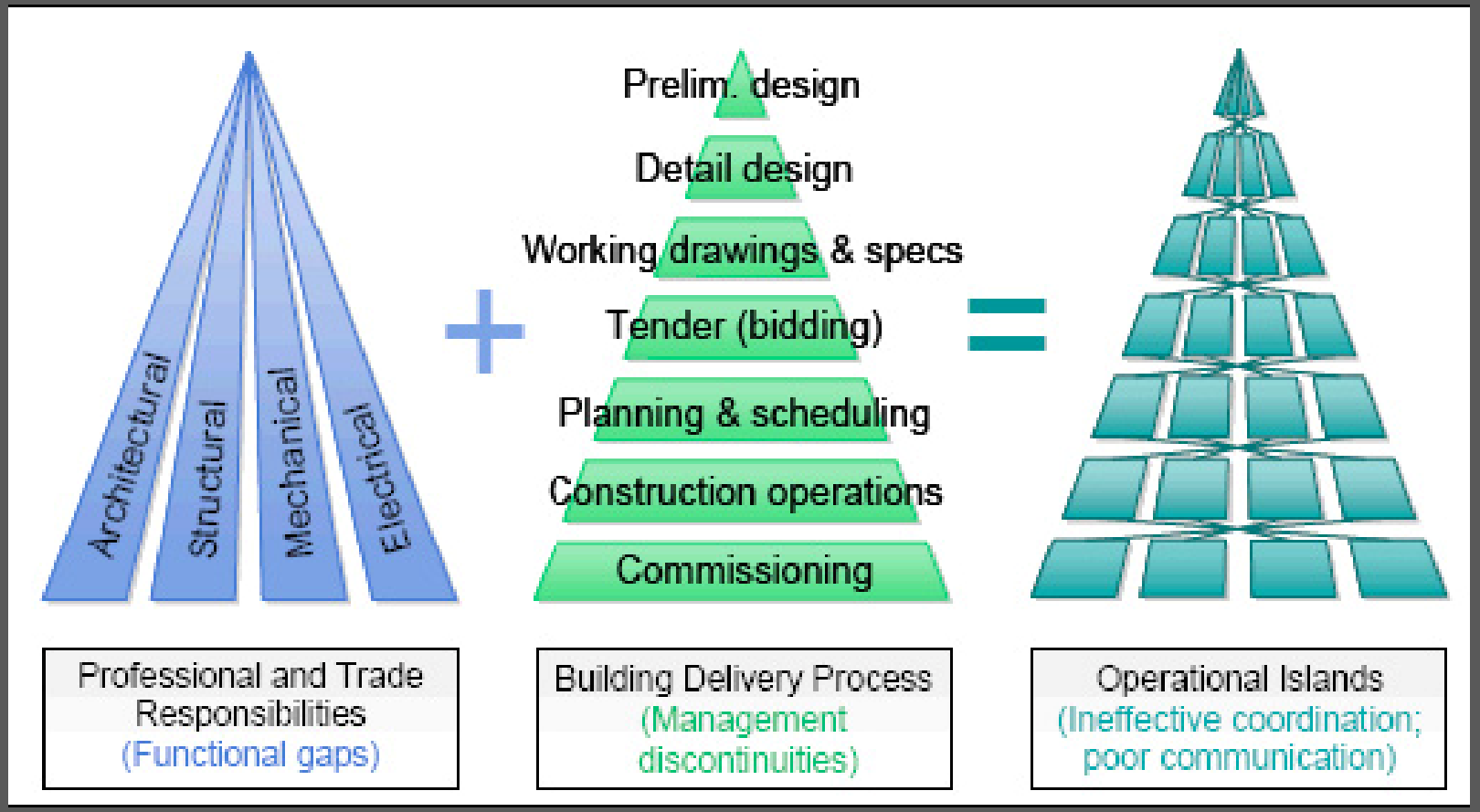
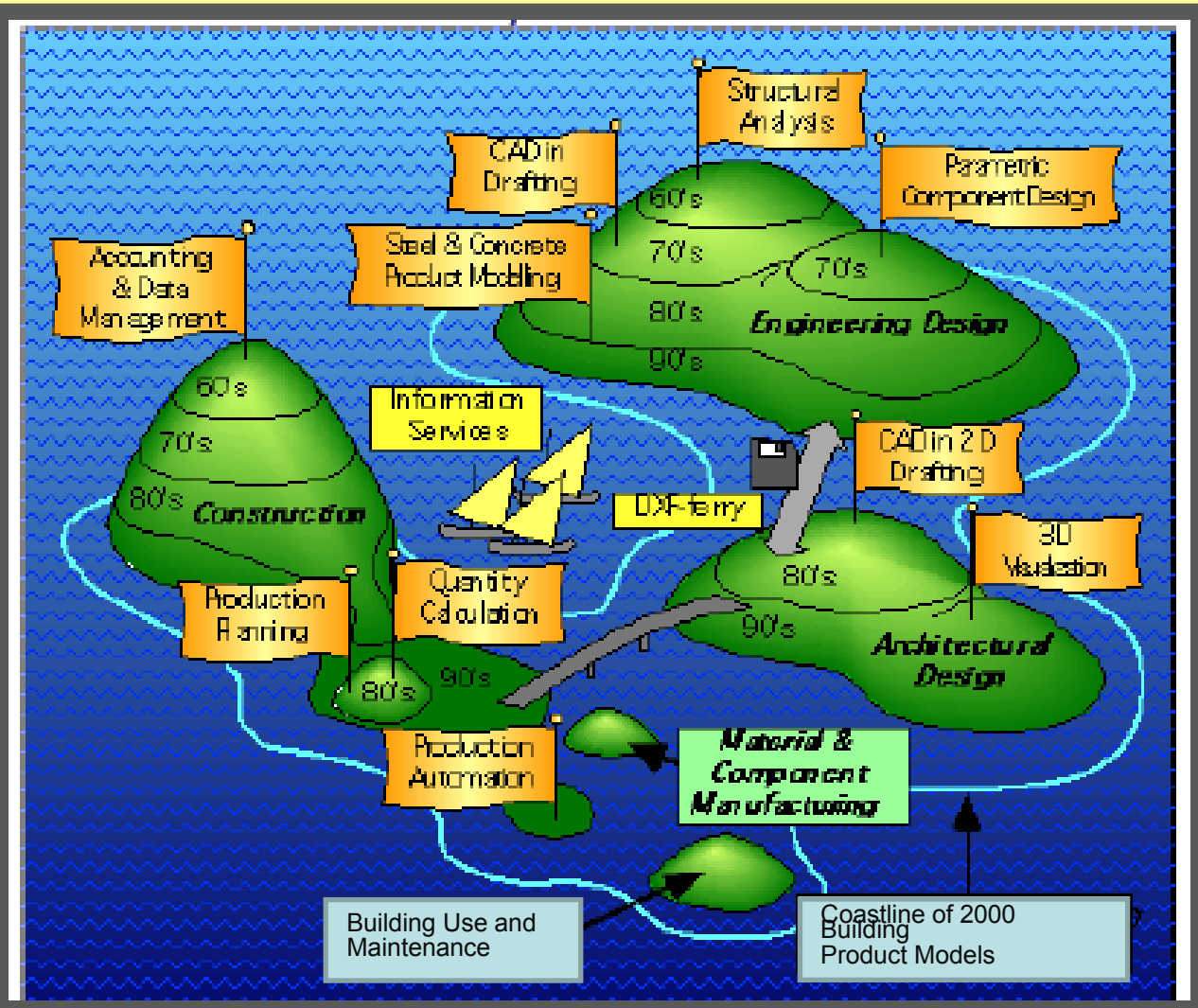
Building Industry Infrastructure



Mattar S.G. **"Buildability and Building Envelope Design".** Proceedings, Second Canadian Conference on Building Science and Technology, Waterloo, Nov. 1983.

Knowledge Islands



Four-function model

Climate modifier

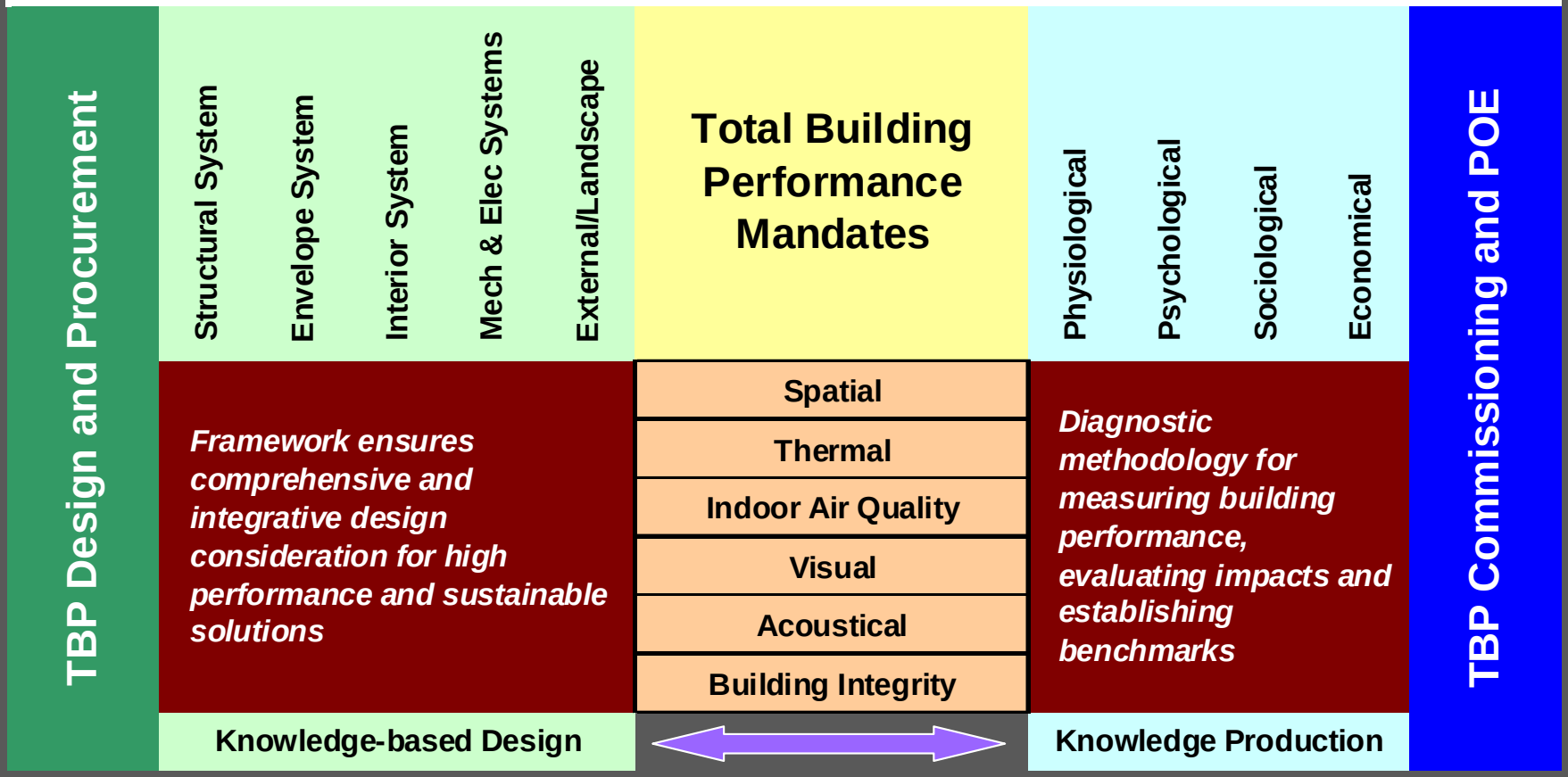
Container of activities

Cultural Symbol

Object of Investment

Total Building Performance & Diagnostics

BUILDING DELIVERY PROCESS



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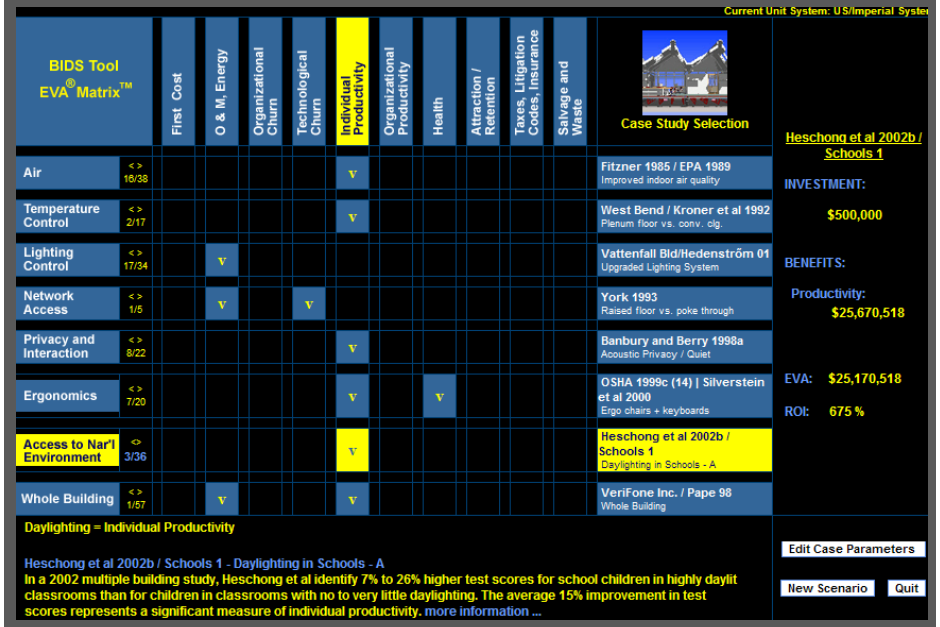
Building Investment Decision Support (BIDS and e-BIDS)



http://cbpd.arc.cmu.edu/bidstrial
http://cbpd.arc.cmu.edu/bids

Cost-Benefit Tools to Promote High Performance Components; Flexible Infrastructures and Systems Integration for Sustainable Buildings and Productive Organizations

