KICT KOREA INSTITUTE of CONSTRUCTION TECHNOLOGY

Design and Implementation of BIM and GIS Interoperability Open-Platform

Changhee Hong[1], Juhyeon Gim[2] , Heegu Park[2]

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1. Korea Institute of Construction Technology
2. Gaia3D, Inc.

Gaia3D The GeoSpatial Company

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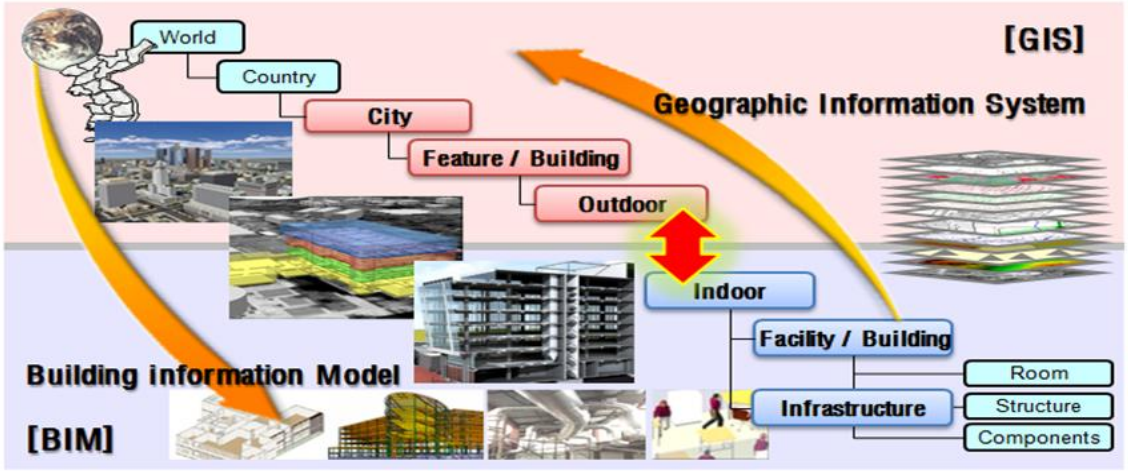
Contents

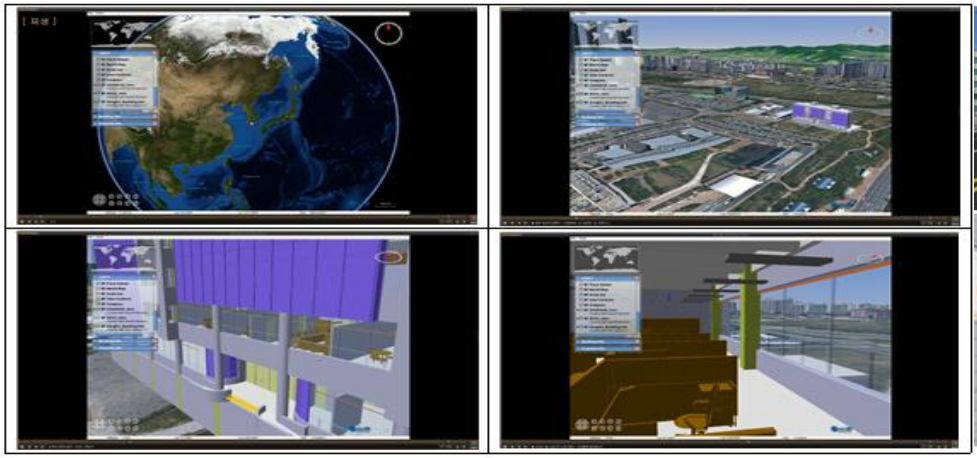
Gaia3D The GeoSpatial Company

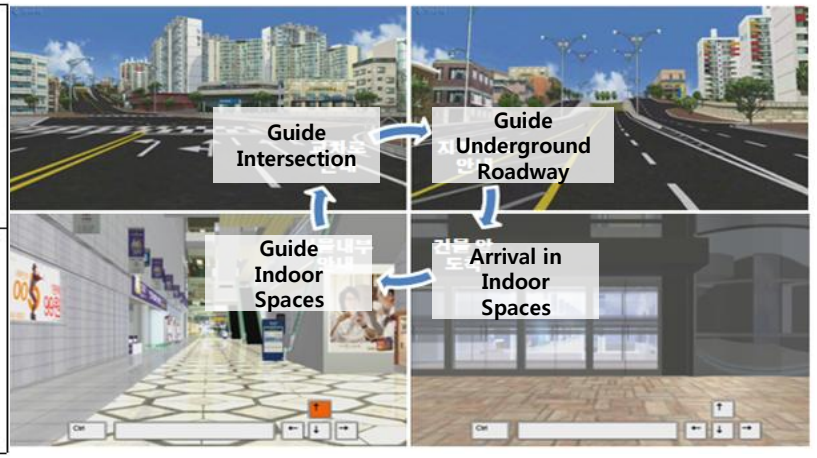
Concept

- Development of a data model to integrate BIM data with GIS data to connect indoor with outdoor
- Development of BIM and GIS interoperability platform for application services



GIS	Geospatial Information
CityGML	GIS Standards
IN/OUT door GI Model (Geospatial Information Model)	OUTdoor Model
	INdoor Model
IFC	BIM Standards
BIM	Construction Drawings Info.





Overall Progress Schedule

Objectives

- Development of BIM & GIS Interoperability Open-Platform

Contents

- Developing geospatial data format for BIM on GIS
- Developing algorithm for LOD representation
- Developing visualization technology about geospatial data of massive BIM on GIS
- Developing Interoperability Platform for BIM on GIS
- Platform Stabilization/Commercialization and development application services

Annual R&D

Implementation Strategy

Base Research
Pilot Implementation, Architecture Design, Specification Definition

Key Technical Elements
Data Model, Element Technology Platform Sever

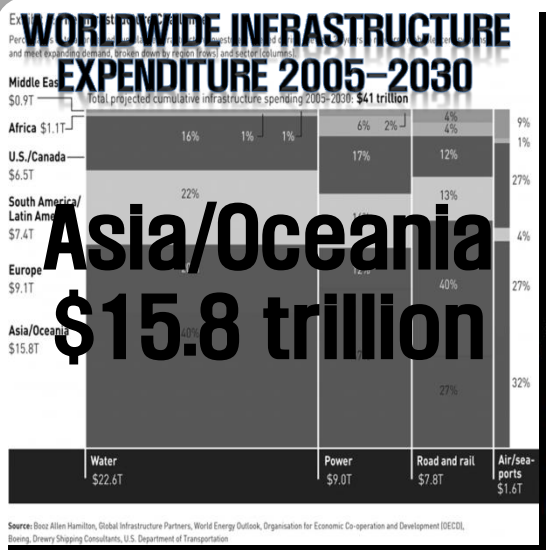
Platform Develement
Adaptive LOD, 3D Visualization Technology, BIM/GIS Platform

Commercialization
Stabilization, Performance Improvement S/W Packaging, Application and Service Technologies

