

# SDI Program at the University of Chicago

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## **SDI Program at the University of Chicago**

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- **Discussion Outline**
  - **University/Facilities Services**
  - **The Story Begins.....**
  - **Major Components of SDI Program**
  - **Support Operations – Current & Future**
  - **Conceptual Design**
  - **Current Status**
  - **Next Steps**

## SDI Program at the University of Chicago

- **University and Facilities Services Department**
  - **Worldwide facilities, Medical Center, national labs**
  - **Nearly \$500 million a year in research**
  - **400 buildings, 20 million square feet**
  - **Department Divisions:  
Planning/Design/Construction/Operations**



## SDI Program at the University of Chicago

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- **The Story Begins.....**
  - Brought in initially to build the GIS – BUT!
  - **The Silos.....**
    - ✓ Both GIS and BIM are coming on line
    - ✓ Big repository of CAD drawings
    - ✓ LiDAR point clouds will develop even more data!
  - **So What is Correct????**
    - ✓ Need a approach to utilize all spatial data – SDI

***Its not a GIS or BIM/CAD – its SPATIAL DATA!!!!***

## SDI Program at the University of Chicago

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- **Goal & Objectives:**
  - **Goal:** Provide a SDI that is fully interoperable in order to add value to the Operation and Academic missions of the University.
  - **Objectives:**
    - ✓ Single Version of Reality
    - ✓ Include ALL physical assets  
*well...not nuts and blots!!!*
    - ✓ Model to include 3D & 4D capability for assets
    - ✓ Built to International Open Standards (OGC)

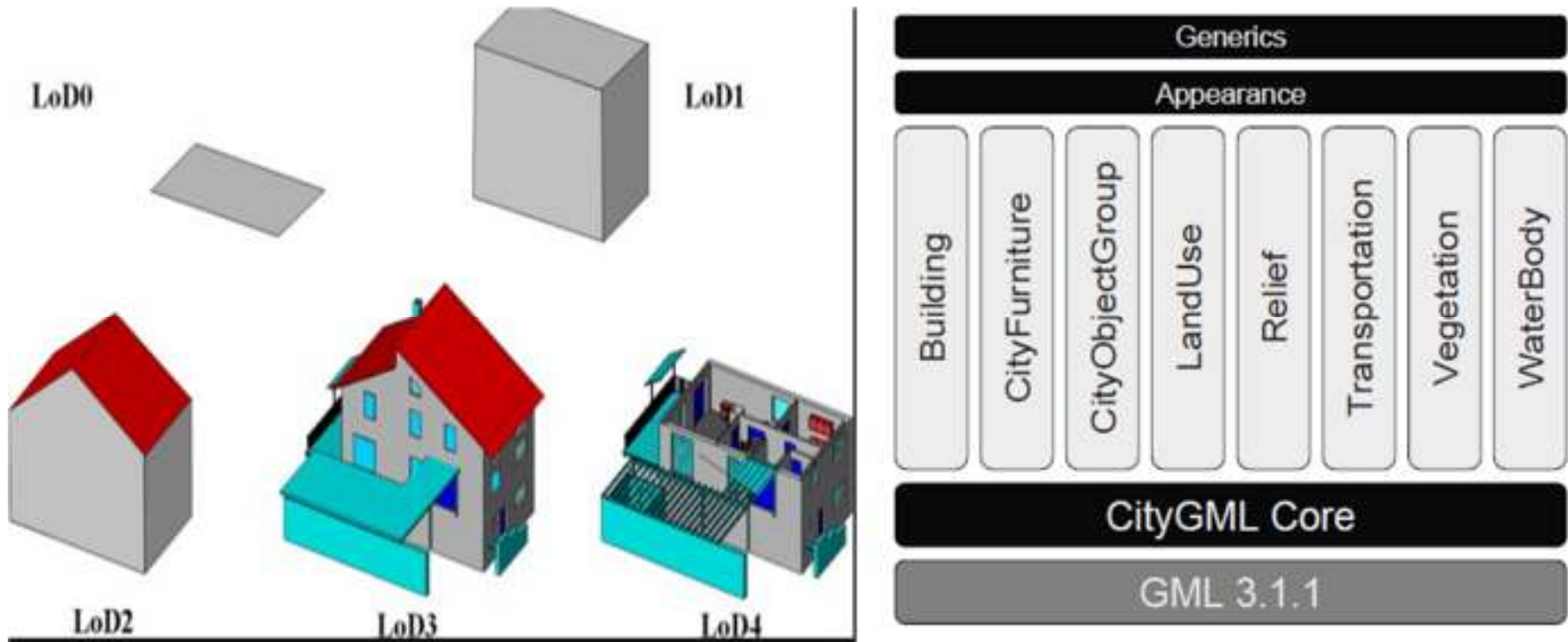
## **SDI Program at the University of Chicago**

