



# Improve sustainability...

---

Billions



One



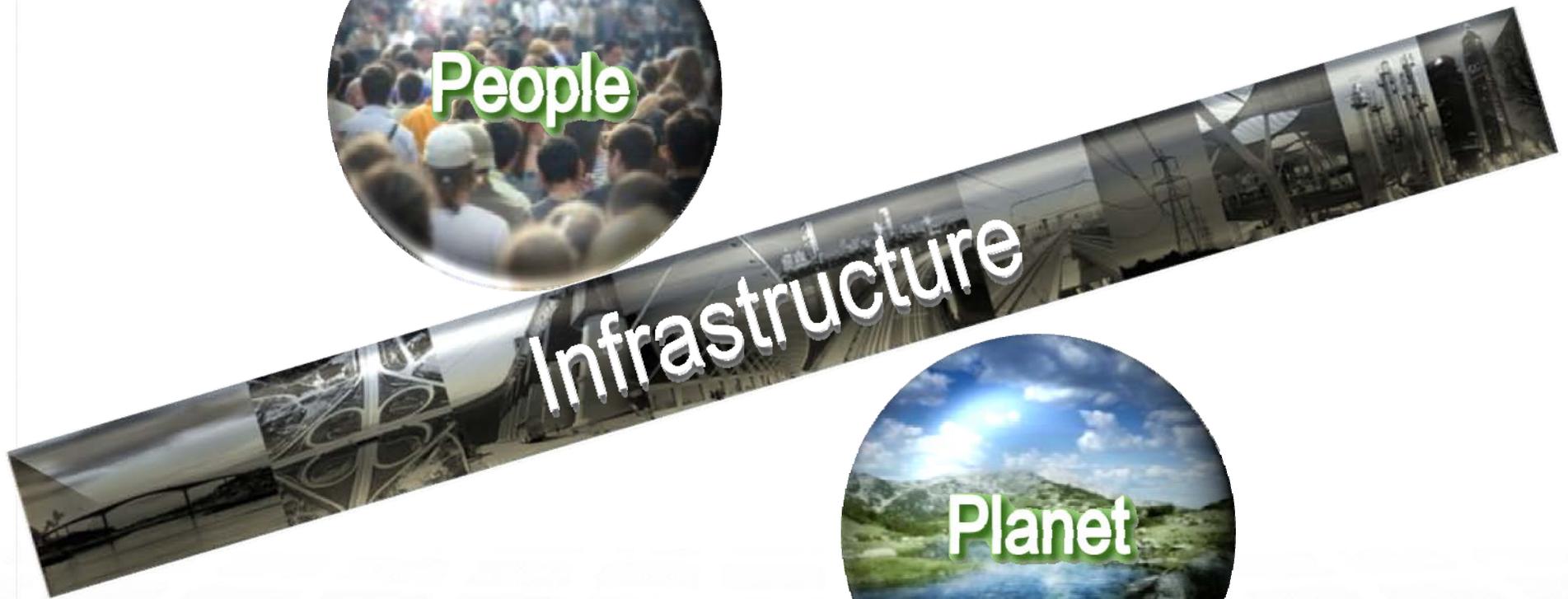
# By *Sustaining* Infrastructure...



Bentley's mission is to provide innovative software and services for the enterprises and professionals who design, build and operate the world's infrastructure - sustaining the global economy and environment, for improved quality of life.

# Sustaining Infrastructure?

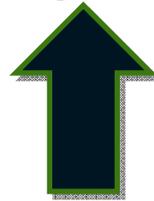
*Infrastructure*: the improvements made by People to our Planet...



# "Sustainability Index"?



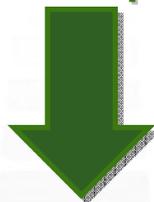
*Infrastructure can increase Economic Capacity...*



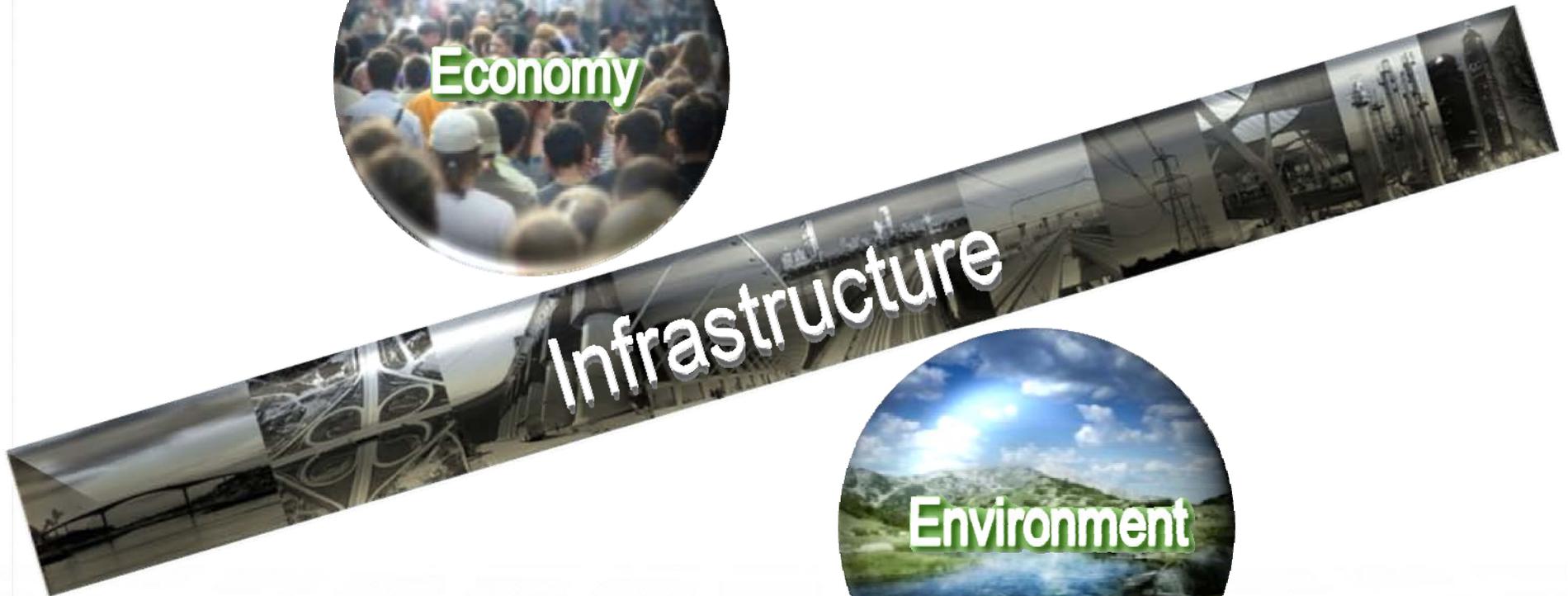
***Economic Capacity***

***Environmental Footprint***

*...and can (uniquely) reduce Environmental Footprint!*



# Responsibility for *Sustaining* Infrastructure?



# Enabling Resilient Development





**MINING**

- STAAD
- OpenPlant
- Raceway and Cable Management
- InRoads
- Bentley Map
- Descartes
- GEOPAK
- gINT
- RAM