First Year (2012) | Second Year (2013) | Third Year (2014) | Fourth and Fifth Year (2015-2016)

Technology Trends

Perspective of Autodesk



Task Force on America's Future Energy Jobs

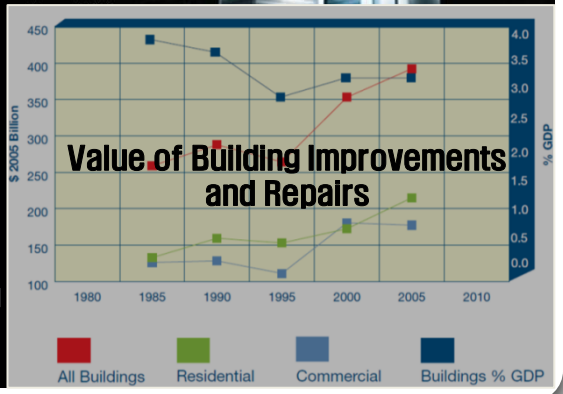
Shrinking workforces

Bipartisan Policy Center

- 30-40% of the 400,000 people employed in electricity generation, transmission, and distribution are expected to retire or the leave the industry by 2013
- 60 000 addition workers needed by 2030 to operate and maintain new smart grid and renewable energy networks
- 90 000 people required to deploy smart grid networks

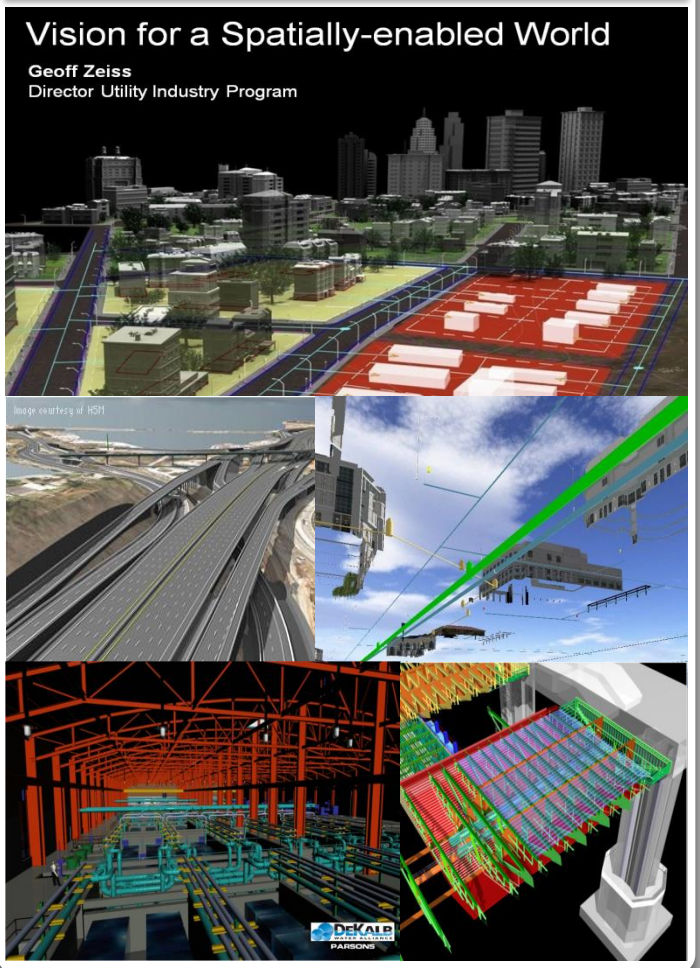
http://bipartisanpolicy.org/library/report/task-force-americas-future-energy-jobs-executive-summary-and-policy-recommendations