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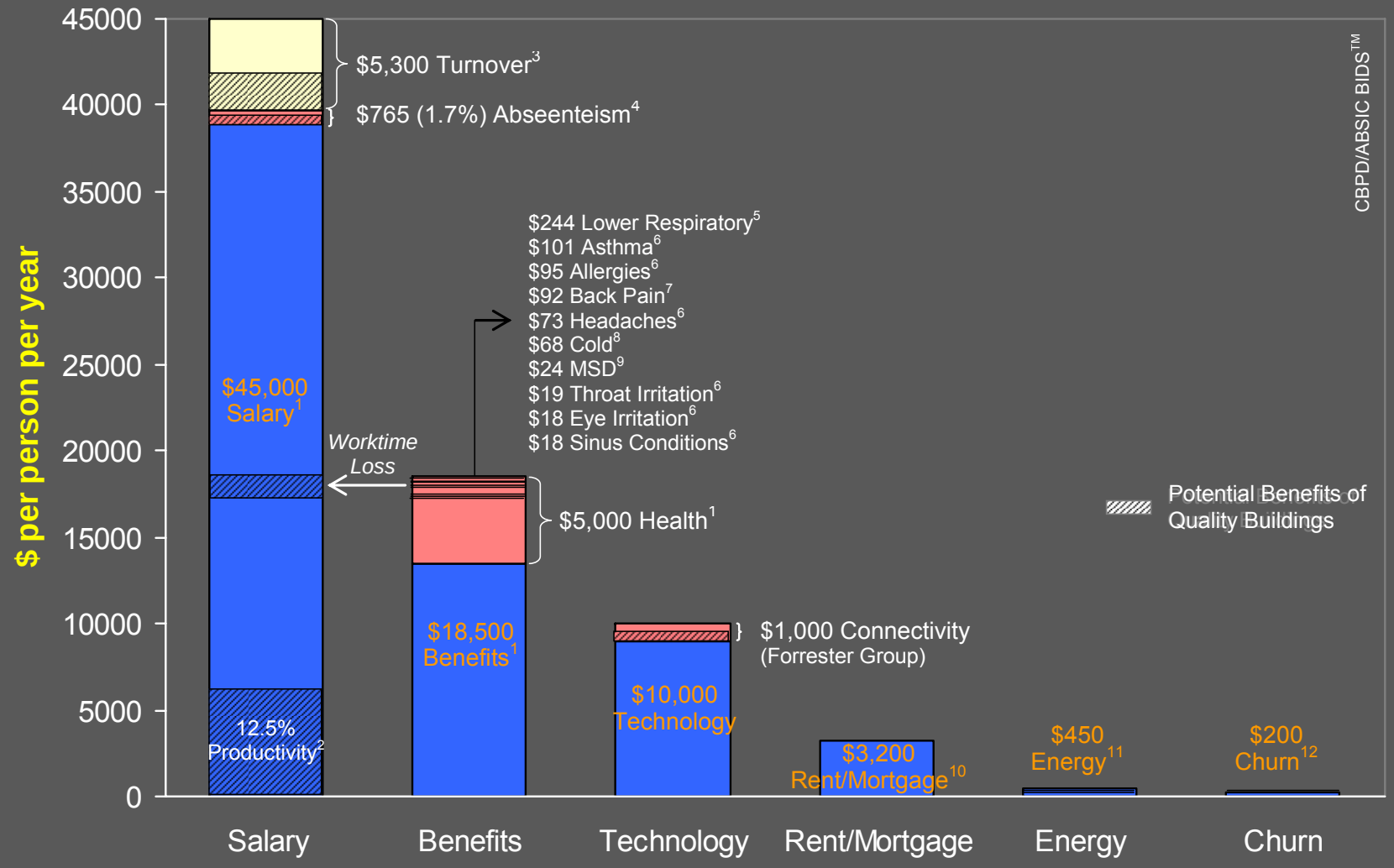
Financial Cost/Benefits Indices/ International Baselines



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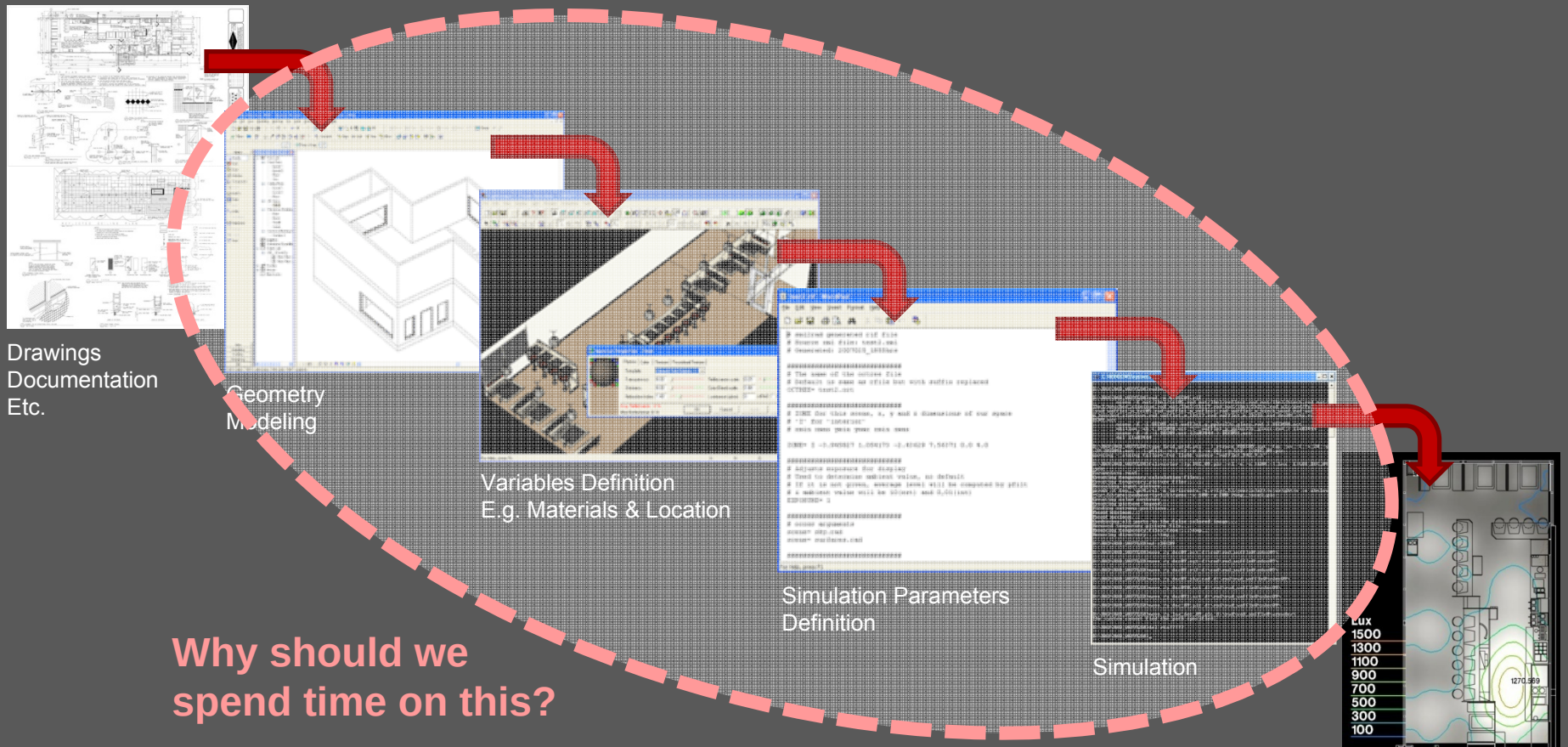
Design Performance Modeling

Reduce resources required to conduct performance simulation

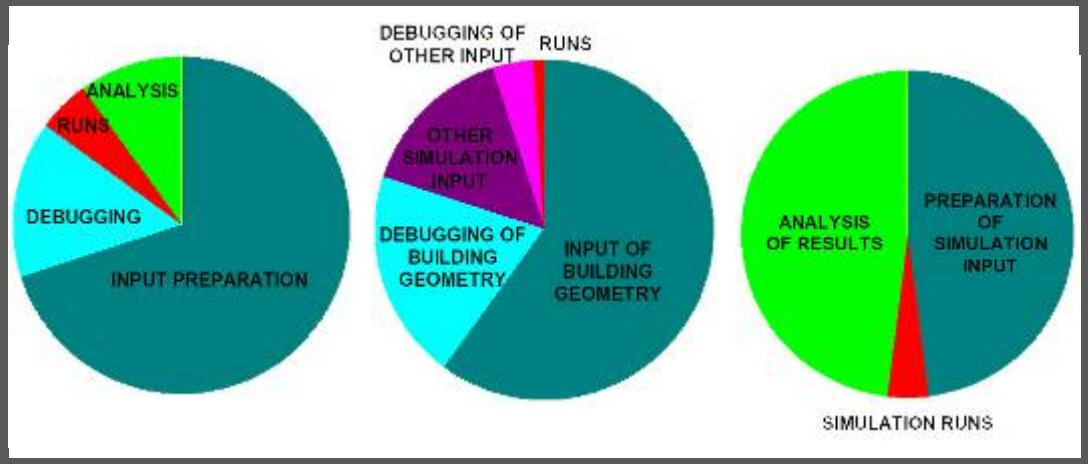
Reducing time and effort required to prepare for simulations (applicable to all domains)



Why should we spend time on this?

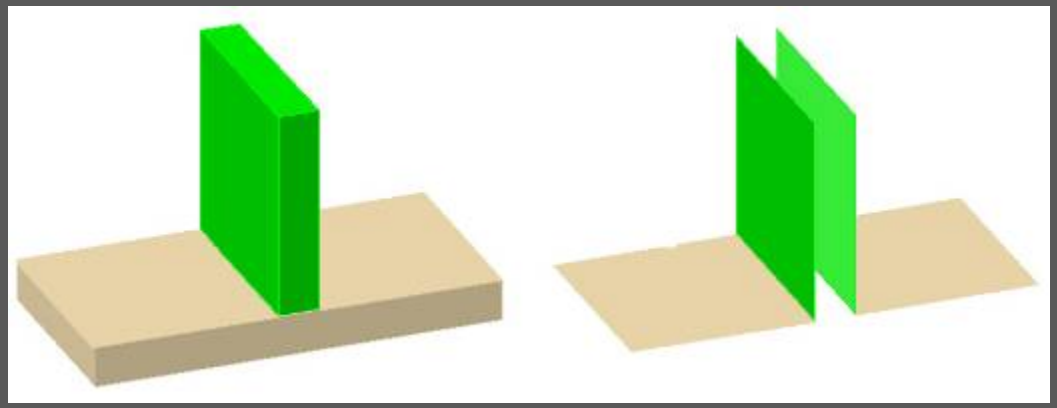
Information Needs During Design Process

Significant time required to set up geometry – redundant tasks



Bazjanac 2001

Significant effort required to deal with semantics – expert knowledge



Examples of BIM Schemas and Languages

Industry Foundation Class (IFC)

A schema with definitions, relationships and rules. Define a standard way of describing, representing, and interfacing with A/E/C objects. Data representation in EXPRESS, data exchange in STEP 21 format.

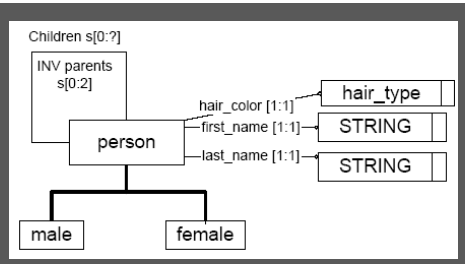
EXPRESS

Language developed within ISO-STEP community for representing application interpreted models.

```
#3=IFCPROJECTAPPREGISTRY(());
#10=IFCNOTATIONFACET('NotationString',$);
#11=IFCCLASSIFICATIONNOTATION((#10));
#12=IFCCLASSIFICATION('WallMaterial',$,#11,'Brick',$);
#13=IFCCLASSIFICATIONLIST((#12),1);
#25=IFCDIMENSIONALEXPONENTS(1,0,0,0,0,0,0);
#4=IFCSIUNIT(*,.LENGTHUNIT.,.MILLI.,.METRE.);
#14=IFCMATERIAL('DefaultWallMaterial',#13);
#15=IFCPROJECTMATERIALREGISTRY((#14,#46));
```

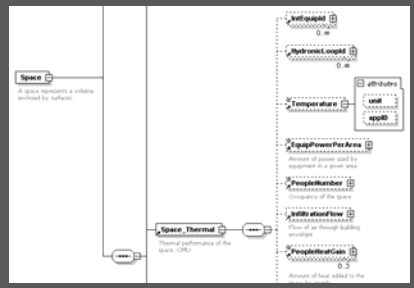
EXPRESS-G

Graphical means of depicting EXPRESS



GbXML

An XML-based schema representing the building information (geometry, material properties..) for energy simulation purpose, and being extended to other simulations.