**WATER & WASTEWATER**

- WaterGEMS
- SewerGEMS
- AutoPLANT
- OpenPlant

**BUILDINGS**

- AECOsim
- GenerativeComponents
- RAM
- ProStructures
- speedikon
- gINT

**CONSTRUCTION**

- ConstructSim
- ProjectWise
- Navigator
- ProStructures
- MicroStation

**3D CITIES**

- Bentley Map
- Geo Web Publisher
- Descartes
- InRoads
- AECOsim
- Geospatial Server

**NUCLEAR**

- eB
- AutoPIPE
- OpenPlant
- Raceway and Cable Management

**COMMUNICATIONS NETWORKS**

- Bentley Fiber
- Bentley Coax
- Inside Plant

**ROADS**

- InRoads
- GEOPAK
- MX
- SUPERLOAD
- LEAP
- RM
- Exor
- gINT

**BRIDGES**

- RM
- LEAP
- SUPERLOAD
- GEOPAK
- InRoads
- gINT
- MX
- ProStructures

**RAIL & TRANSIT NETWORKS**

- Bentley Rail
- Opttram
- InRoads
- MX
- RM
- GEOPAK
- LEAP
- gINT

**SUBSURFACE UTILITIES**

- WaterGEMS
- SewerGEMS
- sisNET
- Exor
- GEOPAK
- gINT
- InRoads
- MX

**POWER PLANTS**

- AutoPLANT
- OpenPlant
- AutoPIPE
- STAAD
- ProStructures
- Raceway and Cable Management
- AECOsim
- RAM
- gINT
- Descartes
- GEOPAK
- InRoads
- Bentley Map

**PROCESS PLANTS**

- OpenPlant
- AutoPLANT
- eB
- Raceway and Cable Management
- promis.e
- AutoPIPE
- ProStructures
- STAAD

**CAMPUSES**

- Bentley Map
- Descartes
- Geospatial Server
- AECOsim
- RAM
- STAAD
- Raceway and Cable Management
- GEOPAK
- InRoads
- gINT
- MX
- OpenPlant

**UTILITY NETWORKS**

- Substation
- sisNET
- Descartes
- GEOPAK
- gINT
- InRoads
- MX
- promis.e
- STAAD

**WIND FARMS**

- SACS
- STAAD
- ProStructures
- Substation

**OFFSHORE**

- SACS
- FormSys
- AutoPIPE
- STAAD
- ProStructures
- ConstructSim

**Sustaining Infrastructure**

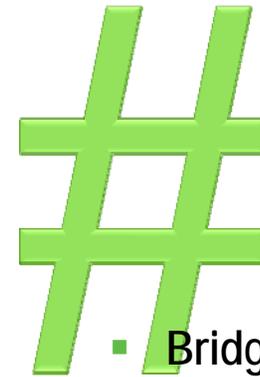
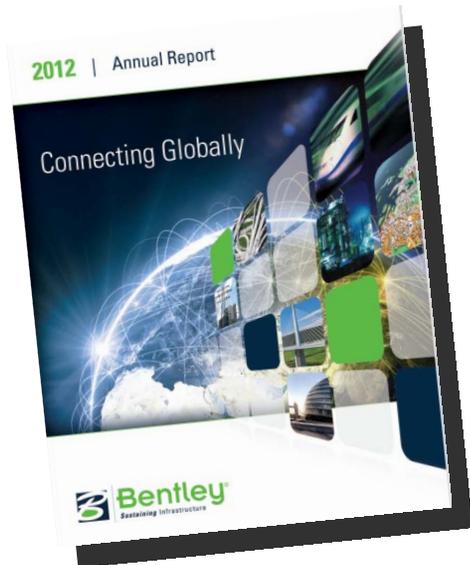
Bentley's Solutions



- MicroStation
- ProjectWise
- AssetWise
- Navigator

# 2012 Annual Report

View or download at:  
[www.bentley.com/annualreport](http://www.bentley.com/annualreport)