Autodesk



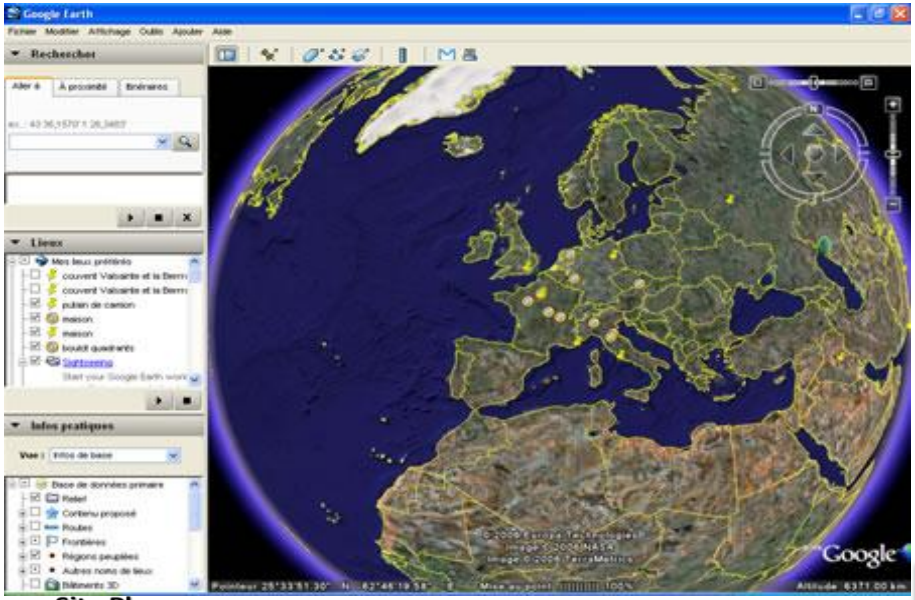
Business Model Shift

Bringing the field into the office

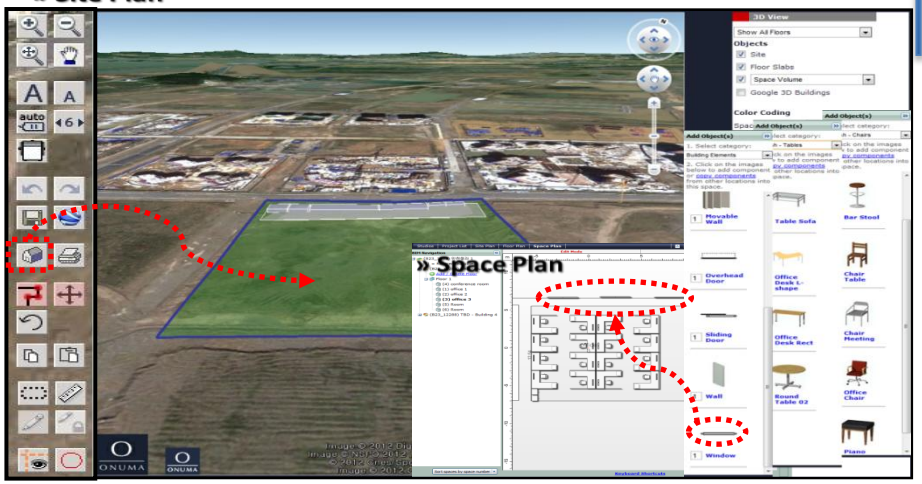


Technology Trends

ONUMA Introduction/Usage

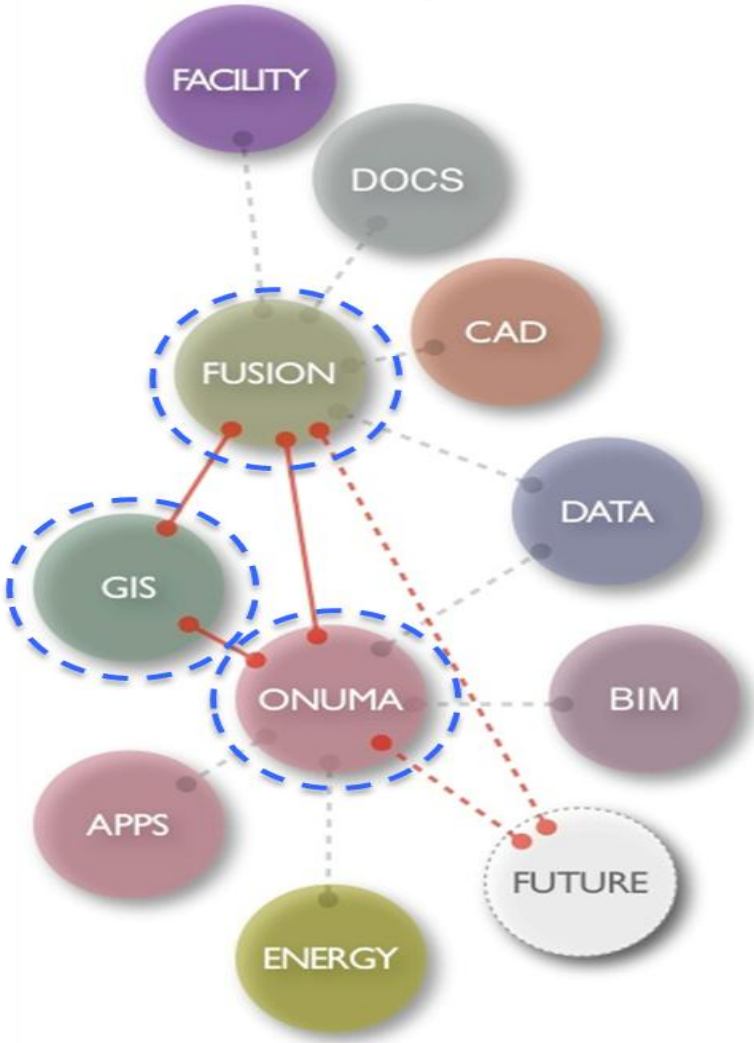


» Site Plan



ONUMA Structure

- BIM Fusion Modeling and Viewing solution based on Web



Technology Trends

ESRI - GIS for Facilities

esri Understanding our world.

Home | Industries | Products | Training | Support | Services | Event

Government

GIS for Facilities

Main | Portfolio | Operations | Safety and Security | Ask an Expert

Overview | Templates for Facilities | BISDM Group | GIS for BIM | Newsletter

Building Information Modeling

Using GIS along with BIM gives a spatial dimension into the building management and analysis process.

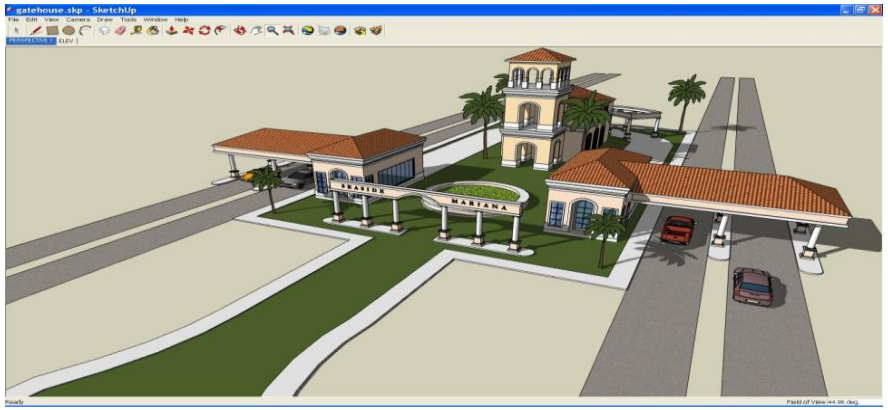
Building Information Modeling (BIM) technology allows facility planners, designers, and builders to collect and manage the great amounts of detailed data needed for building and campus design and construction. Using GIS along with BIM gives a spatial dimension into the building management and analysis process. It allows questions to be asked such as: Where are my assets located and how can I most efficiently place and maintain them? Where are the best locations for groups of people who do complimentary tasks? Where's my energy usage higher than it should be and why?

Esri Insider Discussion: What About BIM?

Articles | Resources

Trimble - Recent Changes

Trimble®

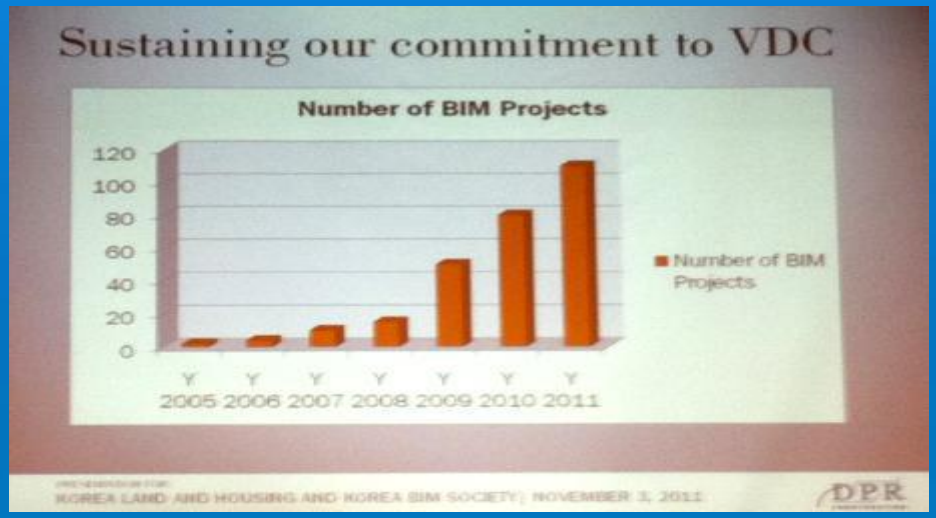


- ✓ In 2011, the acquisition of a leading provider of BIM software, Tekla Corporation of Finland
- ✓ In April of 2012, Persuit of Integration of As-built BIM and GIS with the acqusition of Google´s Sketchup
- ✓ Strong point of Sketchup
  - Directly available Google´s resources (images, digital map, DEM and so on)
- ✓ In 2012, Proposing vision about process efficiency in User Conference
- ✓ Attempt at the convergence and integration of traditional survey/GIS and BIM