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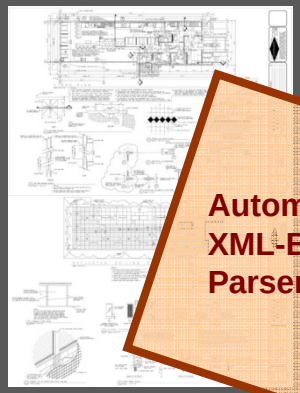
Design Performance Modeling

Reduce resources required to conduct performance simulation

Reducing time and effort required to prepare for simulations (applicable to all domains)



Drawings
Documentation
Etc.

Automated Processing

Automatic XML-Based Parser

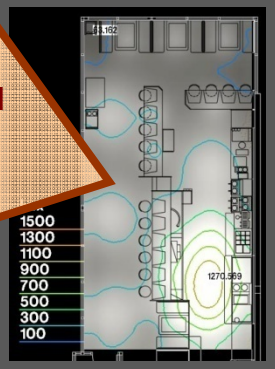
Automatic Default Values

Automatic Engine Selection

Automatic Simulation Files Creation

Improved Analysis Features

User-editable Input



Results processing

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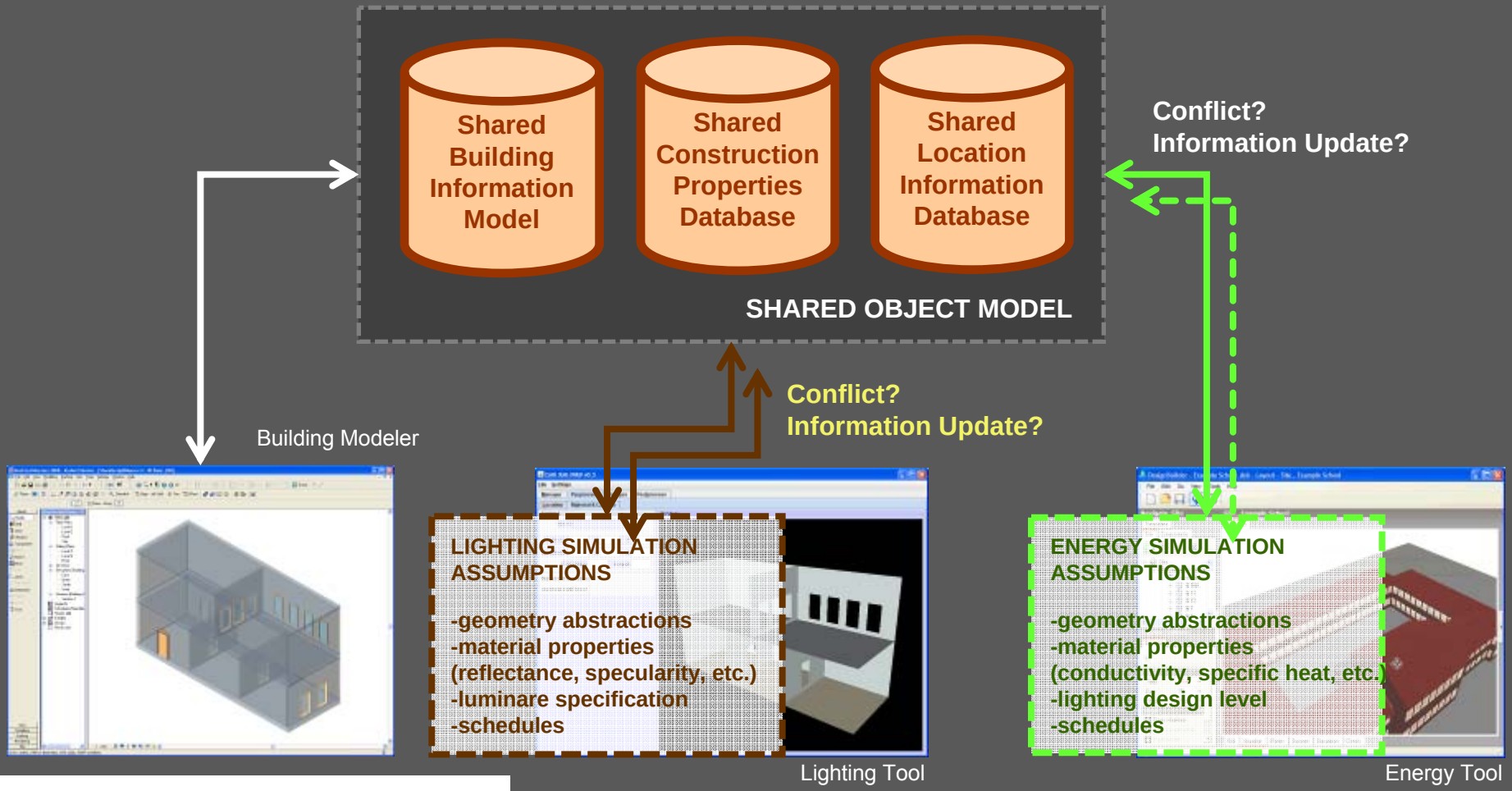
Design Performance Modeling

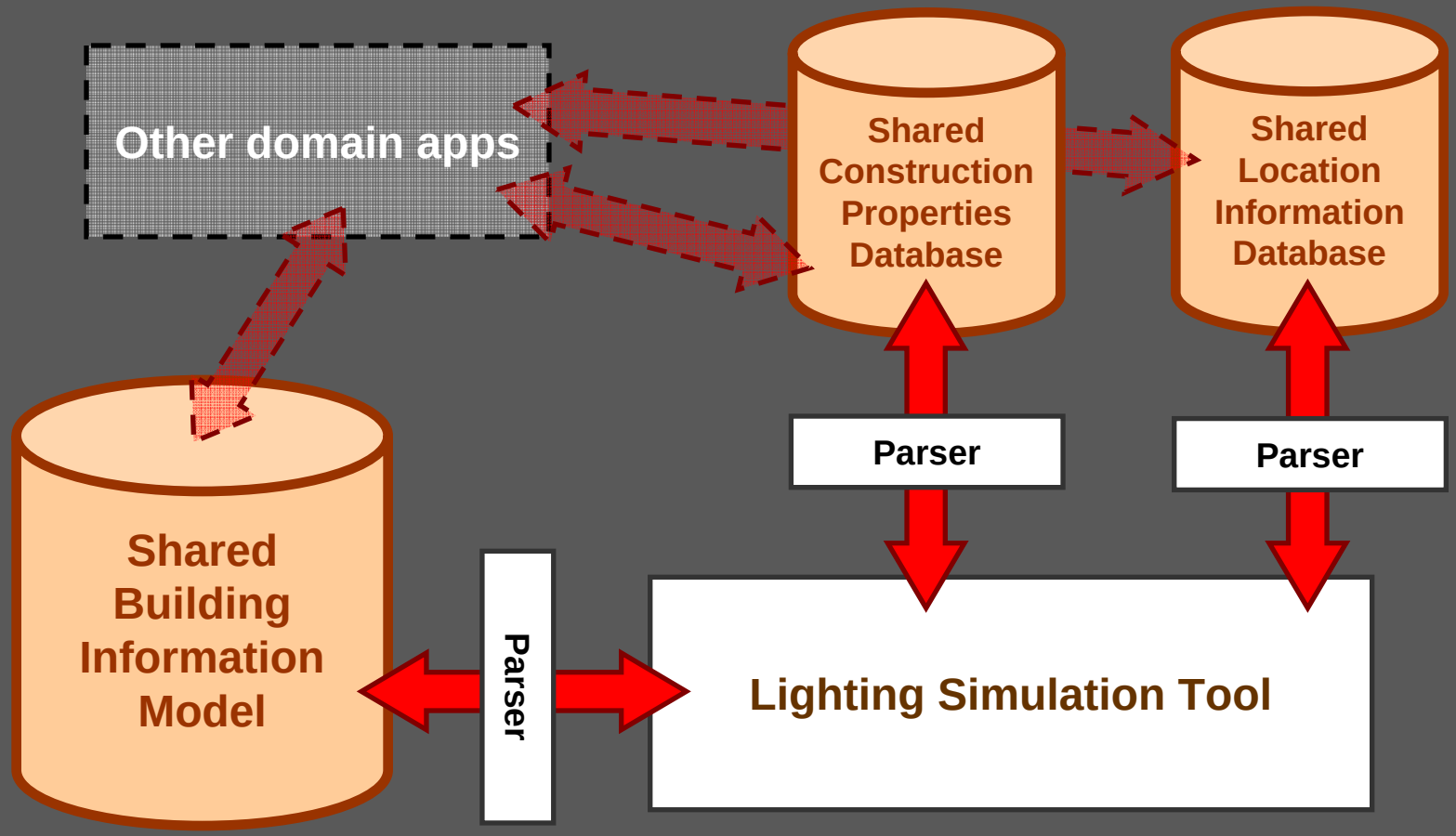
Efficiency and consistency in defining BIM and assumptions

Externalizing project shared information



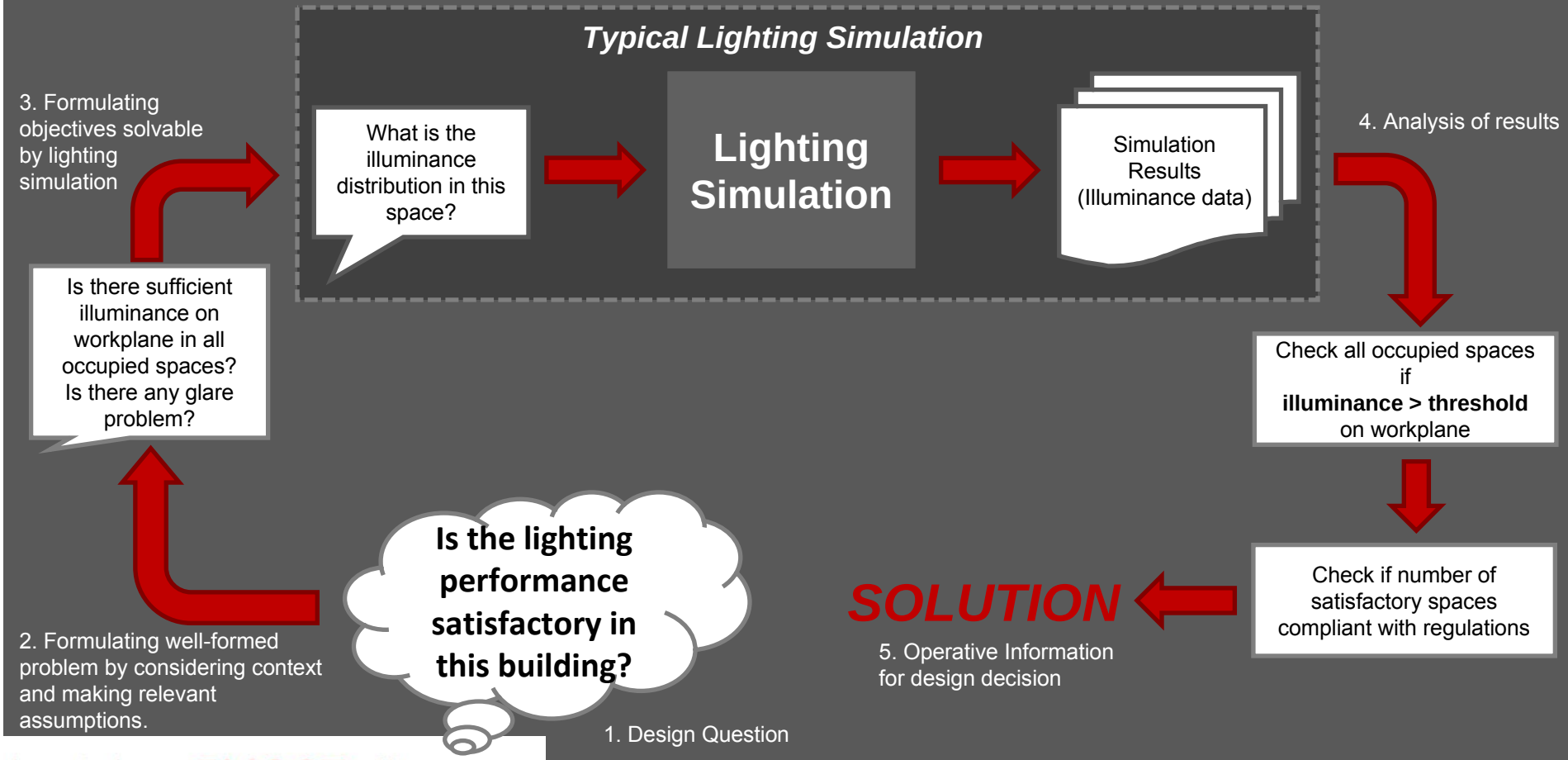
Efficiency and consistency in defining BIM and assumptions