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- **Major Components of SDI Program:**
  - **Open Data Model/Systems of Record**
  - **Spatial Accuracy – different acquisition/results**
  - **Support Department Operations: existing and new**

# SDI Program at the University of Chicago

- **Open Data Model/Systems of Record (SOR)**
  - **Open Data Model – CityGML**
    - ❖ **Geometry/LOD/Ontology-Semantics**



## SDI Program at the University of Chicago

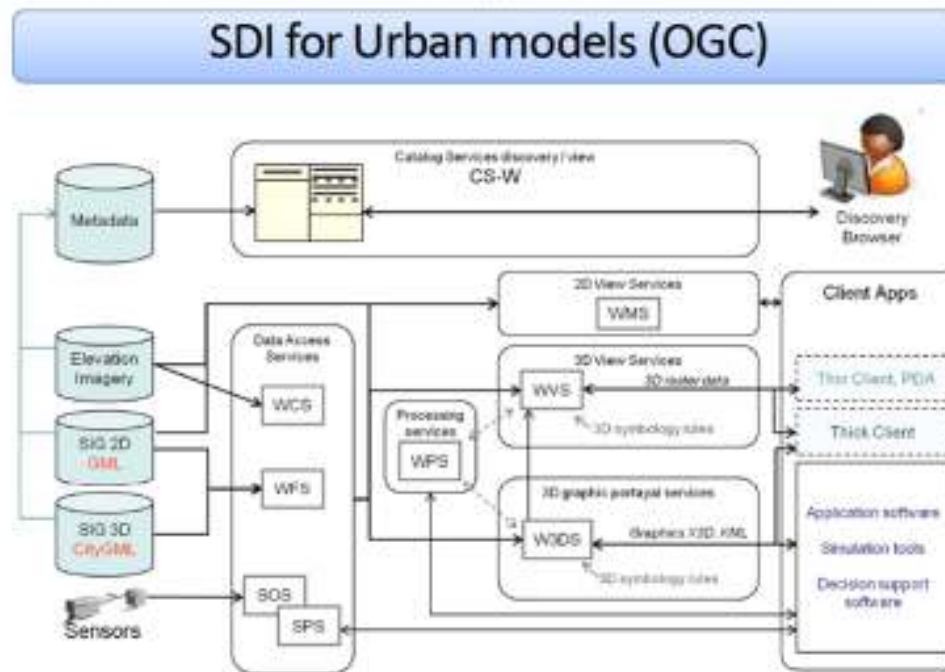
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- **Open Data Model/Systems of Record (SOR)**
  - **Systems of Record: CAD/BIM/GIS**
    - ❖ Existing applications/modeling support
    - ❖ CityGML adding spatial data objects as needed



## SDI Program at the University of Chicago

- **Open Data Model/Systems of Record (SOR)**
  - **OGC Open Standards**
    - ❖ **Open Web Services (OWS) Sensors (Smart Cities), COBie (Asset Management)**