Policy Trends

Why Warren Buffett Wants You to Use BIM

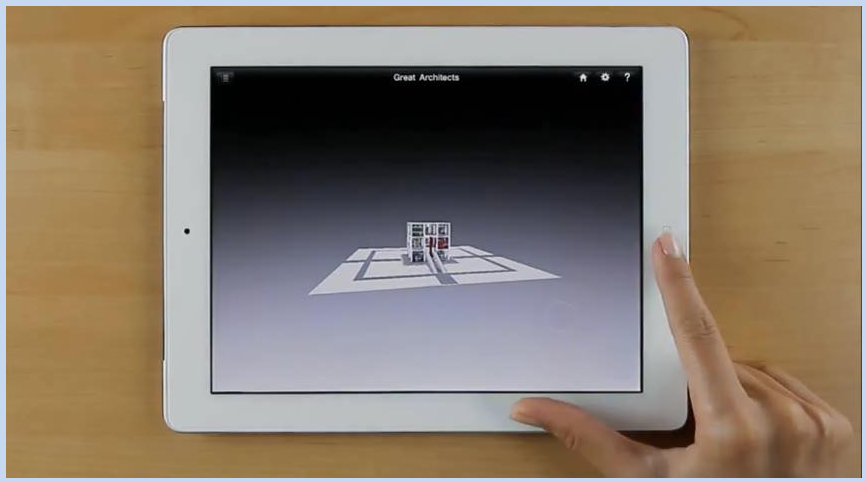
DPR BIM Project (2005 – 2011)



2007 Finland – Open BIM Compulsory
2008 US GSA – Open BIM Compulsory
2008 US COE – BIM Compulsory
2010 Norway Ordering Organization for Public Building – Open BIM Compulsory
2011 UK – Declare Open BIM Compulsory for Public Building
2013 Singapore – License Compulsory based on Open BIM

Target System

BIM Explorer (Graphisoft)



01 Rapid displaying Terrain model and Photorealistic 3D buildings

- Supporting various kinds of data types including BIM data, terrain elevation data, orthoimage, photorealistic 3D building model, indoor texture, etc.

02 Supporting database structure

- Supporting database based data structure and schema
- Simultaneous spatial query with BIM and 3D GIS
- Overlapping analysis with previously built data
- Supporting BIM/GIS data model

03 Rapid 3D display of big size data

- Rapid 3D display of big size data
- 3D engine development supporting mobile environment throughout hierarchical structuration of BIM/GIS data

Server

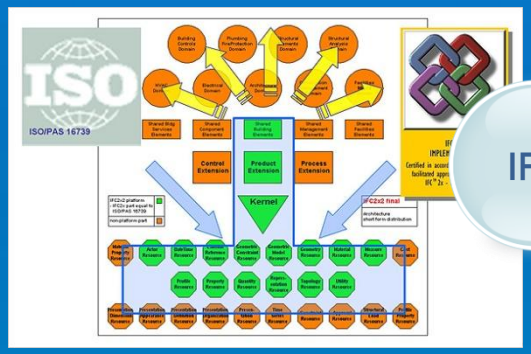
- Data Simplification
- Spatial Indexing
- Data Compression

Mobile device

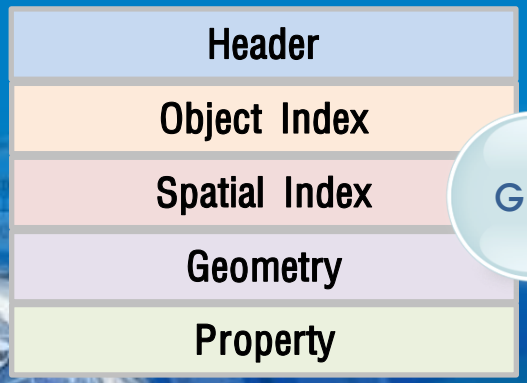
- 3D Rendering
- Memory Management
- Data Streaming

Service Model of IFC for Interoperability

- Service Model : IFC conversion format for BIM/GIS interoperability
- Developed for rapid display of big size IFC data based on GIS



IFC



G3D

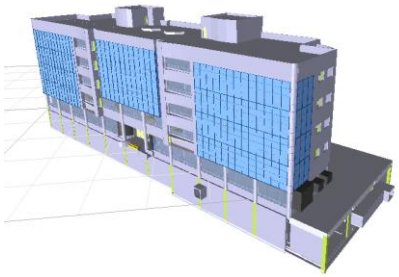
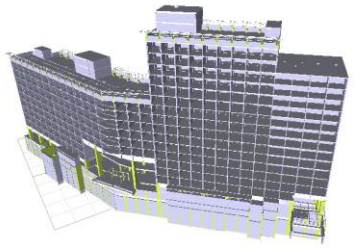
Characteristics of G3D

- Including IFC geometry and property information
- Relative coordinate + Georeference information (Latitude, Longitude, Altitude, Direction, Etc.)
- LOD and spatial indexing information for rapid display
- Geometry information based on file system
- Property information based on database (ongoing)

Service Model of IFC for Interoperability

- Converting as link model about sample IFC data
- Data size up, but loading speed is better than other software

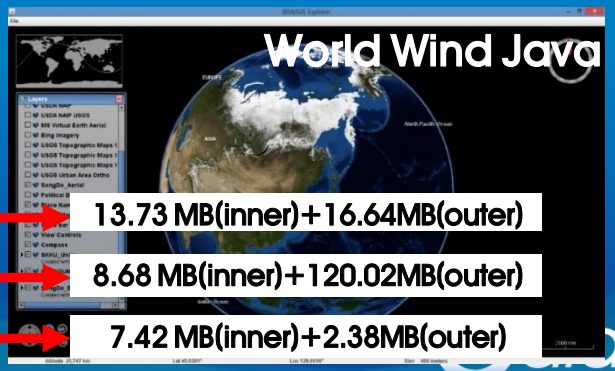
Test Data

Item	Data #1	Data #2	Data #3
Name	• Headquarters of Chungwoon University	• Korea Institute of Construction Technology	• Dormitory of Sungkyunkwan University
Shape			

Test Result

Item	IFC Data		Service Model(G3D)	
	Capacity (MB)	Load Time in Commercial S/W(second)	Capacity (MB)	Load Time in our viewer (second)
Data #1	67	about 17	168.99	2.3
Data #2	64	about 15	326.30	5.4
Data #3	12	about 6	18.78	0.5

Visulalization of Geometry Info.