Externalizing project shared information



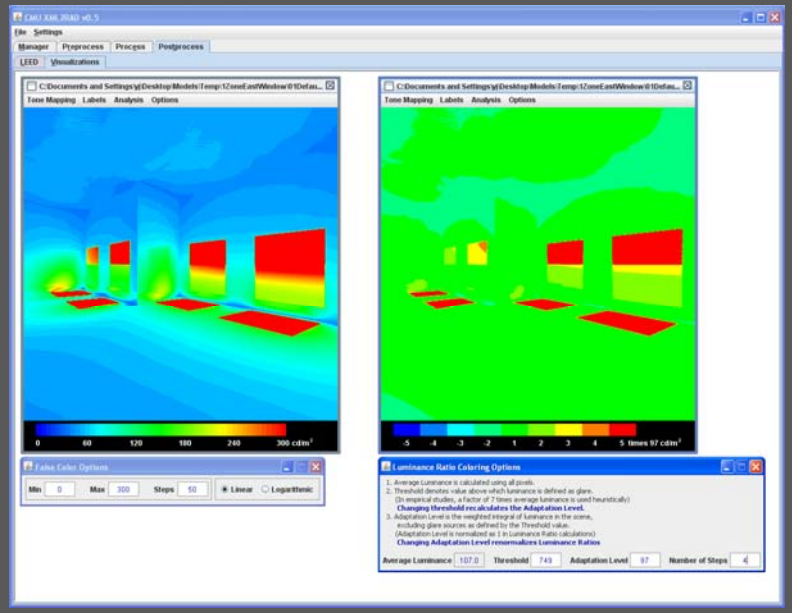
Obtaining Operative Information for Design Decisions

Lighting simulations address low-level objectives, not higher-level questions typical of primary design inquiries.

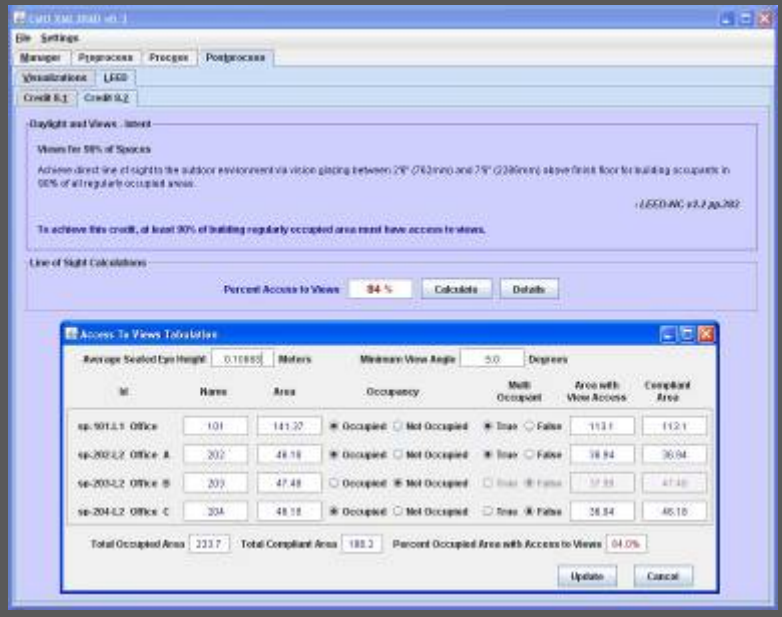


Obtaining Operative Information for Design Decisions

Providing post-processing analysis toolkit

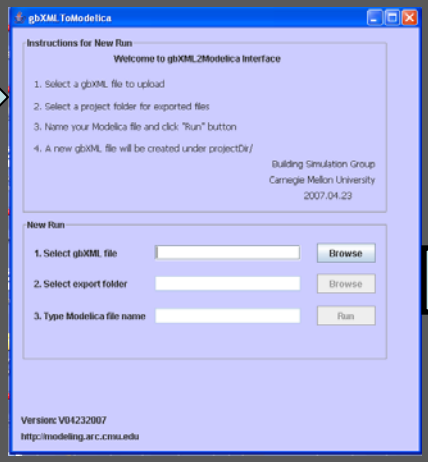


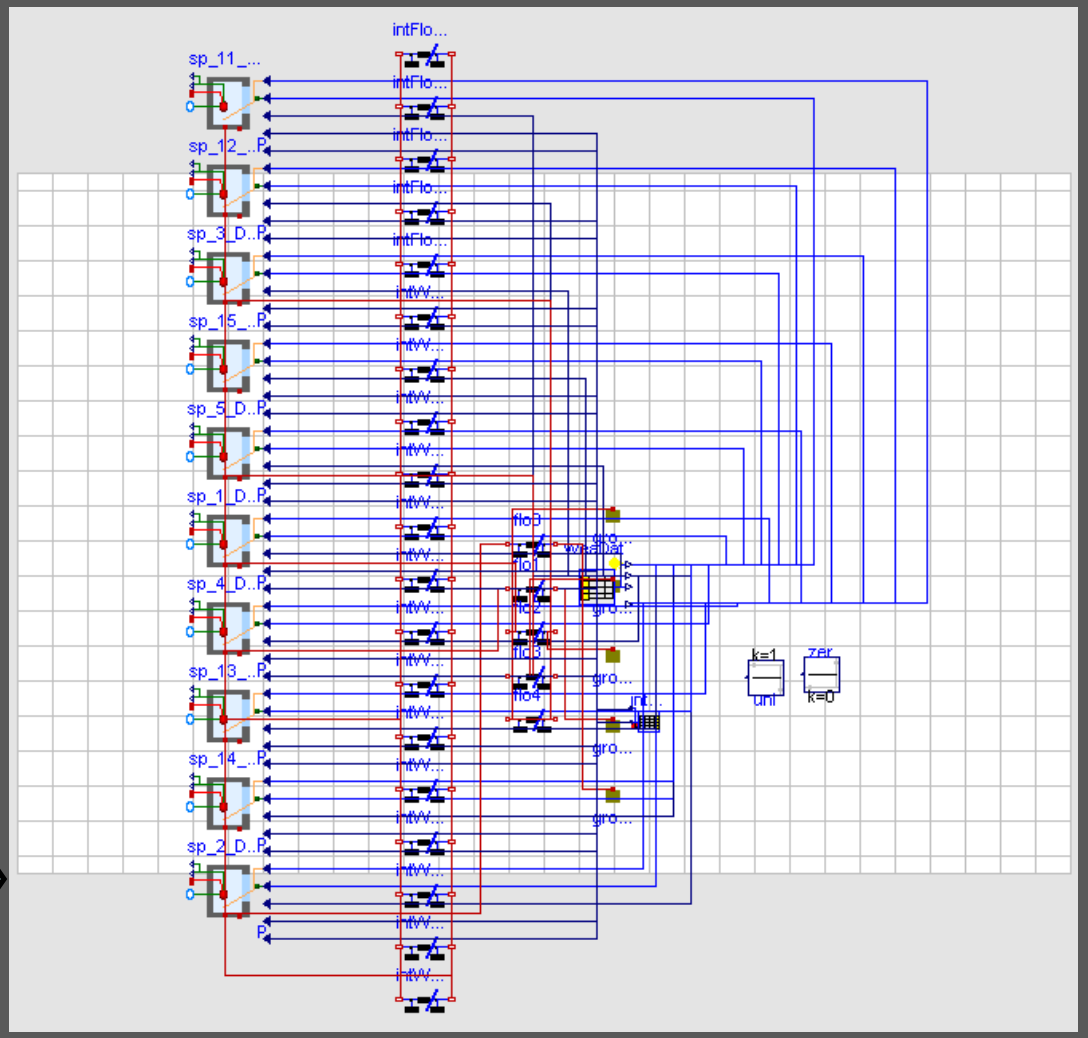
Tone-mappers
Luminance data inspection and false-color analyses
Luminance ratios calculator
Data comparisons



LEED rating system Credit 8.1 & 8.2 calculators
Tabulation of results

N-Dimensional Mapping – BAPP Dymola Model





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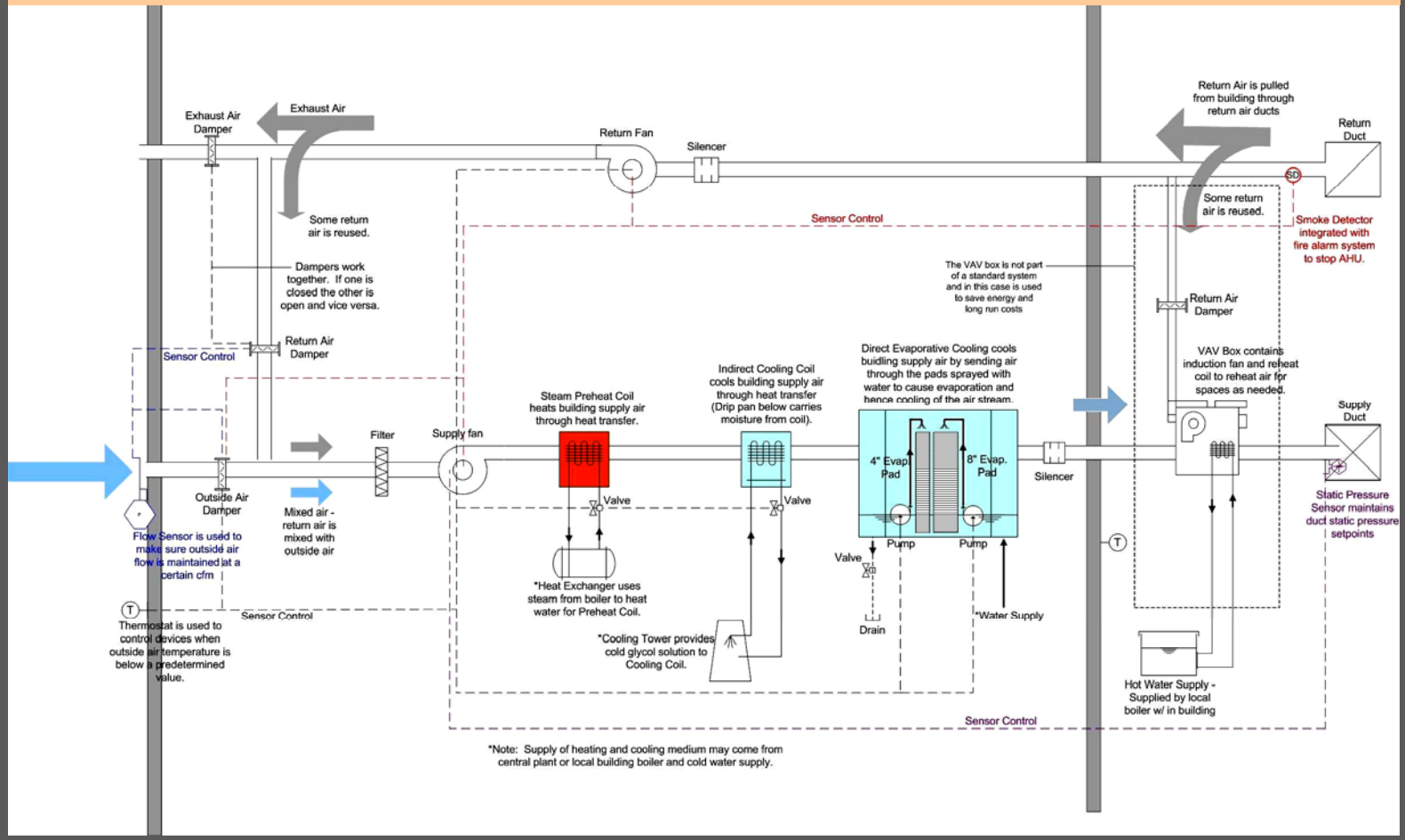
BIM Application in Continuous Commissioning