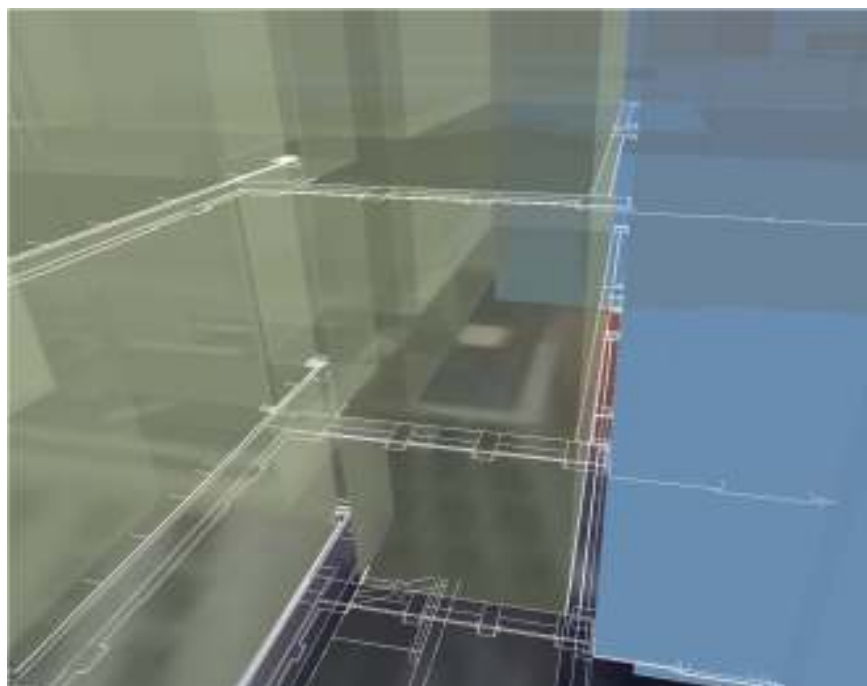
## SDI Program at the University of Chicago

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- **Open Data Model/Systems of Record (SOR)**
  - **The Balance...**
    - ✓ **Central Repository (CR) – how much is enough?  
SOR will have all the data.**
  - **The Challenge....**
    - ✓ **Not all of the CityGML/GML standards are completely in place – but its coming!**
    - ✓ **Few Software/Models run in CityGML – but this is changing with OWS plugging into spatial models**

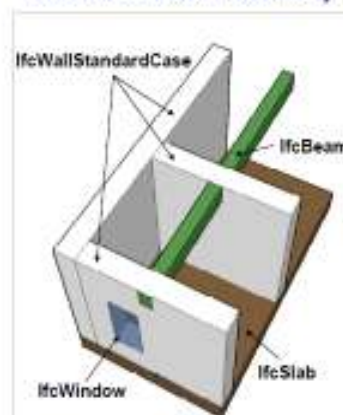
# SDI Program at the University of Chicago

- **Spatial Accuracy**
  - Data Harvesting from the SOR's
  - Data Harmonization



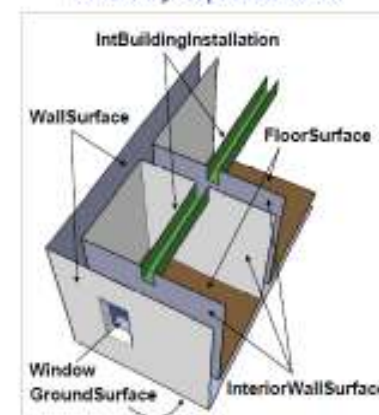
## Differing Modeling Paradigms

**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



## SDI Program at the University of Chicago

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- **Spatial Accuracy: Data Harvesting from SOR's**
  - Data Acquired from different models and sources
  - Varying levels of Accuracy – Class System
  - Often not in State Plane

*How we will Address with these issues:*

*Standards & Templates: (Data Creation)*

*People: Program Managers – BIM, GIS, CAD & SME's  
(SOR Management)*

## SDI Program at the University of Chicago

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- **Spatial Accuracy: Data Harmonization**
  - Central Repository (CityGML) is very large/complex – rule based system:
    - ✓ Geometric: connectivity
    - ✓ Retain/Replace: SOR and Data Classes
    - ✓ ‘Coherent Spatial Unit’ concept for spatial objects: replacement/archive/future