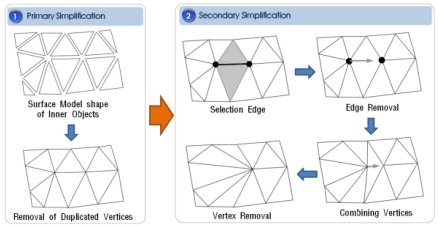


Technology for Rapid Display

Simplification

Hierarchical LOD generation throughout applying simplification algorithm

- Simplification of building inside
- Simplification of building envelope



Building inside objects simplification and LOD creation

LOD 1 LOD 2 LOD 3 LOD 4 LOD 5

Coarse ← + → Fine

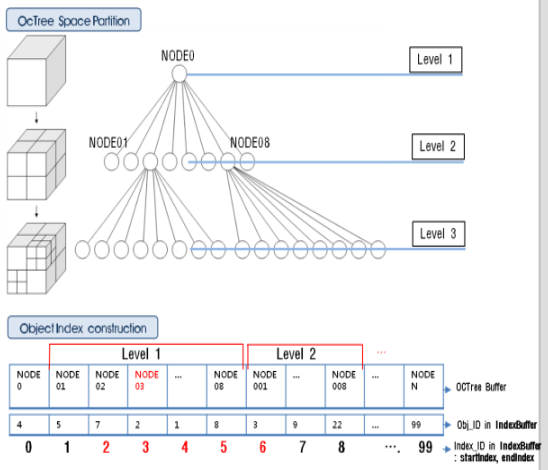
Building outside objects simplification and LOD creation

LOD 1 LOD 2 LOD 3 LOD 4

Hierarchical Data Structure

Data structure throughout spatial indexing based on Octree

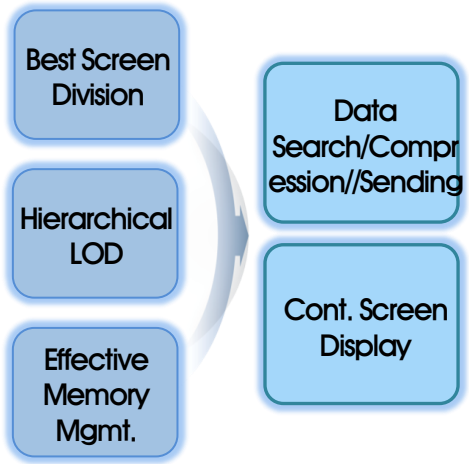
- Spatial division method based on Octree for spatial query about building objects



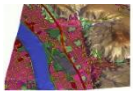
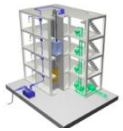
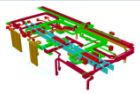
Data Streaming

High speed rendering throughout data streaming and visualization

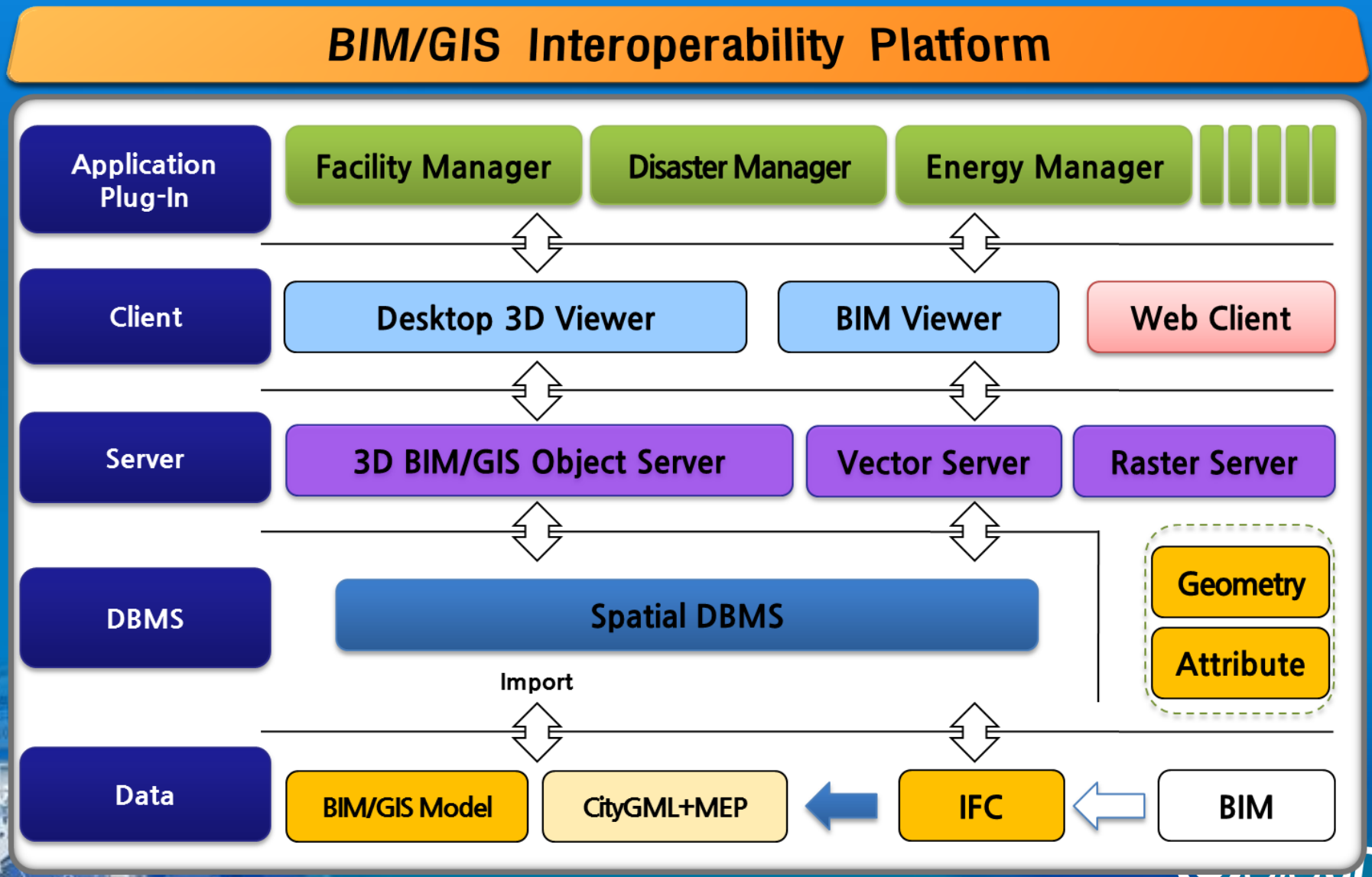
- Proper LOD level display from screen division
- Improving rendering speed throughout loading necessary data