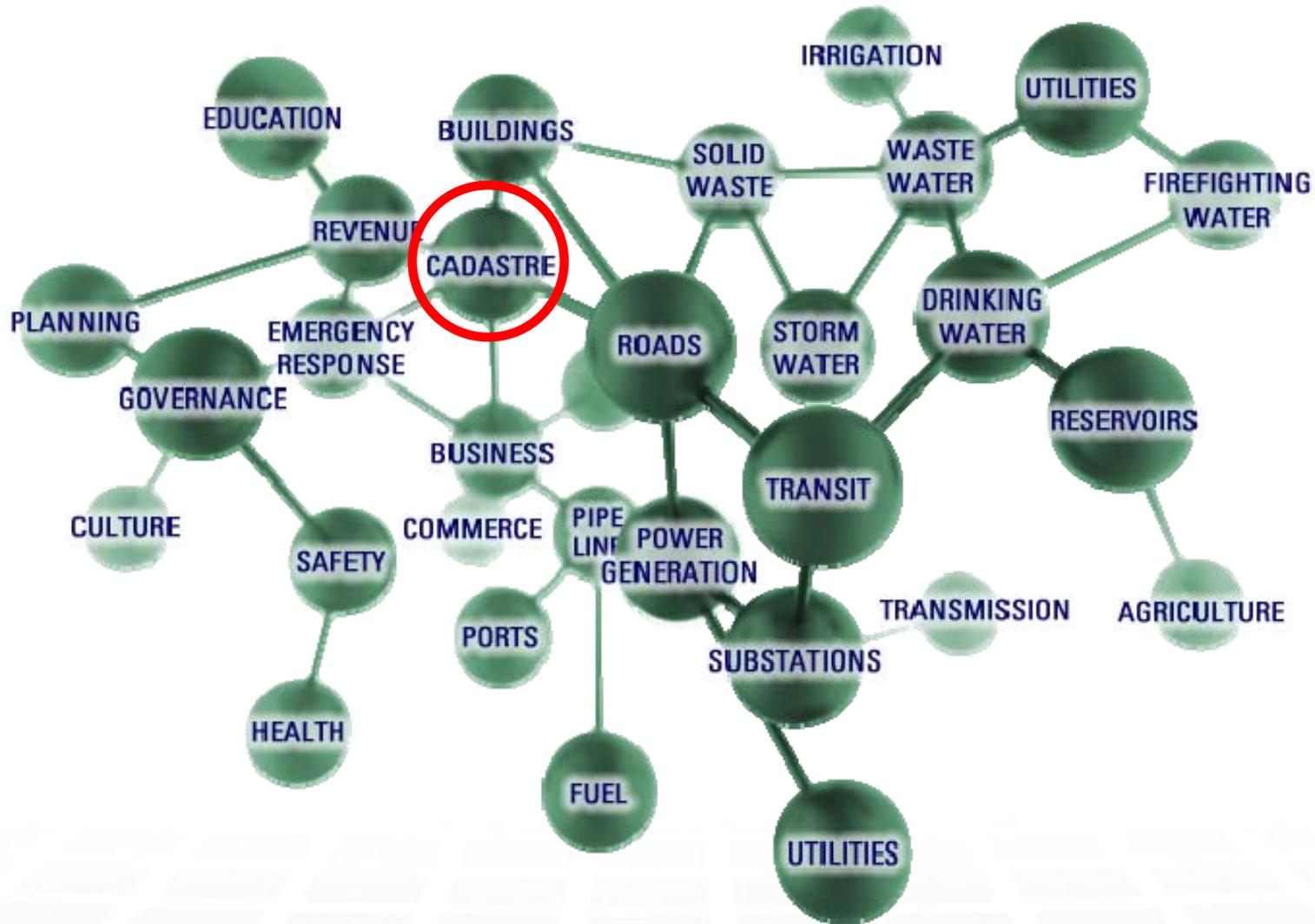


- Bridges
  - Roads
  - Rail and Transit Networks
  - Power Plants
  - Water and Wastewater Utilities
- 
- 3D City Modeling
  - Construction Simulation
  - Collaboration Services
  - Process Plant Operations
  - Structural Analysis