A product model for commissioning

Based on standards, products, designers, and commissioning authority



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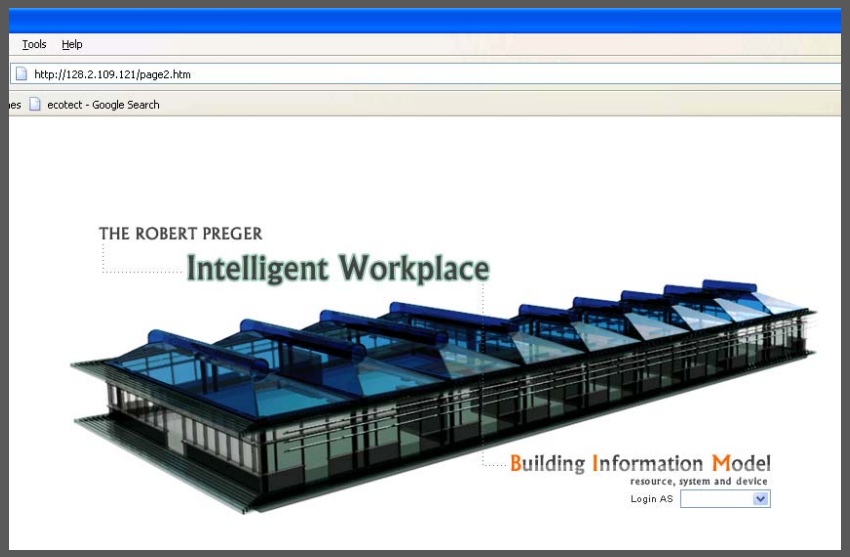
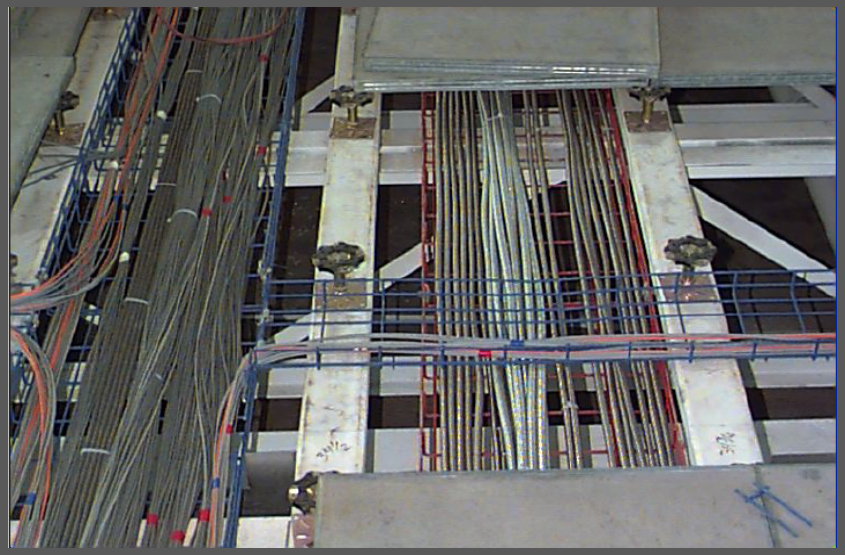
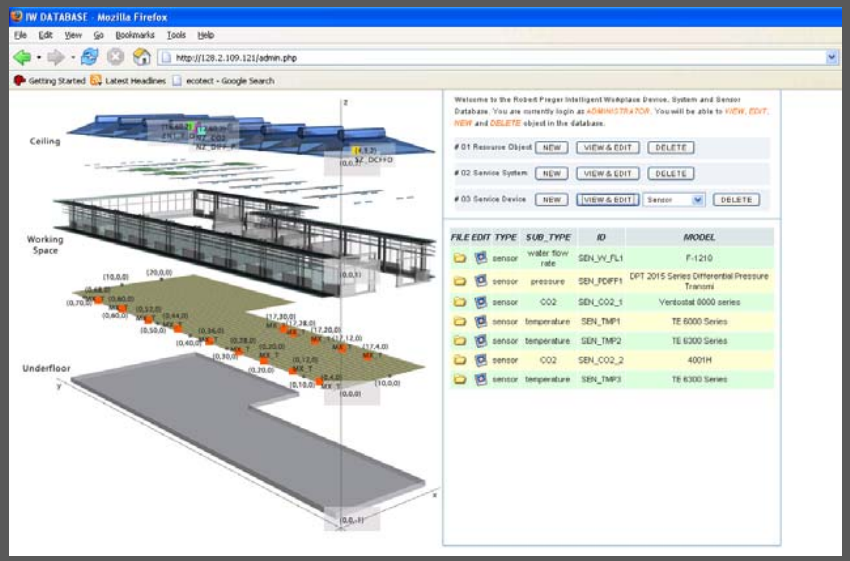
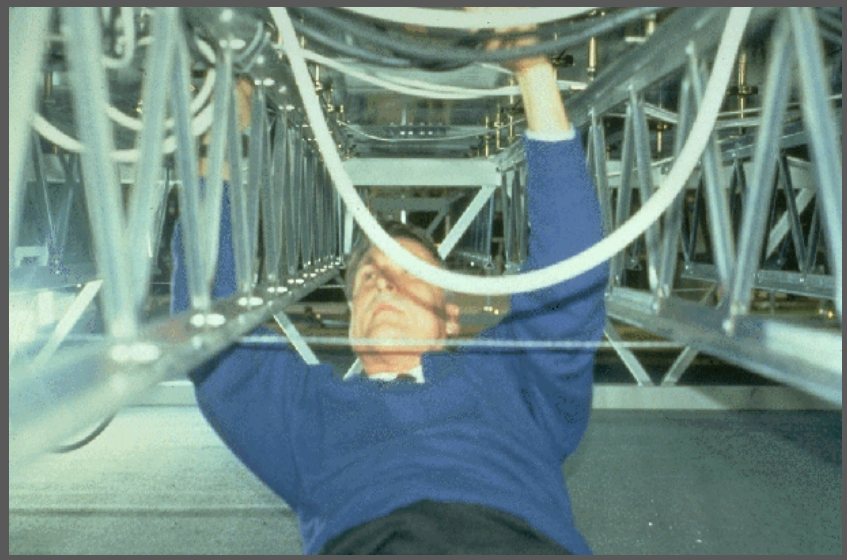
Future Challenge: Integrative Information Management