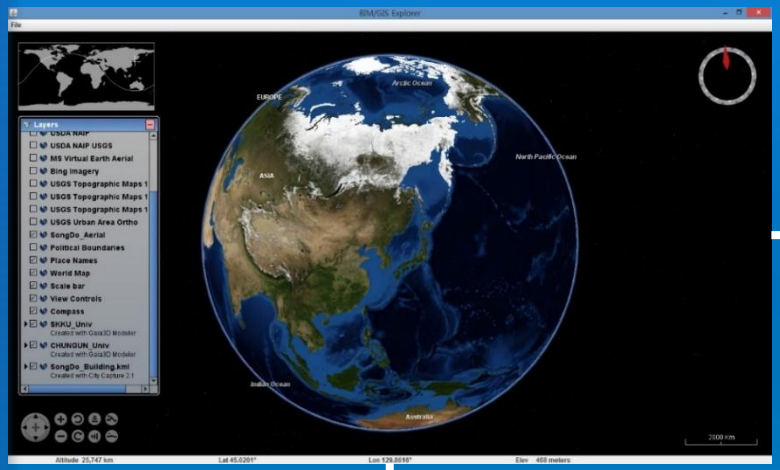
Design of Level of Detail

space	Level of Detail	Geometry			Properties (Semantic LOD)
		BIM data	GIS data	Shape	
out – door	LOD0	–	• only terrain data • DEM+orthoimage		• none
	LOD1	• boundary model • prismatic buildings • virtual texure	• DEM+orthoimage • prismatic buildings • virtual texture		• general properties
	LOD2	• boundary model • simple roof structures • photorealistic texture	• DEM+orthoimage • simple roof structures • photorealistic texture		• floor specific properties
	LOD3	• boundary model +Parametric model • representation of precise Object • photorealistic texture	• DEM+orthoimage • representation of precise Object • photorealistic texture		• properties of exterior • facilities properties of exterior
Indoor +out– door	LOD4	• boundary model +parametric model • building envelope	• DEM+orthoimage • representation of precise Object • photorealistic texture		• properties of building envelope
Indoor	LOD5	• parametric model • building envelope	–		• all properties of building
	LOD6	• furniture, MEP model • Irregular shaped objects	–		• all properties of building

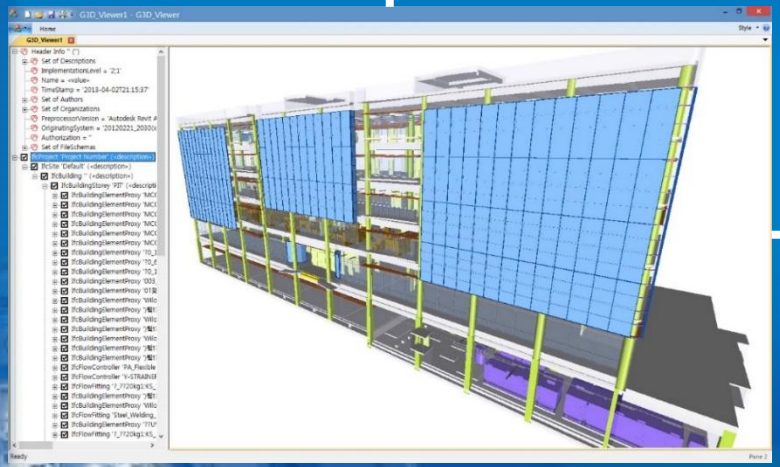
System Architecture



Development of Client



[WWJ]

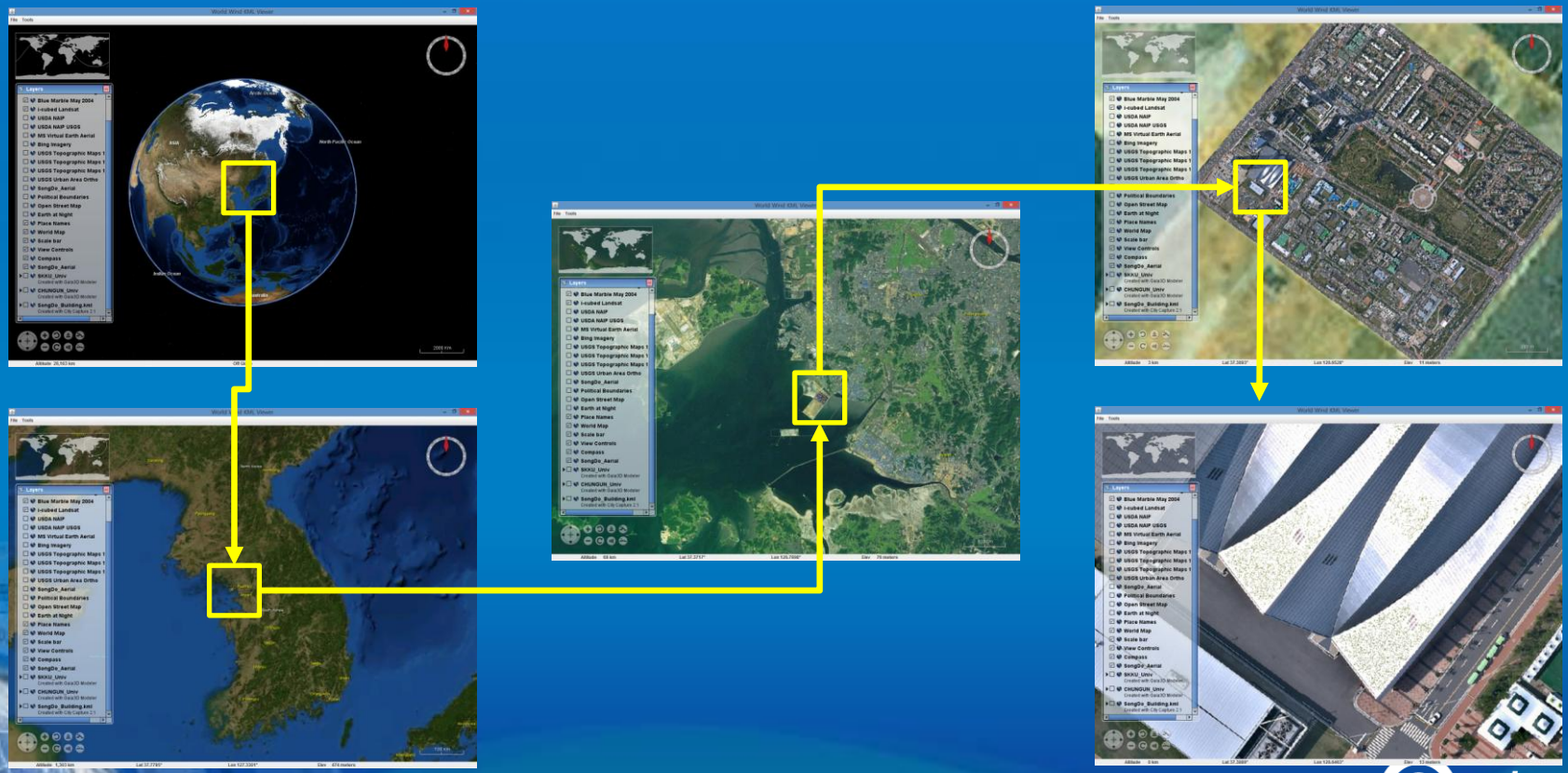


[IFC Viewer]

[BIM + GIS]