# 3D Cadaster



# Semantic Infrastructure



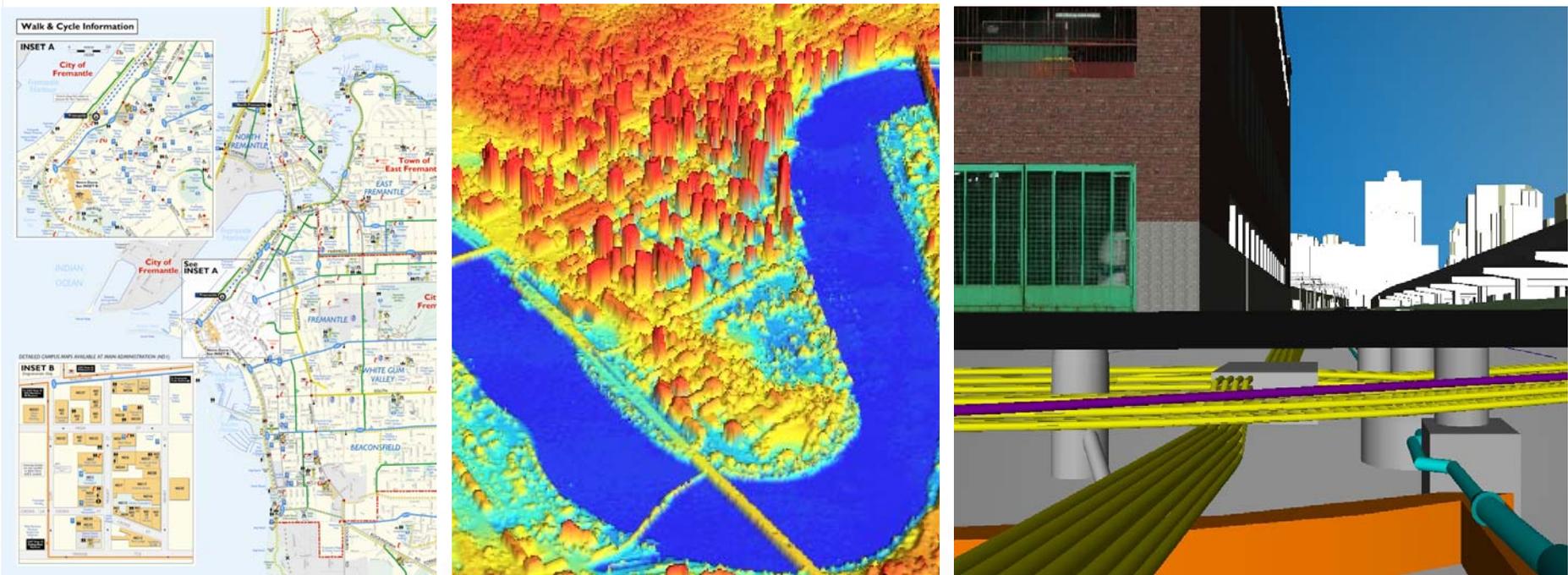
# Geospatial Developments

1990's

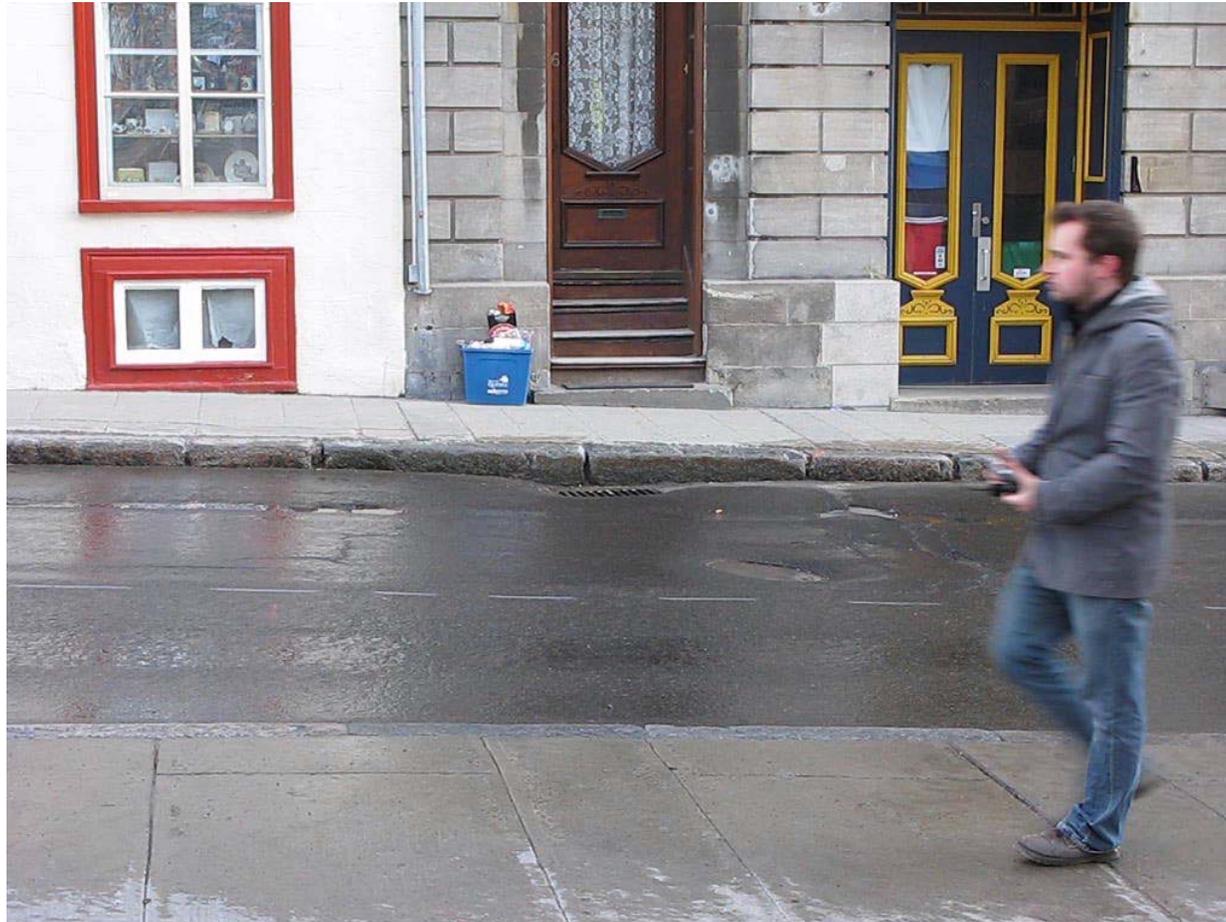
2000's

2010's

GIS Mapping + **Geospatial Modeling** + **Semantic Simulation**



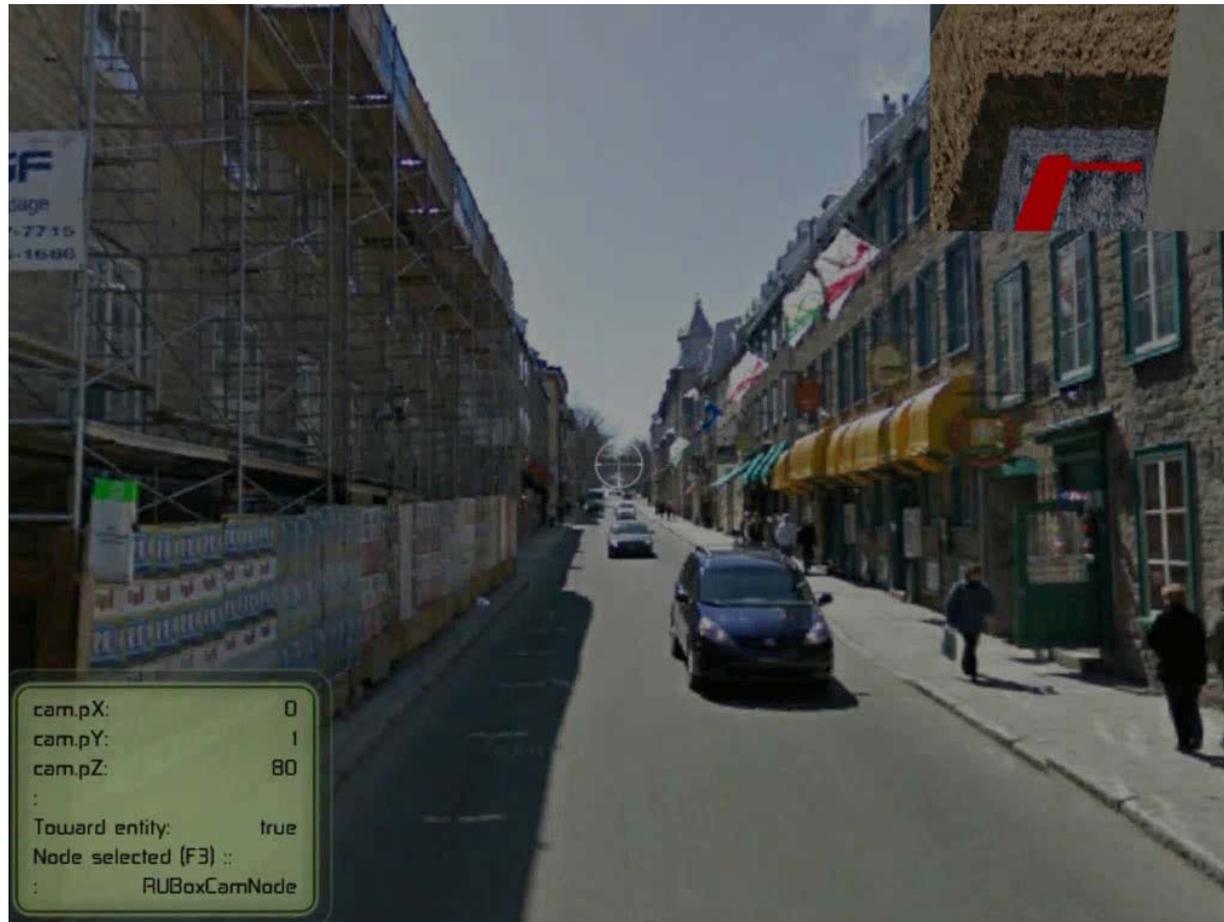