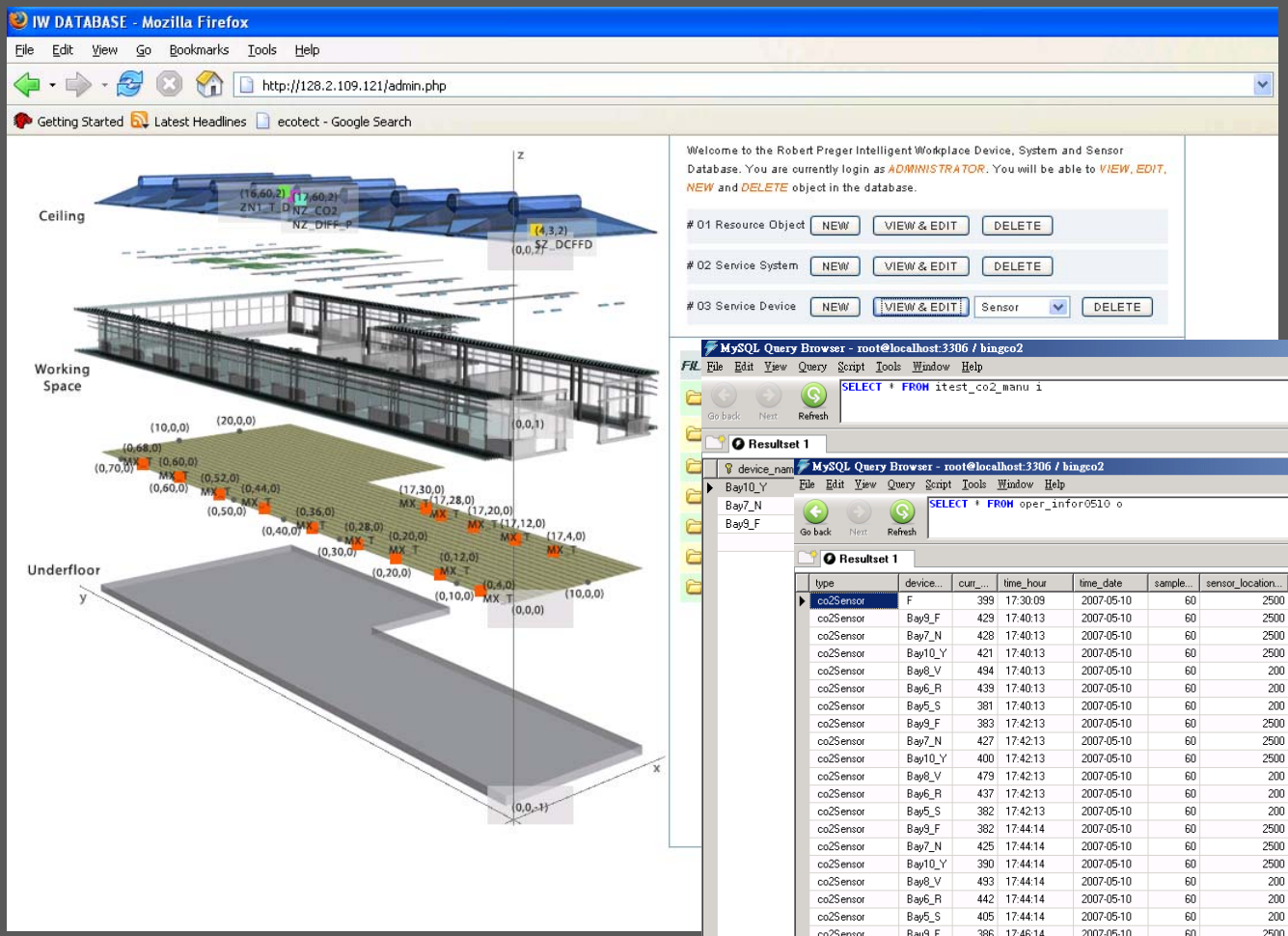


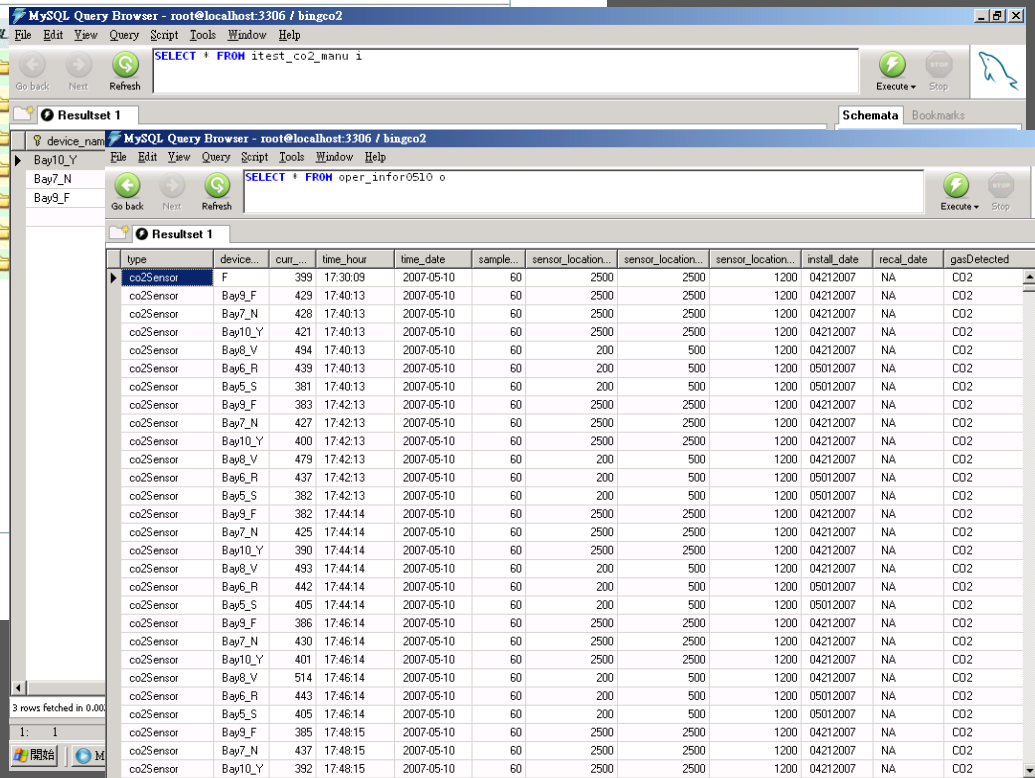






BIM Tools Development-Information Visualization





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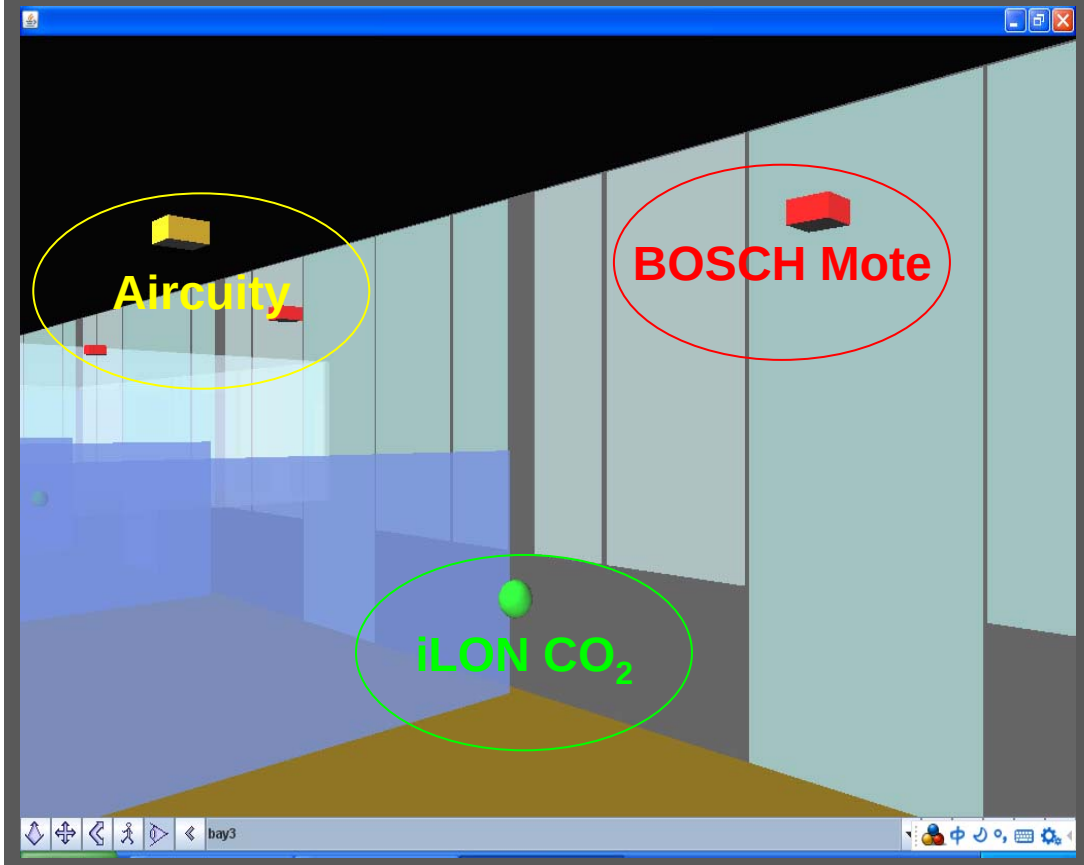
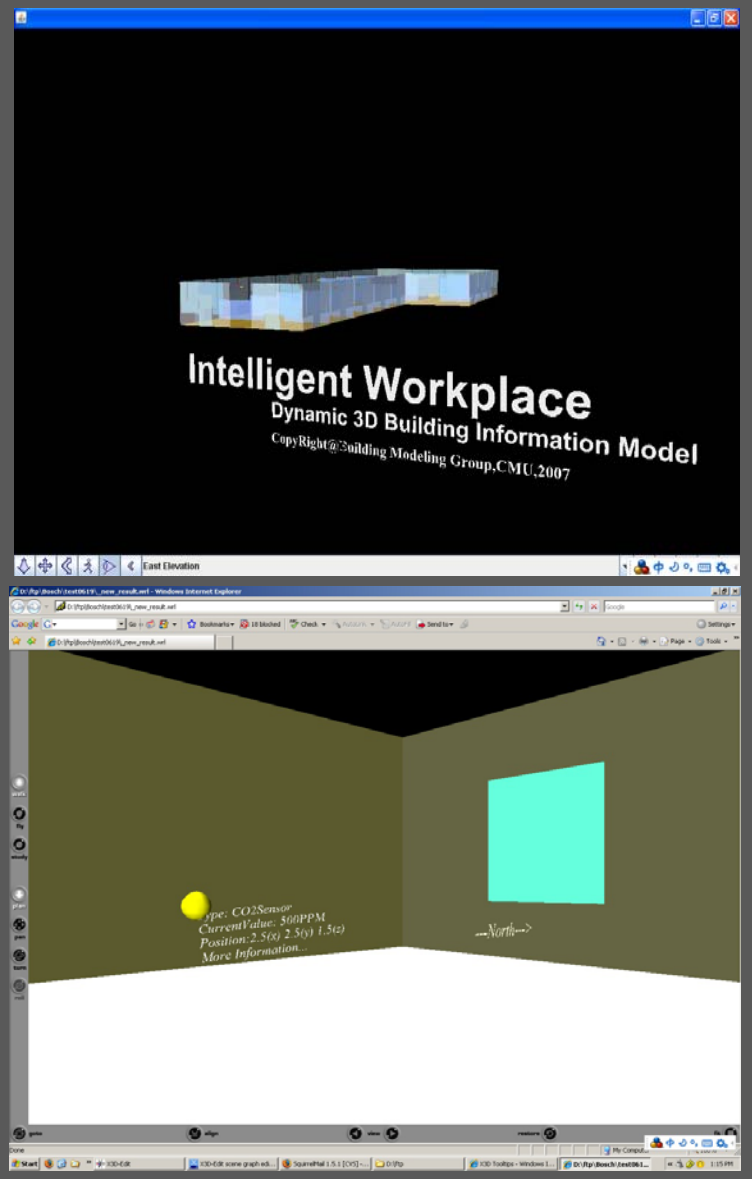
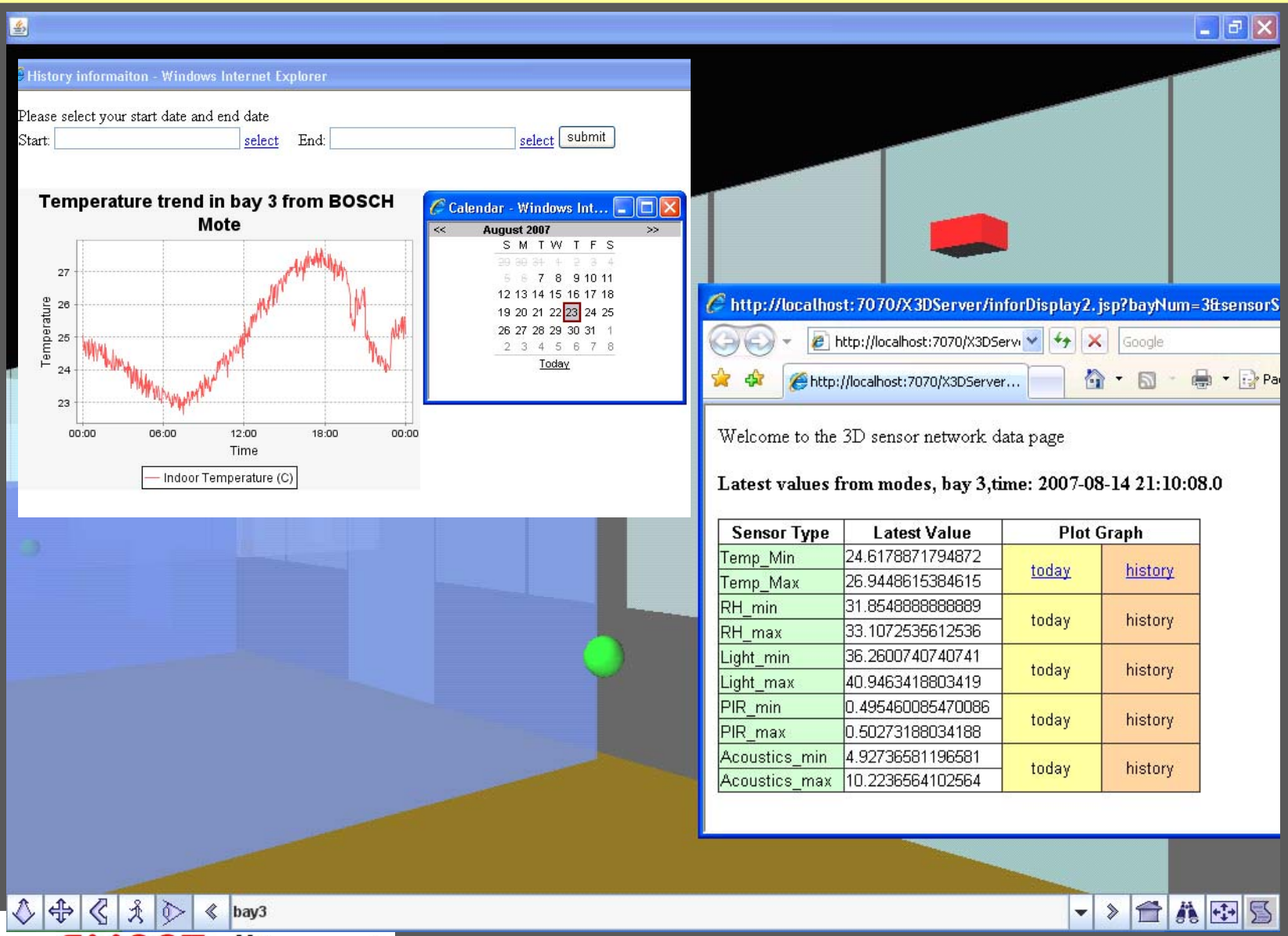
BIM Tools Development - Information Visualization





BIM Tools Development - Information Visualization



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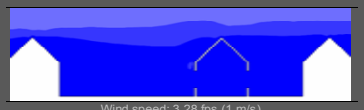
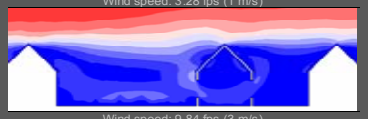
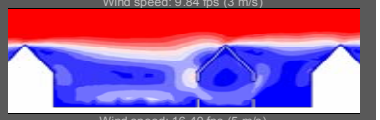
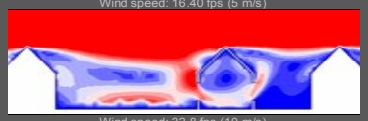
Sustainable Building Information Model