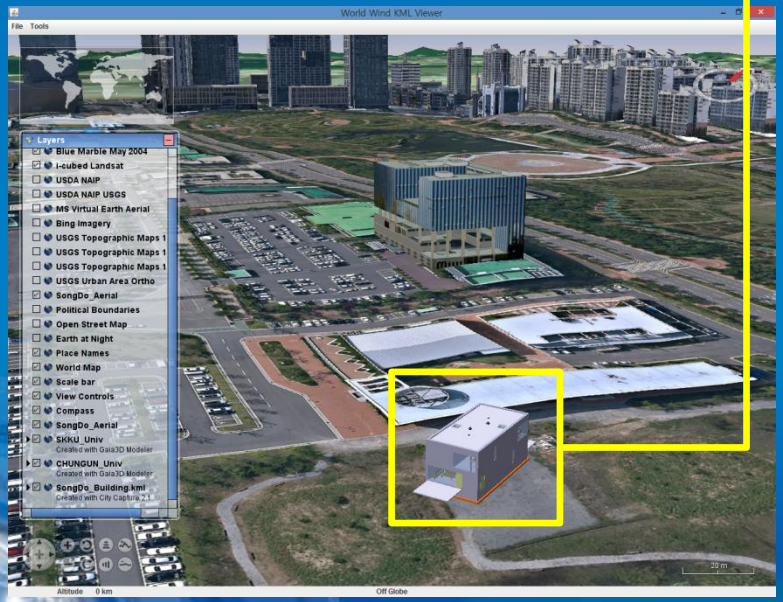
Development of Client

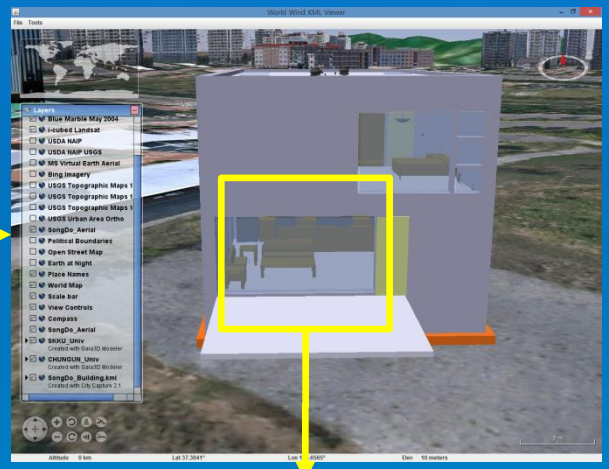
- Providing satellite image/aerial photo service using WMS (Web Map Service) from GIS server
- NASA Blue Marble Imagery, I-cubed Landsat Imagery, Aerial Photo(12cm Spatial Resolution)

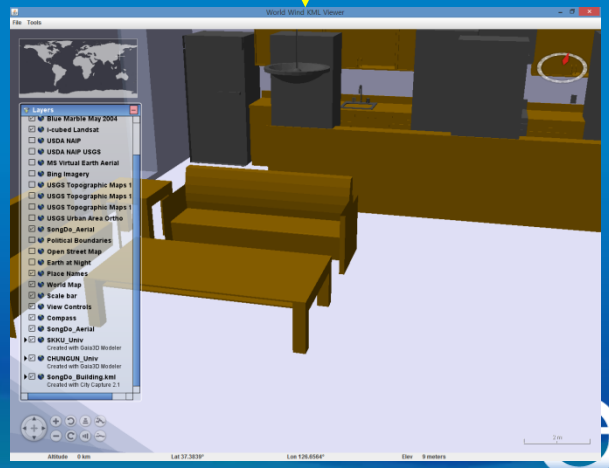


Development of Client

- Throughout BIM/GIS interoperability service, displaying inside and outside of building
- Displaying BIM data with relative coordinate on absolute coordinate based WWJ based on georeference information of spatial data link model(G3D)
- Georeference information:
  - Location : Latitude, Longitude, Altitude
  - Orientation : Heading, tilt, roll
  - Scale : scale X, scale Y, scale Z