# Semantic Simulation



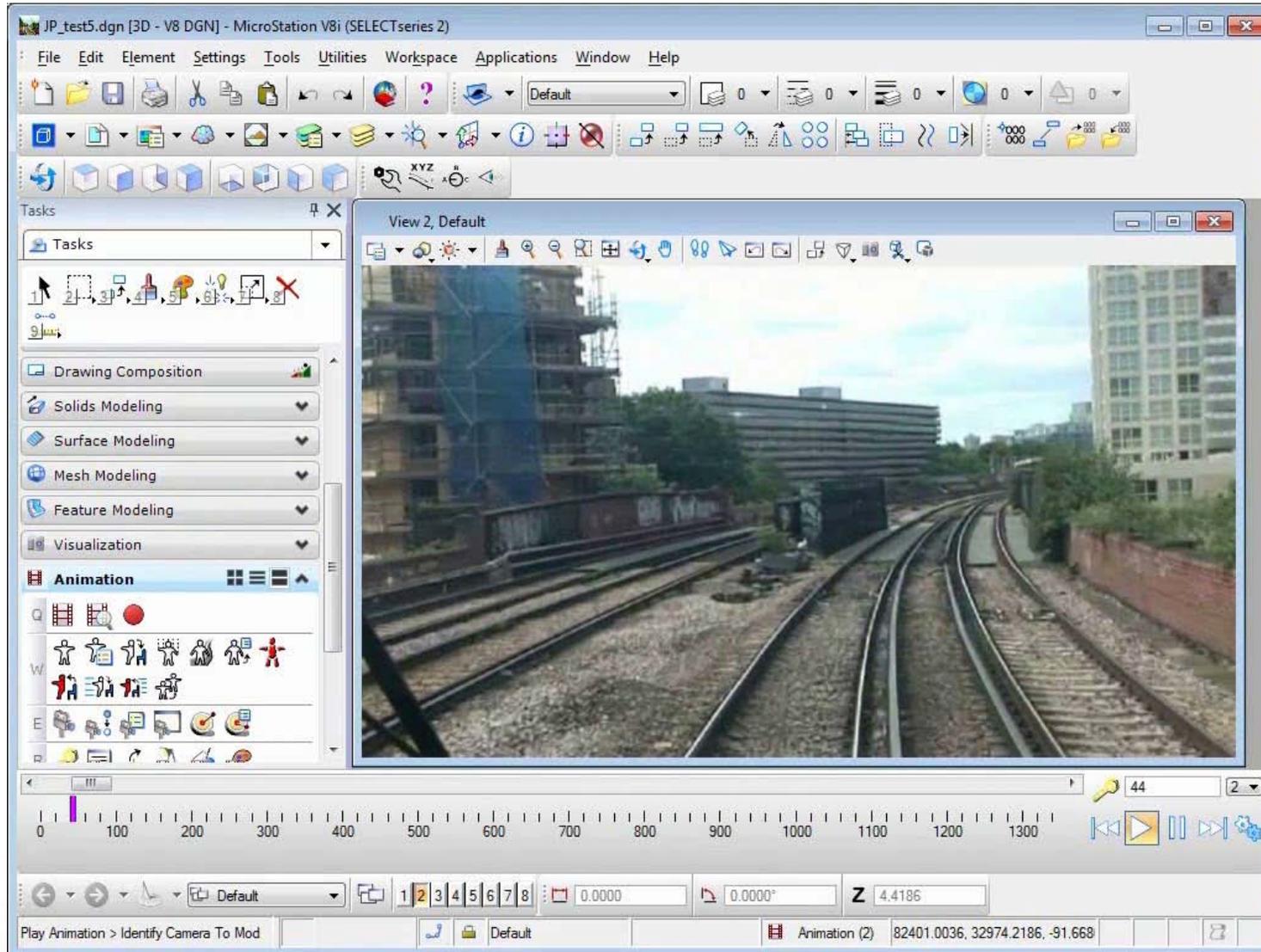
# Semantic Simulation



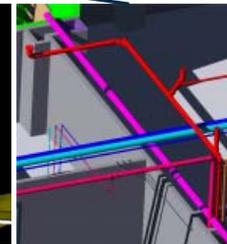
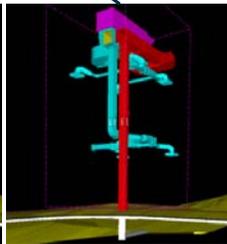
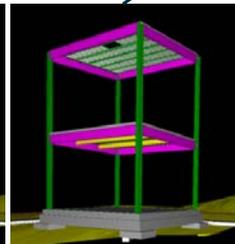
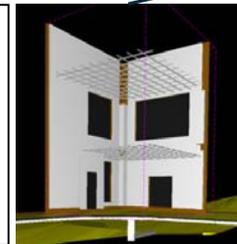
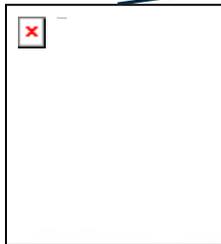
# Semantic Simulation