*Will attempt to hit the 80/20 rule – some manual review will be required.*

*Fully leverage **Oracle Spatial/Golden Gate** Technology*

## **SDI Program at the University of Chicago**

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- **Support Operations – Current:**
  - **Space Management: Archibus – CAD only**
  - **Asset Management: Maximo – BIM/GIS**
  - **Engineering/Landscape Architecture – CAD**
  - **System Modeling/Monitoring – CAD/BIM**

## SDI Program at the University of Chicago

- **Support Operations – Future:**
  - **Space Optimization: NASA – ArcGIS Server**
  - **Visualization: Central Repository/Virtual Campus**
  - **Map front end for the FS Catalog:**
    - ✓ **Get to all data sources within the Department**
    - ✓ **Link into SOR objects for the details**



## **SDI Program at the University of Chicago**

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- **Support Operations – Future:**
  - **Space Optimization: NASA – ArcGIS Server**
    - ✓ **Key Functionality:**
      - Schematic Presentation of the Campus
      - Models important variables in the space planning process for Planning & Design
      - Real-Time Web Based Scenario application



## **SDI Program at the University of Chicago**

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- **Support Operations – Future:**
  - **Visualization: Central Repository/Virtual Campus**
    - ✓ **Key Functionality:**
      - Consolidation of the existing data sources (BIM/CAD/GIS) into 3D model
      - Advanced Immersed Visualization System: UIC EVL CAVE
      - Advanced Visualization System – informs the data modeling process

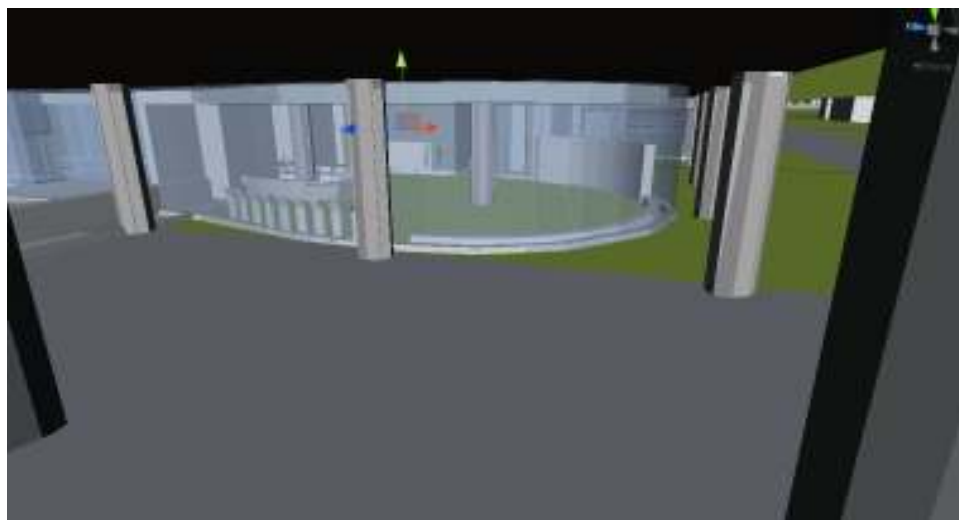
## SDI Program at the University of Chicago

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- **Visualization - UIC EVL:**
  - **Data Consolidation Methods**
    - ✓ **GIS: CityEngine** data for the ‘Base’ of the model roads and buildings - FBX
    - ✓ **CAD: building footprints/ 3D CAD Model - FBX**
    - ✓ **BIM: Revit** with FBX export into **3ds MAX**
    - ✓ **SketchUp: migrated to CityEngine via Collada**
    - ✓ **Used Unity** Gaming software for final Model