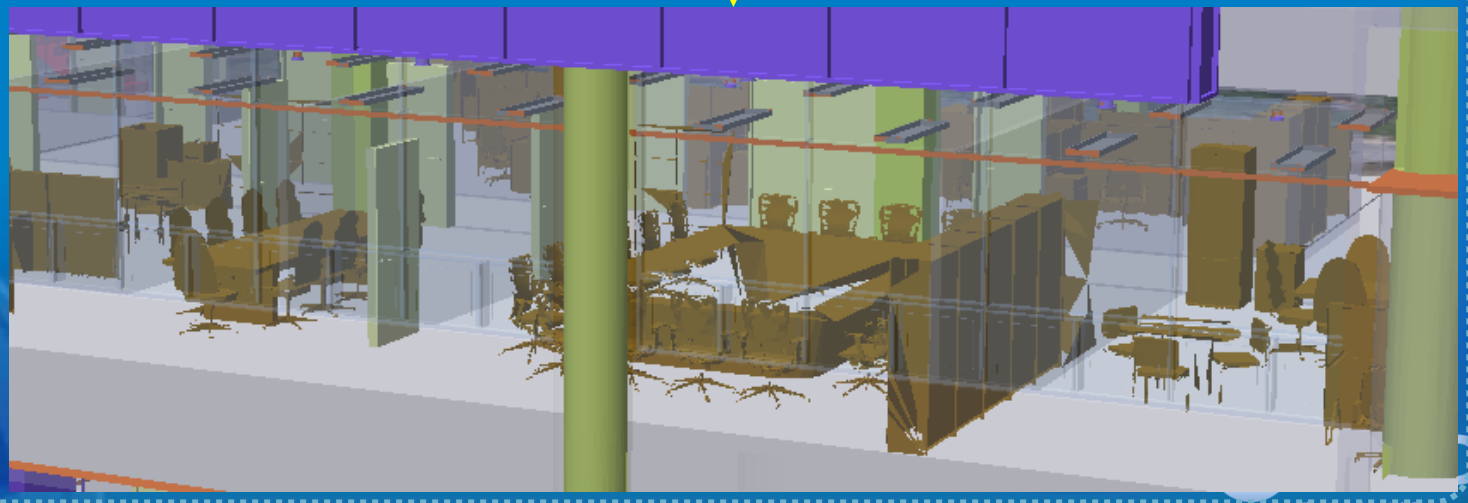




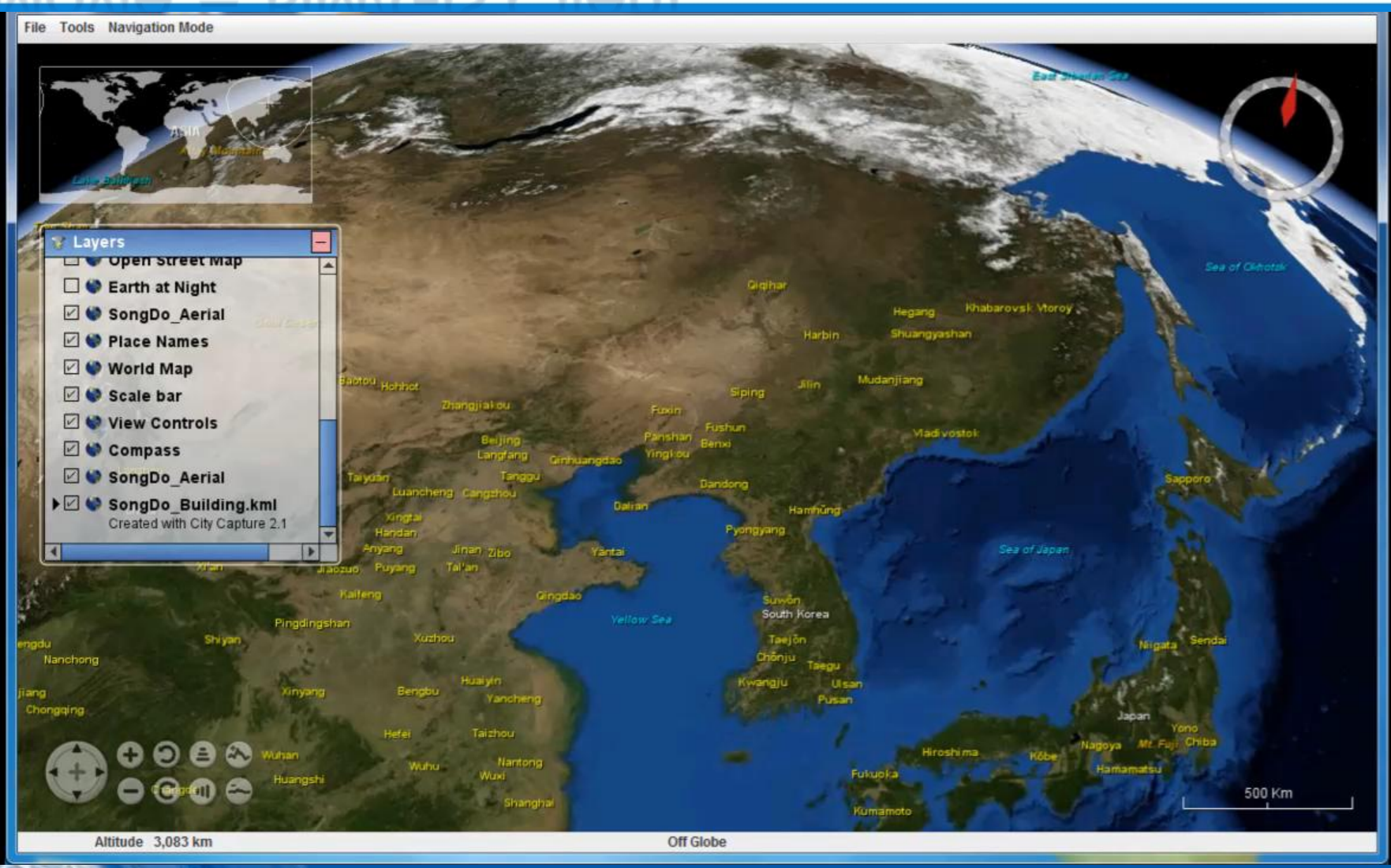


Development of Client

- BIM(IFC) data visualization – Visualizing inside and outside of building

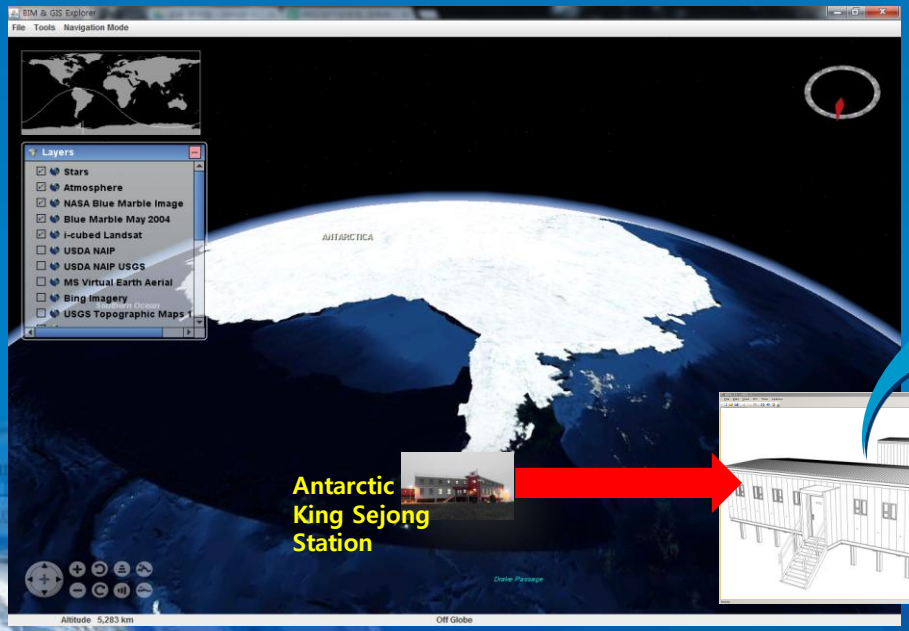


Movie – BIM/GIS Client

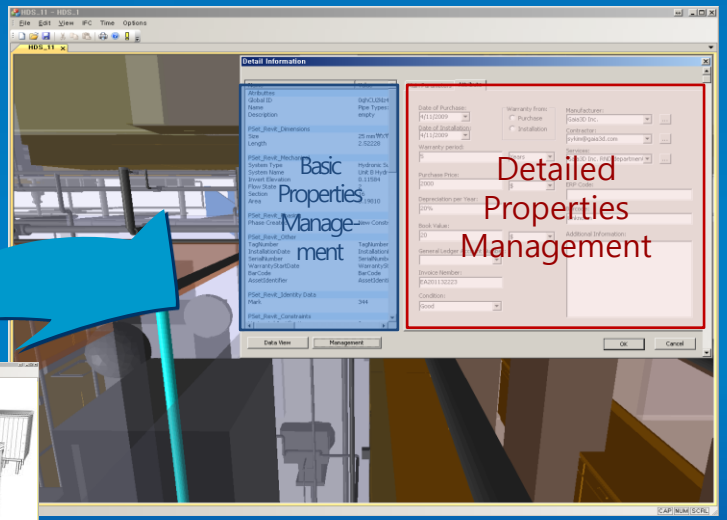


Current Project(FMS)

- **Effective facility management sysetm for Antarctic King Sejong Station**
  - Interactively viewing inside and outside King Sejong Station
  - Convenient editing properties of features in King Sejong Station
  - Comparing and analyzing features for better maintenance of facilities in King Sejnog Station
  - Easy Checking Current Status of each features and overall status



BIM/GIS Platform



3D Visualization of Internal Structure

Conclusion and Future Work

- IFC conversion format was developed for BIM/GIS inter-operability and Visualization on WWJ
- Complete combination between BIM data and GIS geometry data
- Platform server and DBMS are under development and property query will be possible in the near future.
- In 2014, big size BIM/GIS data processing platform will be developed.

Thank you