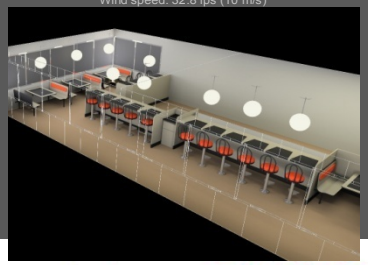
Virtual ⇢ **Real**

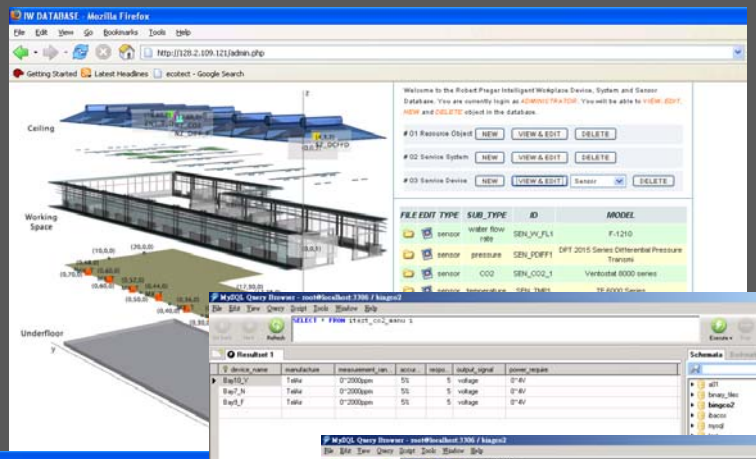


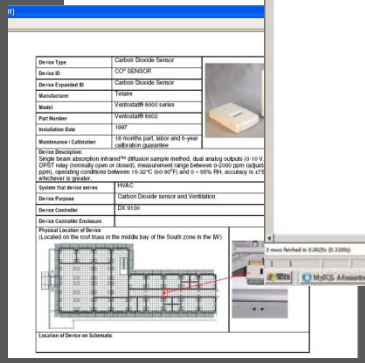


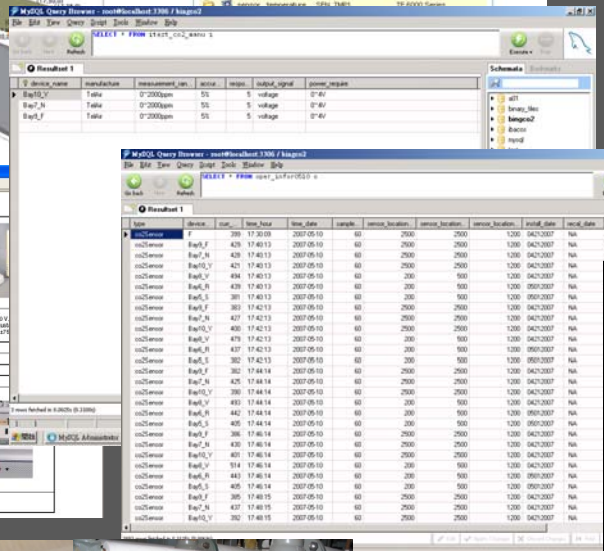


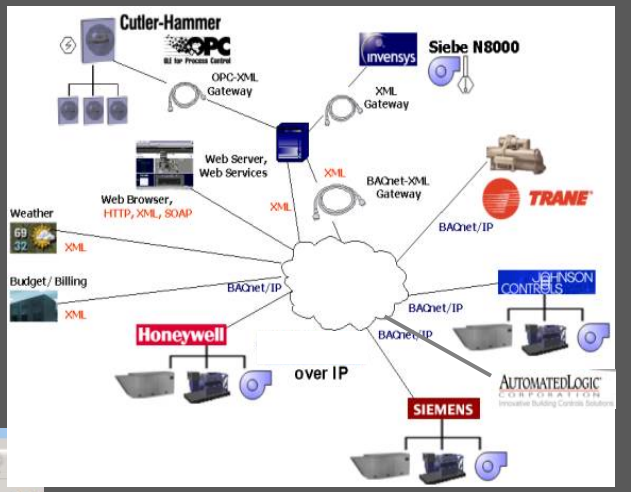


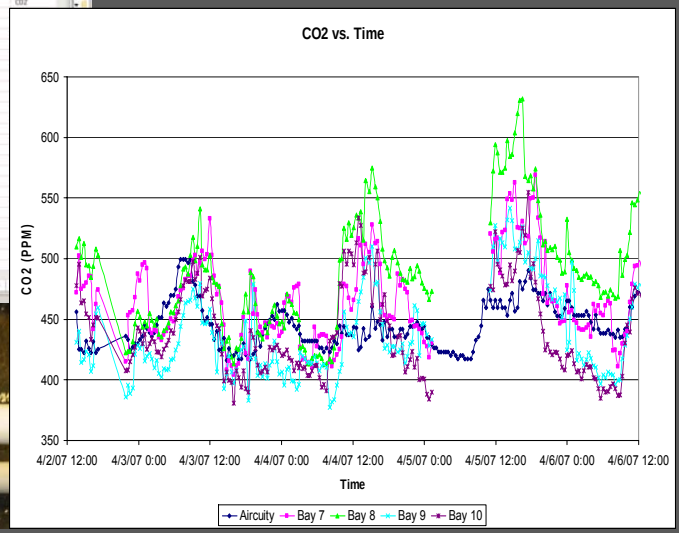












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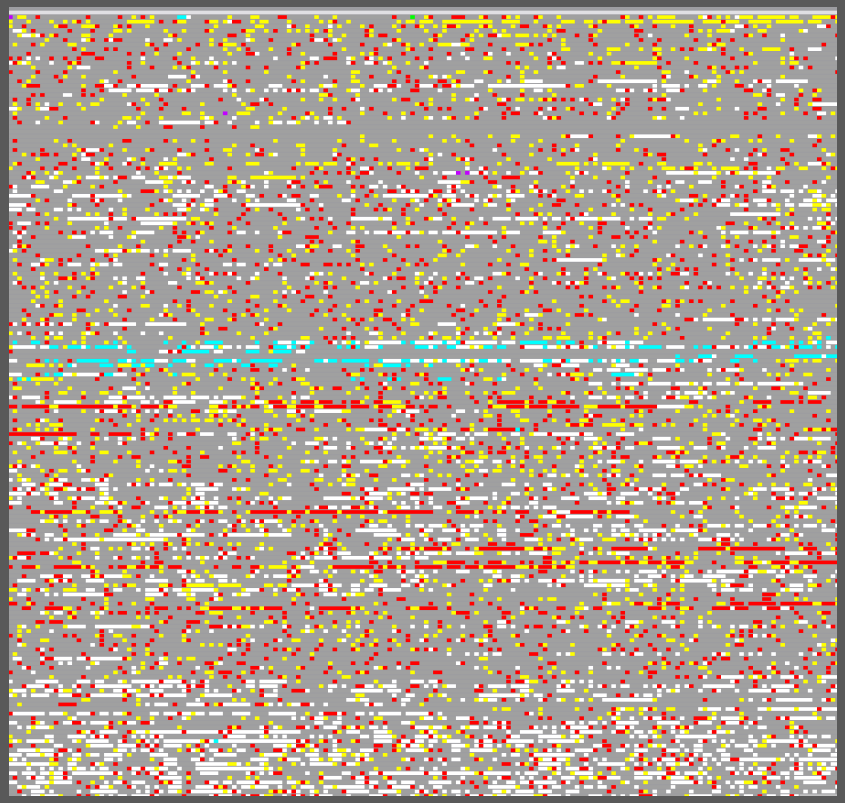
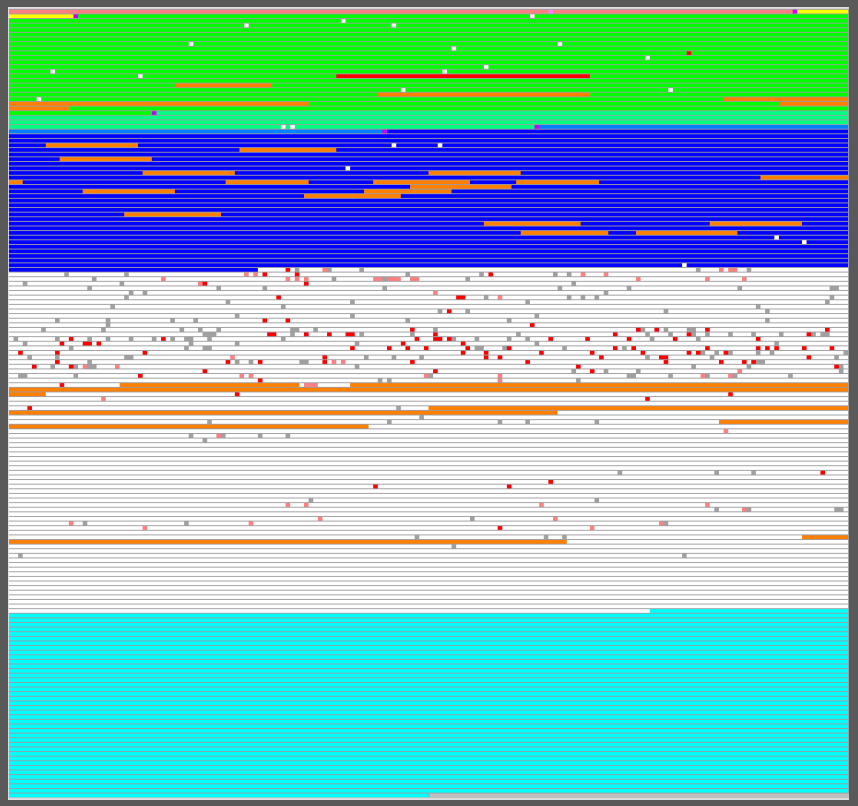
What does your hard disk look like?



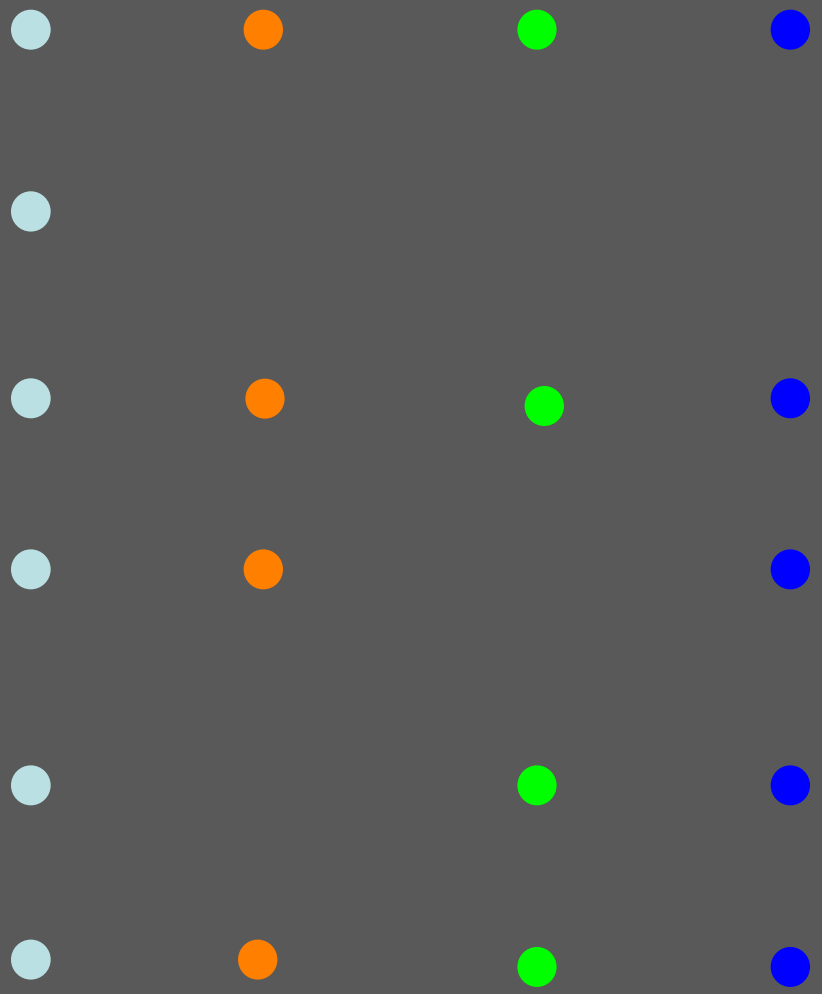
OR



Building Life Cycle Phases

Version control

Design Construction Commission Operation



Oculus 6 Pillars

Requirements
Definition and quantification of “what is good?

Concept
Definition and management of design alternatives

Sequence
Framework for seamless integration with BIM tools

Results
Capturing and managing all building performance measurements including simulation artifacts

Performance
Real time tracking of results against requirements using performance metrics

Revision
Framework for collaborating with all project participants and the deposit/retrieval of all project life cycle documents

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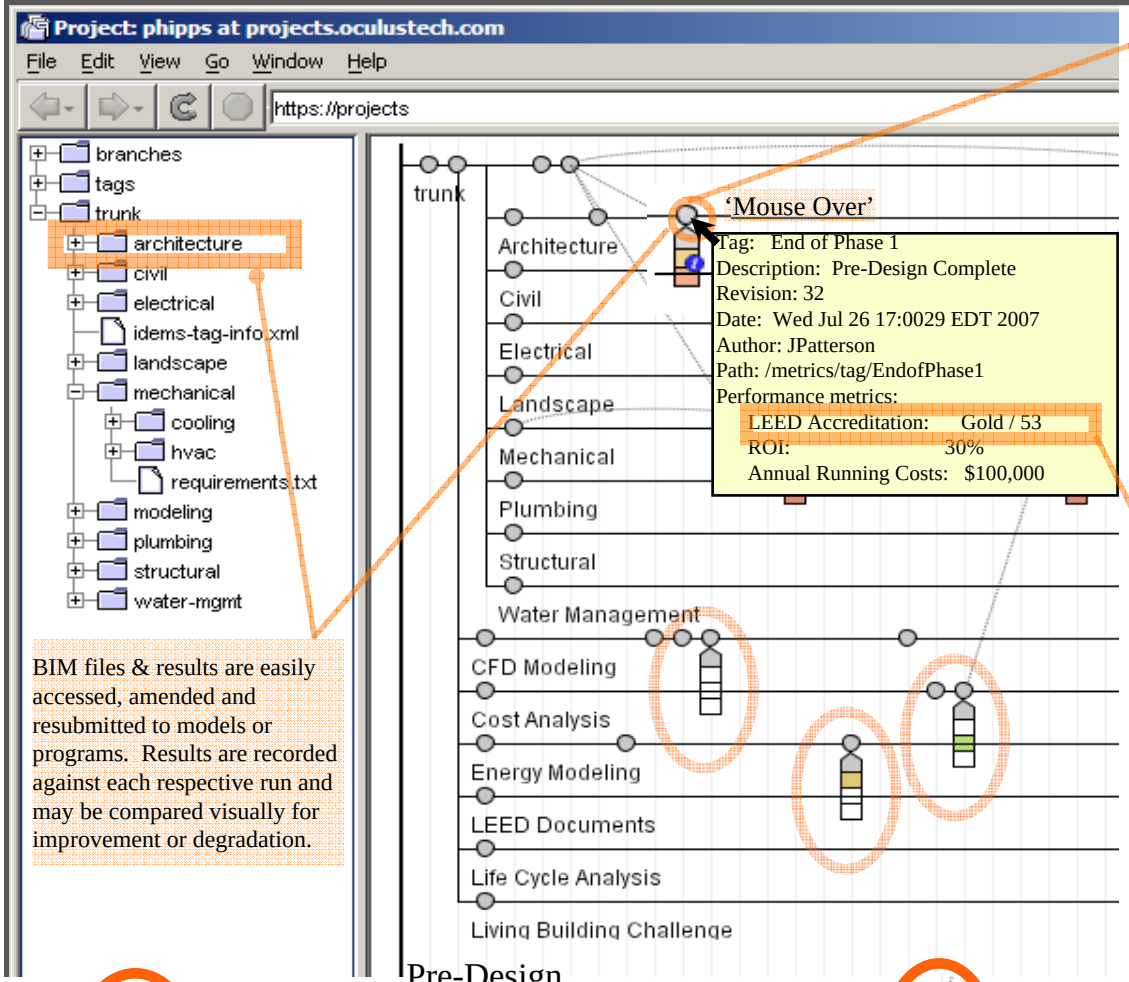
Oculus TECHNOLOGIES CarnegieMellon

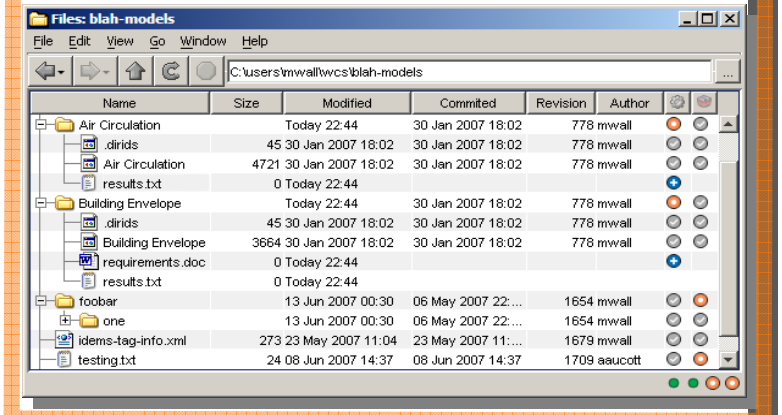
BIM Interoperability



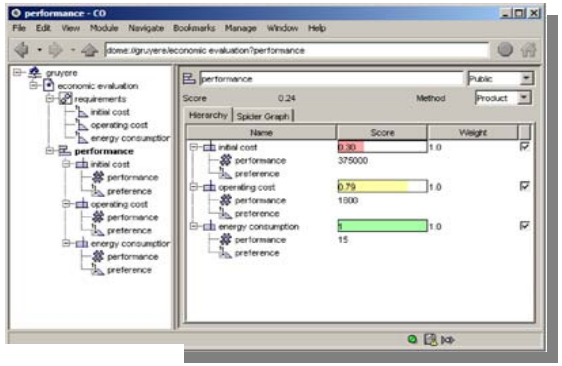
BIM files & results are easily accessed, amended and resubmitted to models or programs. Results are recorded against each respective run and may be compared visually for improvement or degradation.