## SDI Program at the University of Chicago

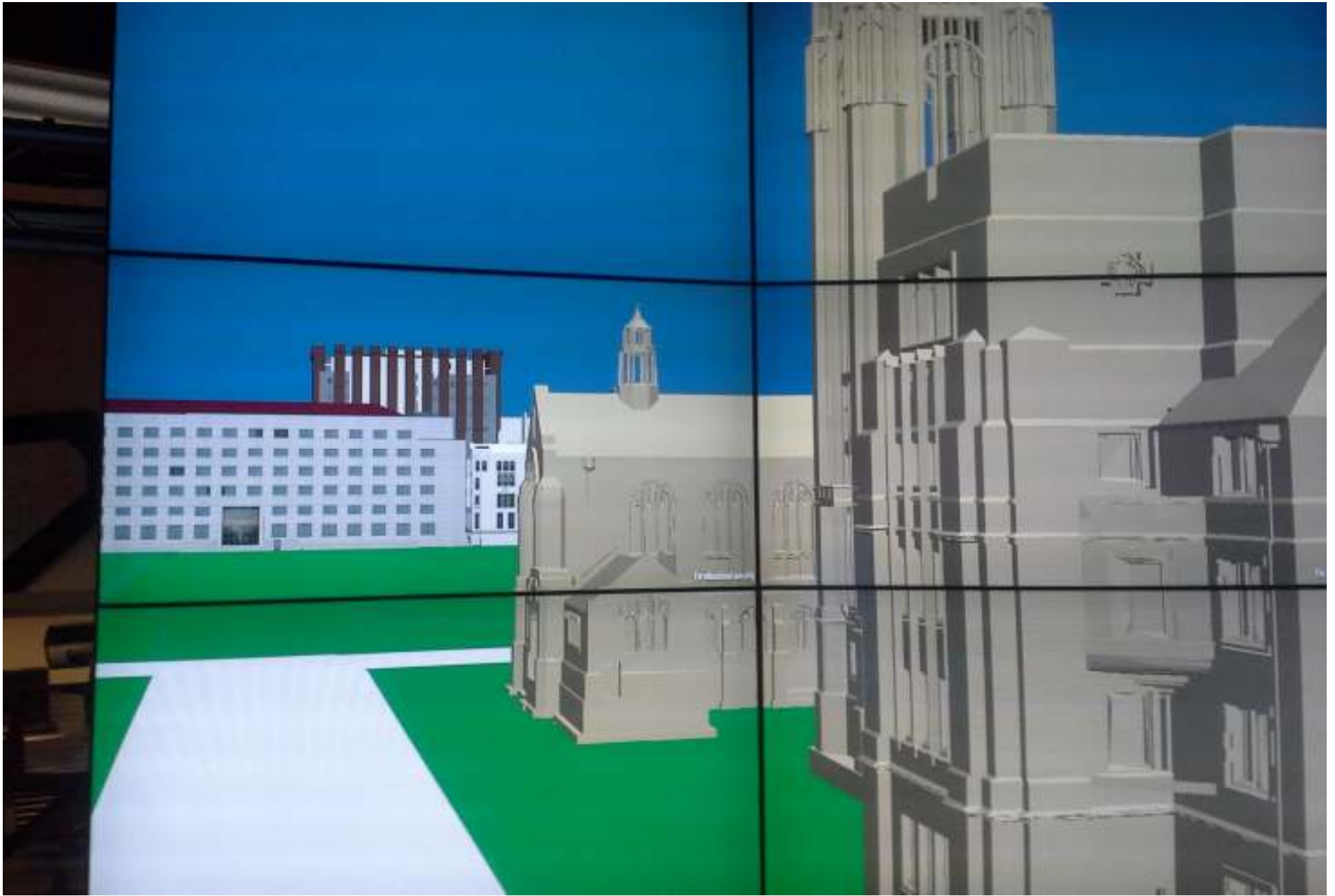
- **Visualization - UIC EVL:**
  - **Virtual Campus Specifications:**
    - ✓ **Over 2 million objects**
    - ✓ **2,000 texture files: images and graphics**
    - ✓ **Total Model size: 2.5 GB**
    - ✓ **This is a small model – only 4 buildings are BIM**