# Semantic Simulation



# Building Information Modeling



GEO

CIVIL

ARCH

STRUCT

MECH

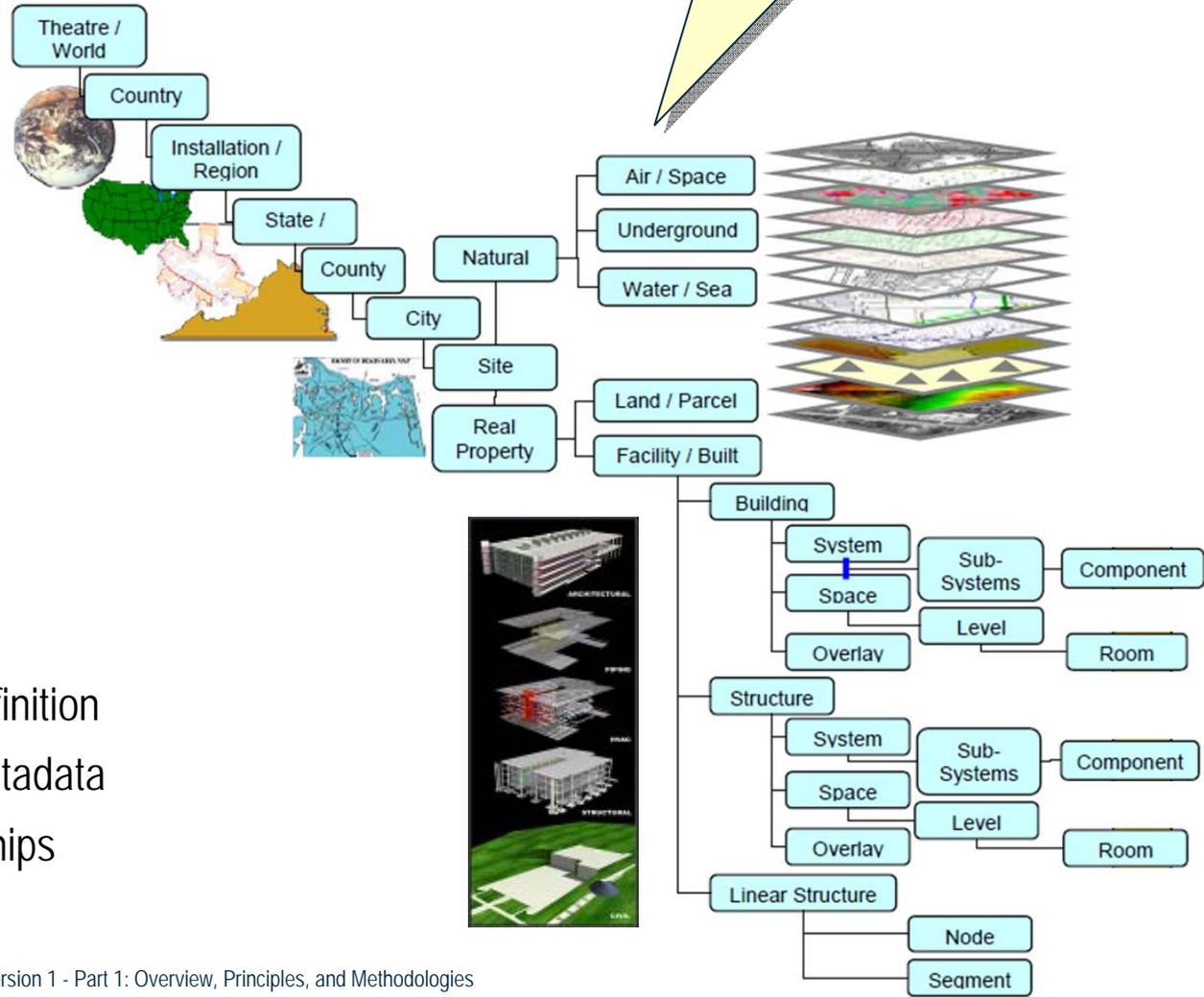
ELEC

PLUMB

FM

# GIS + BIM Data Schema

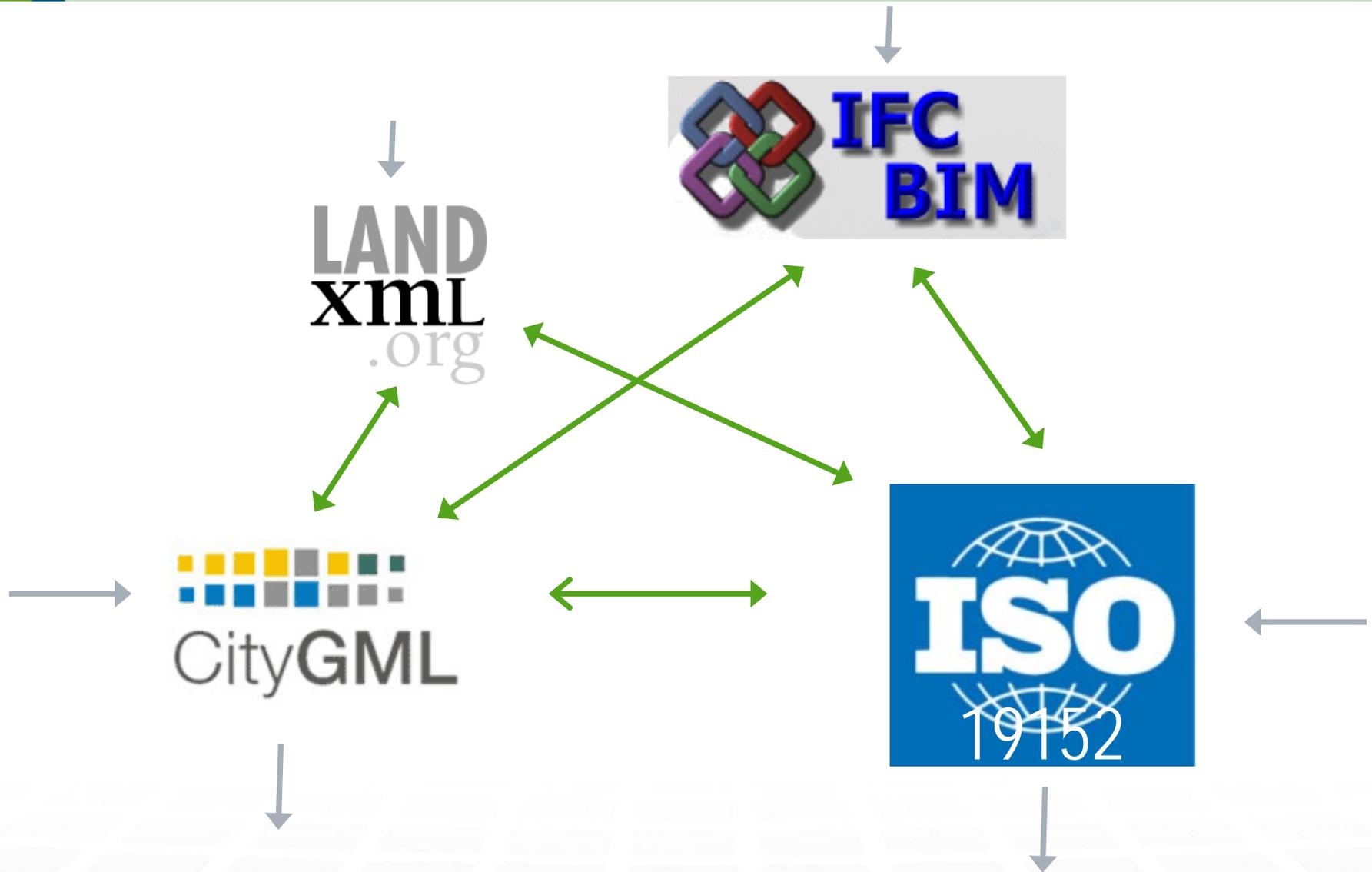
Common data model bridging both GIS and BIM