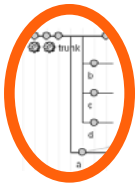
Pre-Design

'Double-click Mouse' to display/access BIM files

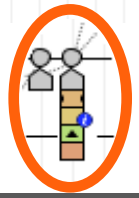


The LEED Accreditation metric is an aggregate of all LEED credits (which may be viewed separately) and is displayed as a color and number of credits secured.





- branches 'swim lanes' enable concurrent exploration of design alternatives



- performance metrics are visible to all participants at all times
- effects on performance are displayed immediately

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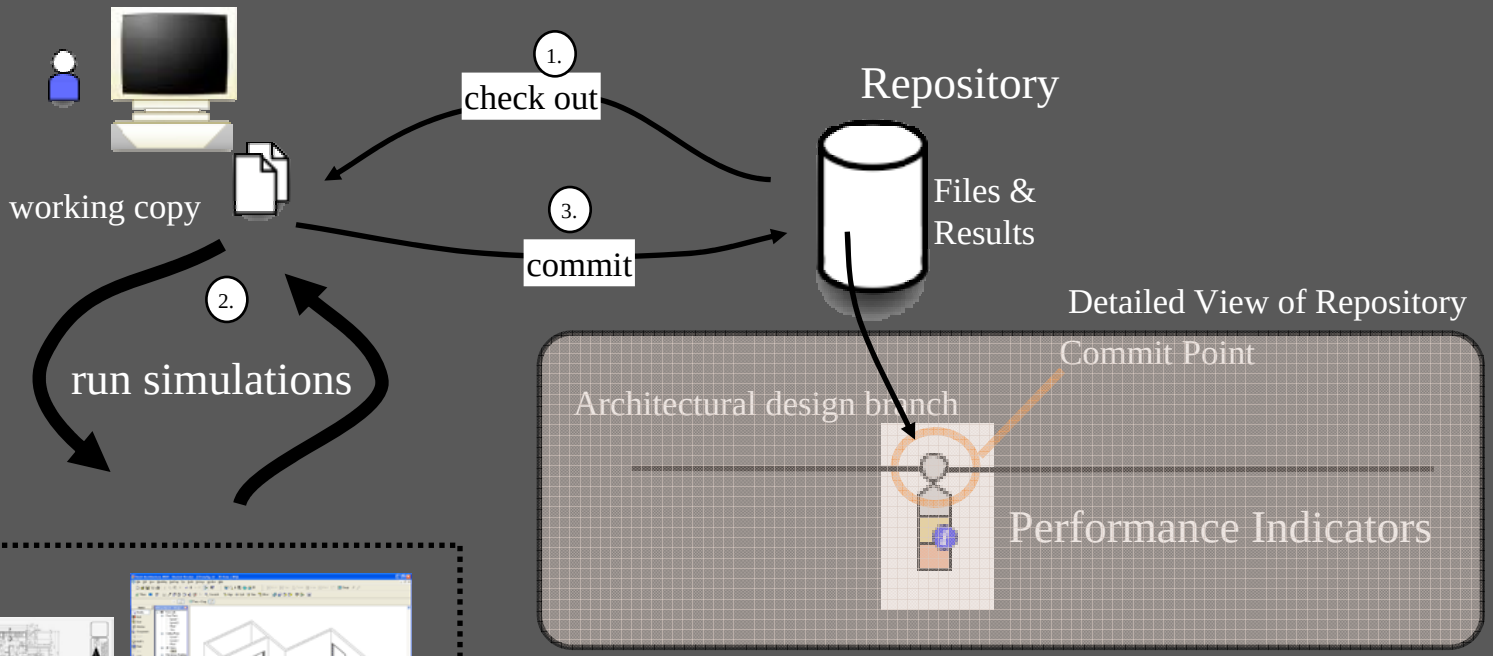
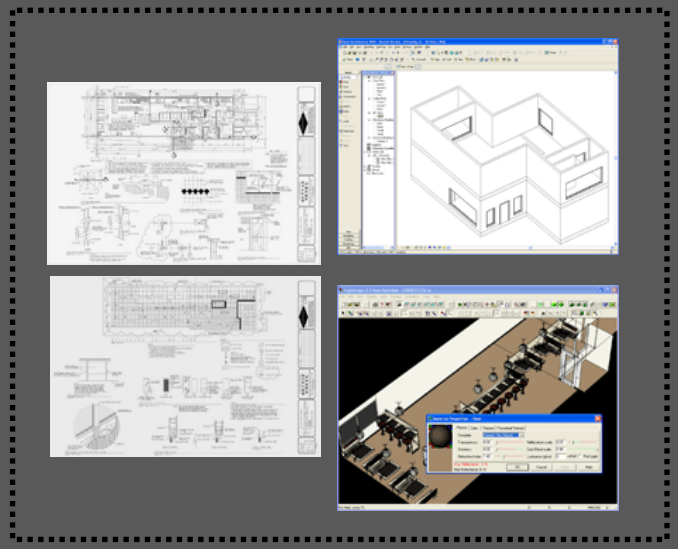
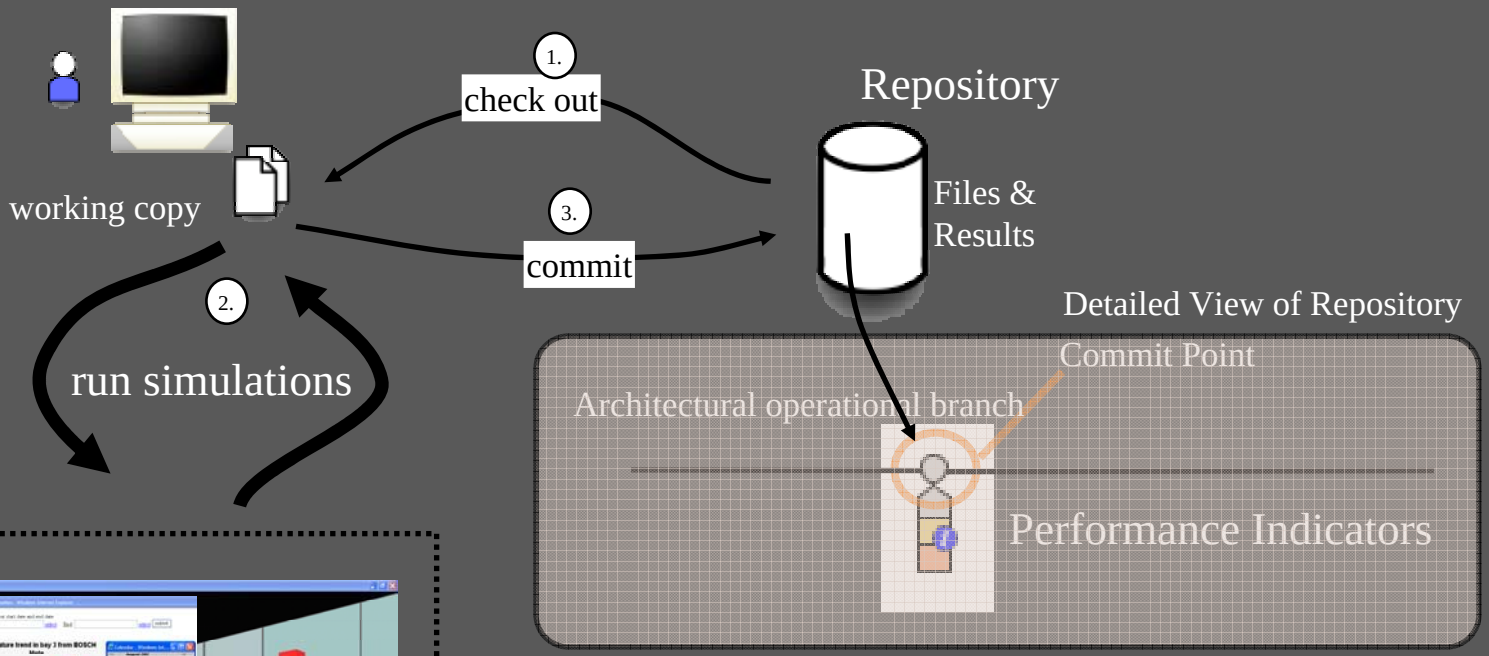
BIM - Design Phase

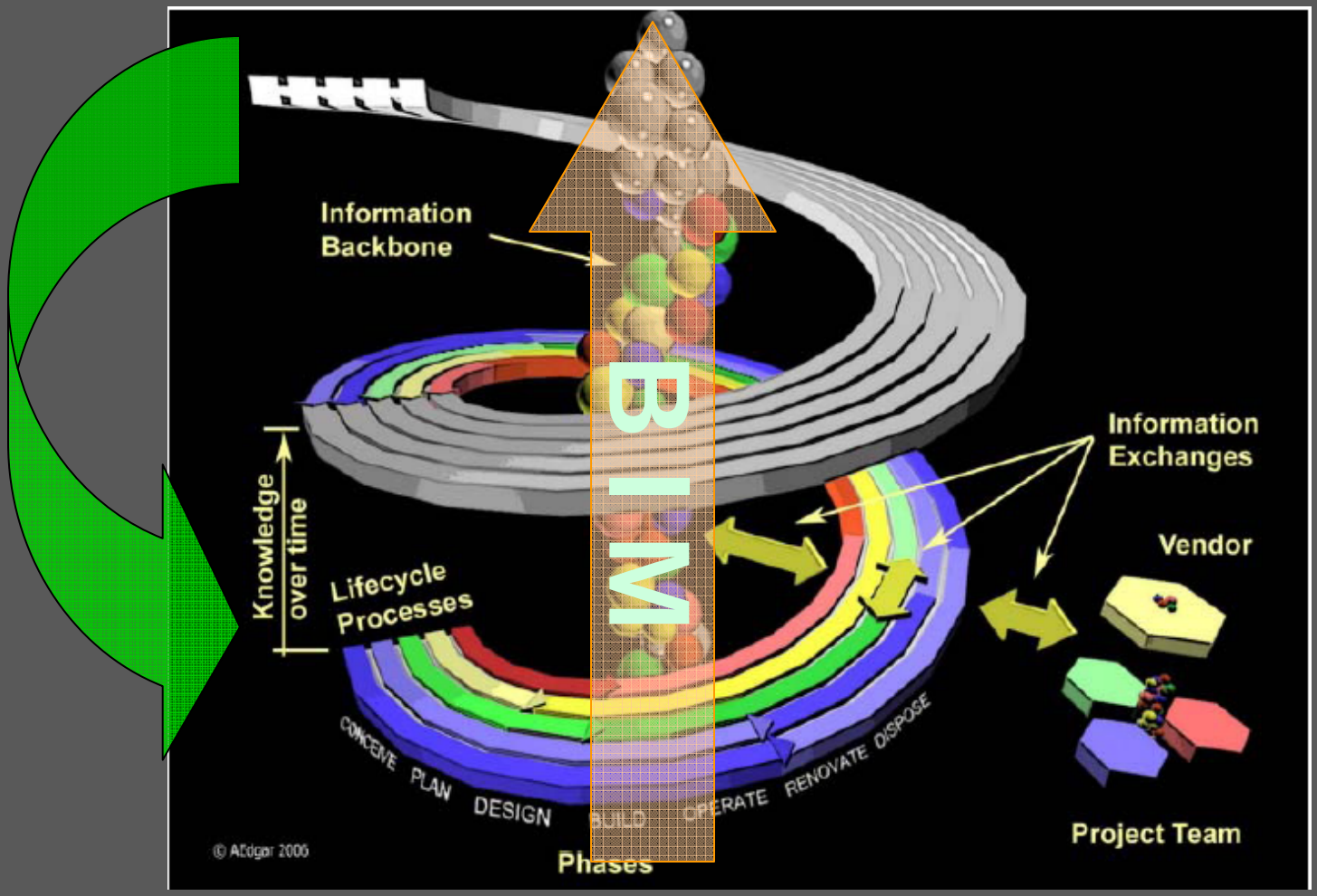




BIM - Building Operational Phase



Information Needs Through Building Life Cycle (NBIMS 2007)



Gone out...here is a computer simulation of your dinner

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Thank you
谢 谢

National Institute of Building Sciences

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International Alliance for Interoperability