## SDI Program at the University of Chicago

- **Visualization - UIC EVL:**
  - **CAVE2 – Virtual Reality System**
    - ✓ 320 degree panoramic 3D that matches human visual acuity
    - ✓ 480 SqFt of viewing surface
    - ✓ .029 inch per pixel resolution – 100 million pixels
    - ✓ 10 camera optical tracking system

















## SDI Program at the University of Chicago

- **Visualization – Evaluation of Euclidean Technology**
  - **Unlimited Detail (UD) for Point Clouds:**
    - ✓ Can use Data Sets of any size
    - ✓ No Reduction of Resolution
    - ✓ Does not require massive Computing Power
    - ✓ Extremely Fast to Load and use



## **SDI Program at the University of Chicago**

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- **Visualization – Evaluation of Euclidean Technology**
  - **UD Technology: the basics:**
    - ✓ **3D search algorithm – establishes one point for every screen pixel (called Atomization)**
    - ✓ **Seamless display of the image – zoom from large to small scale instantly**
    - ✓ **At full resolution: photographic quality – but it's a 3D model of space**
    - ✓ **Data size of point cloud is compressed**

## **SDI Program at the University of Chicago**

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- **Visualization – Evaluation of Euclidean Technology**
  - **Pilot Project for the Central Quadrangle:**
    - ✓ **Interior/Exterior Point Clouds for 37 Halls**
    - ✓ **Terrestrial LiDAR from Cook County**
    - ✓ **Existing BIM models for buildings**
    - ✓ **CAVE2 Visualization Environment**

## **SDI Program at the University of Chicago**

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- **Visualization – Evaluation of Euclidean Technology**
  - **Potential Impacts to SDI Program:**
    - ✓ **Visualization will be done via Point Clouds**
    - ✓ **Spatial parameters and objects will still be needed**
    - ✓ **Could result in a very simplified physical model:**
      - **Points in 3D space with unique ID's?**
      - **Do we need full geometry for modeling purposes?**
      - **Spatial objects extracted from point clouds?**
      - **Lowering Price points of LiDAR technology**

## **SDI Program at the University of Chicago**

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- **Conceptual Design – SDI Program:**
  - **Planning/Design/Construction/Management – Major Components:**
    - ❖ **Planning – Space Optimization**
    - ❖ **Design – program package/design evaluation**
    - ❖ **Construction – E-builder: management/payouts**
    - ❖ **Management - COBie, Central Repository, Catalog, Visualization**

## SDI Program at the University of Chicago

- **Conceptual Design – SDI Program:**
  - **Case Study: Building Energy Efficiency**
    - ❖ **Program: Program Development/Specifications**
    - ❖ **Design: Energy modeling – Building Performance**
    - ❖ **Construction: Quality Control/Inspections**
    - ❖ **Management: EMIS, calibrate BAS, post occupancy audit, changes in FS energy modeling efforts.**





## **SDI Program at the University of Chicago**

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- **Current Status - Completed:**
  - **SDI Program Plan**
  - **Initial Visualization Testing – CAVE2**
  - **CAD/GIS Standards**
  - **Core Collaborative Partners established for key implementation areas**



## SDI Program at the University of Chicago

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- **Next Steps:**
  - **Completing Systems of Record/Establishing Standards/Methods:**
    - ✓ **BIM Standards – mid 2015**
    - ✓ **Evaluation of Euclidean Technology - 2015**
    - ✓ **GIS SOR: Utilities – GIS end of 2016????**
    - ✓ **BIM SOR: Existing Buildings – long time horizon**
  - **System of Record > Data Harvesting > Central Repository (CR): Buildings end of 2015?**
  - **Building the Data Management Tools (CR): start in 2016**

## SDI Program at the University of Chicago

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- **Next Steps:**
  - **System of Record > Data Harvesting > Central Repository (CR): Started September 2014**
    - ✓ Collaboration with **Fondazione Graphitect** – current data sources in GIS and BIM to CityGML format
    - ✓ Esri extended support for CityGML data
  - **Building the Data Management Tools (CR): start in 2016**
    - ✓ Building Oracle Spatial Data Repository and Management System

## SDI Program at the University of Chicago



Thank You

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