- Object definition
- Object metadata
- Relationships

National BIM Standard Version 1 - Part 1: Overview, Principles, and Methodologies

# Standards



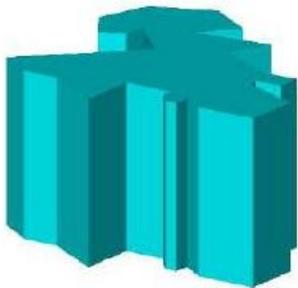
# BIM vs. 3D GIS world

---

- The BIM/IFC world
  - Detailed 3D building volumetric and advanced surface geometry BIM objects
  - Detailed business data
  - Focus on file based exchange
  - Typically used for modeling *new building design*
- The 3D GIS world
  - Planer surface geometry boundary objects
  - Variable Level of Detail (LoD)
  - Focus on server based (central)
  - Typically used for modeling *existing data*

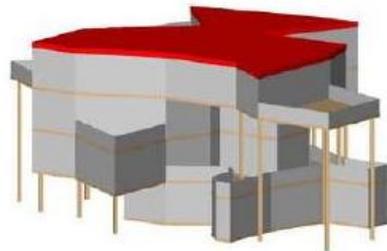
# CityGML Levels of Detail (LoD)

- CityGML Levels of Detail (LoD) for each object
  - LoD 0 - Building footprint on topographic surface
  - LoD 1 - Extruded building footprint with flat roof
  - LoD 2 - Add roof slopes and detail
  - LoD 3 - Add door and window openings
  - LoD 4 - Add interior partitions



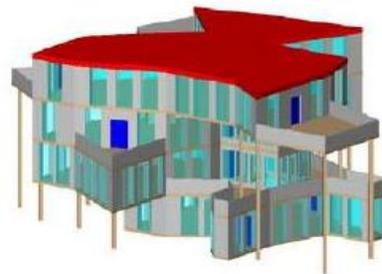
**LoD 1 Model**

**File size: 0.02 MB**



**LoD 2 Model**

**File size: 0.7 MB**



**LoD 3 Model**

**File size: 4.9 MB**



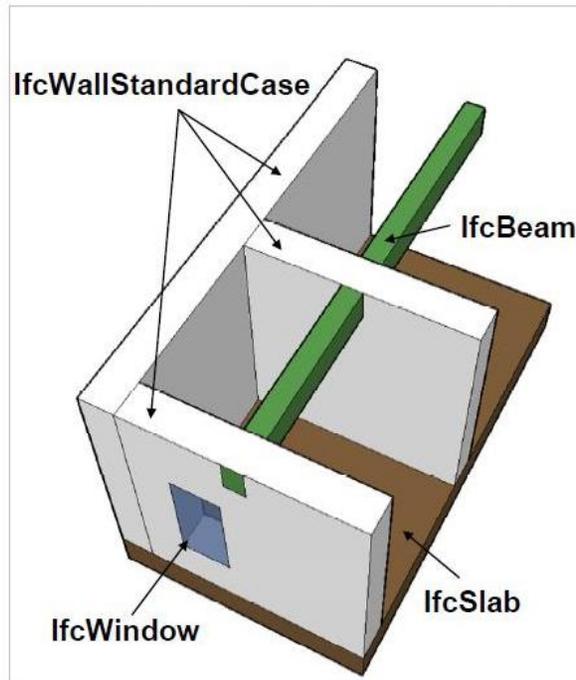
**LoD 4 Model**

**File size: 8.7 MB**

# BIM/IFC vs. CityGML Modeling

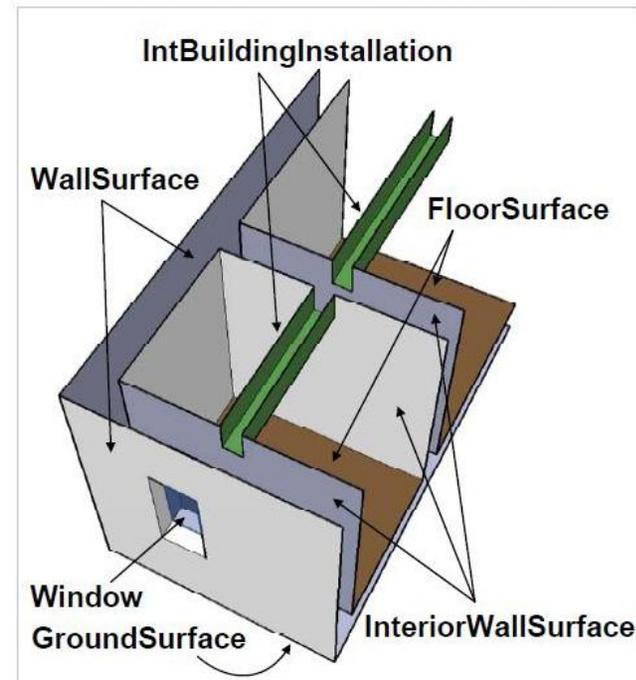
## Differing Modeling Paradigms

**BIM (e.g., IFC)**  
Constructive Solid Geometry



Volumetric, parametric primitives representing the structural components of buildings

**3D GIS (e.g., CityGML)**  
Boundary Representation



Accumulation of observable surfaces of topographic features

(C) slide from: Thomas H. Kolbe - joint work with Claus Nagel & Alexandra Stadler

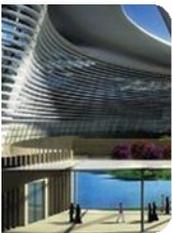


# Findings

---

- It can be done, but...customizations data case specific and are only partially reusable from case to case
- Should only be employed after the use case is defined, the input IFC specifics are known and output requirements are specified



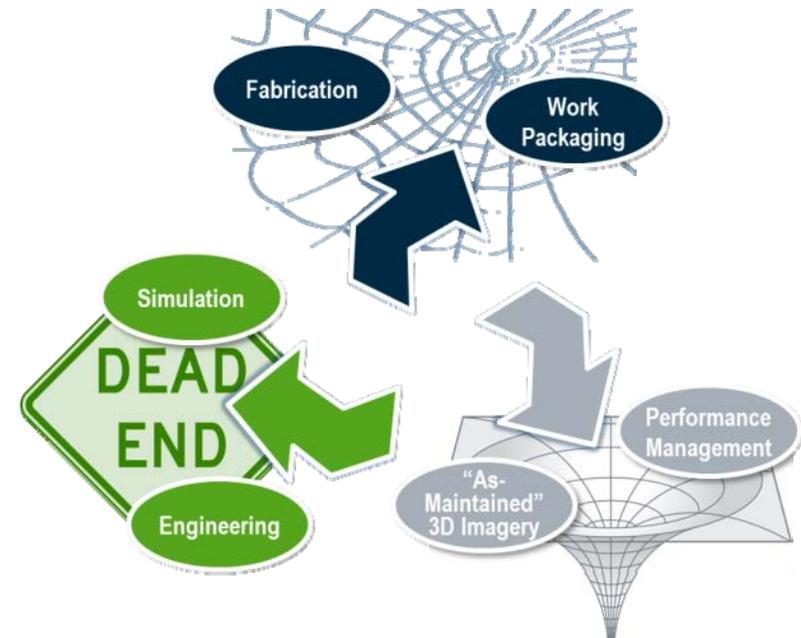
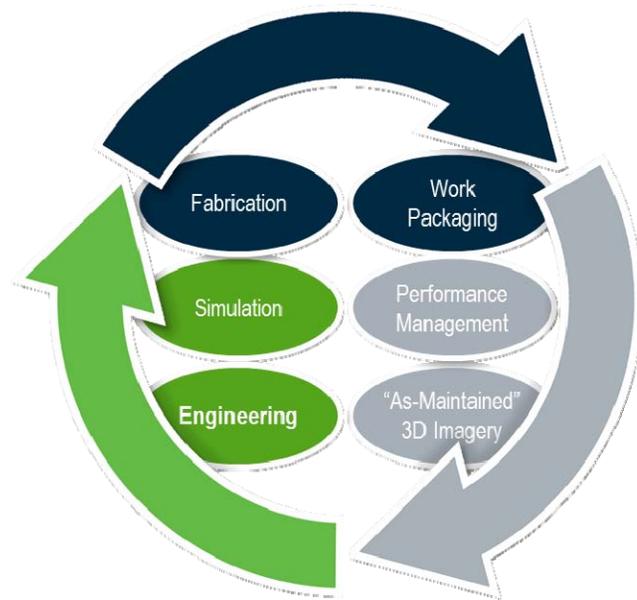


## Side note: Information Mobility

# Information Lifecycle

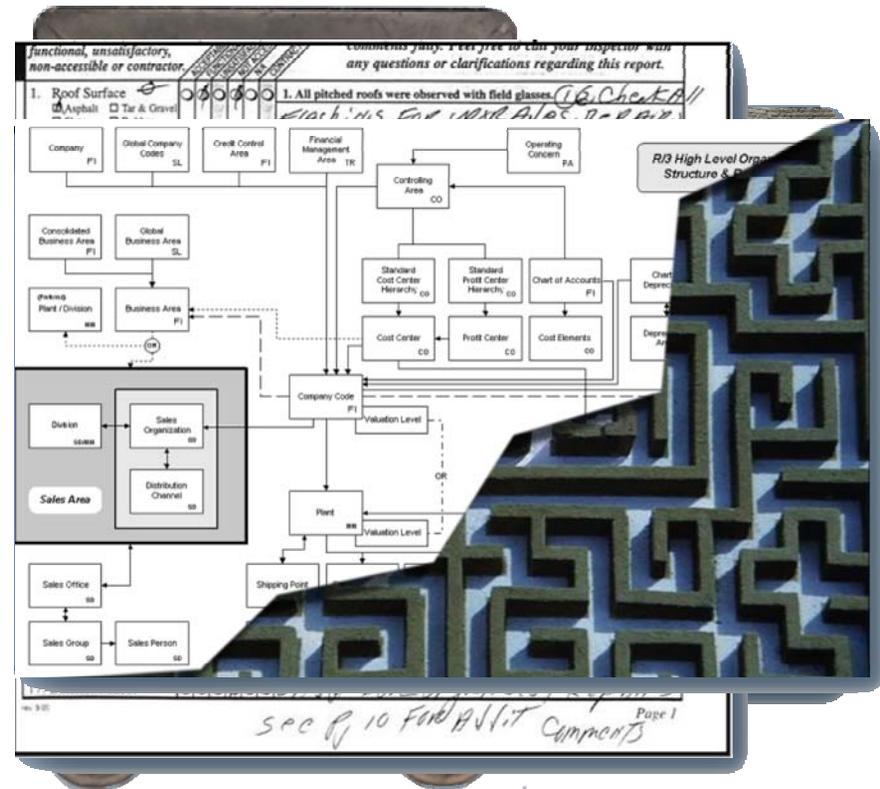
VS.

# Information Mortality



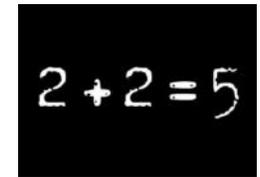
# Information Mortality...

"Blobs" of closed information  
 Monoculture data silos  
 Enterprise labyrinth



# Information Mortality *Waste...*

Can't ~~Eliminate~~ *Eliminate*  
the work



No access for  
unauthorised  
persons

# Information Lifecycle (!)

- Information Mortality...
- Information *Mobility!*



# Information *Mobility* (at Work!)

Delivering  
Referencing  
Reusing  
Reviewing  
Transforming  
Sharing  
Updating  
Approving  
Improving  
Validating  
Analyzing



# Information Mobility *Dividends*

- Quality
- Confidence
- Teamwork
- Alignment
- Virtualization
- Globalization
- Agility
- Responsiveness
- Synchronization



# Standards for Information Mobility

---



