3D City GIS
for intelligent cities
A Bentley eSeminar
Introduction

Speakers

**Ton de Vries**  
*Solutions Executive Government*  
*Bentley Systems*

**Keith Raymond**  
*Product Manager*  
*Bentley Systems*

**Mika Salolahti**  
*Business Development Manager*  
*Terrasolid*
Agenda

3D City GIS introduction  
Ton de Vries

3D City GIS platform  
Keith Raymond

LIDAR in creating 3D City model  
Mika Salolahti

3D Analyses and publishing  
Keith Raymond

Wrap-up and Q&A  
Ton de Vries
3D City GIS introduction

Ton de Vries
Solutions Executive Government Bentley Systems
Why 3D City GIS?

- Integrate the management of assets in the same 2D-3D platform
- Generate realistic visual renderings for communication of projects to stakeholders
- Perform more accurate analysis using 3D model
- Perform analysis not possible in a 2D GIS
- Convey complex physical infrastructure plans using photo-realistic images
- Create 3D data once and reuse for multiple projects
3D City GIS

- Noise Simulation
- Shadow Analysis
- Urban Planning
- 3D Analysis and Design
- Bentley 3D City GIS
- 3D City GIS
- Public Relationship Management
- Natural Disaster Mitigation
Bentley 3D City GIS

- Full 3D, leveraging existing 2D GIS/Imagery and 3D models
- Easy to start, quick results, excellent ROI, scalable
- Integrated solution to create, manage and use 3D City GIS Model
- Real CAD/GIS/BIM integration
Visualization in Google Earth
3D CITY AND BIM INTEGRATION
Accurate
Up-to-date
Intelligent
Accessible
3D City GIS for Intelligent Cities
3D City GIS Workflow

**Model/QC**
- Bentley Map/Bentley Descartes
  - Capture smart 3D data (Laser Scanning, Photogrammetry)
  - Integrate data (ETL)
  - Quality Control
  - Create 3D textures/material Rendering
- TerraScan
  - (aerial) LiDAR feature extraction
- InRoads Suite, GEOPAK CES, Power InRoads, Power GEOPAK MXROAD
  - Integrate survey data
  - Create surfaces

**Manage/Serve**
- Bentley Geospatial Server
  - Manage 3D models
  - Manage workflows
  - Manage textures files
  - Manage 3D images
- Bentley Geo Web Publisher
  - Publish 3D data
- Oracle Spatial 3D 11G
  - Store 3D data

**Explore/Analyze**
- Bentley Map
  - Visualize 3D model
  - Create maps, reports
  - 3D spatial analysis
  - Photo realistic rendering
  - Animations
- InRoads Suite, GEOPAK CES, Power InRoads, Power GEOPAK MXROAD
  - Line of sight analysis
  - Compute volumes
- ProjectWise Navigator
  - Visualize 3D model
  - Collaborate on 3D model
  - Review
- KML Client
  - Public 3D model visualization
  - Casual 3D model visualization
3D City GIS

Advancing Municipal Infrastructure
3D City GIS

Urban Planning

Noise Simulation

Shadow Analysis

Bentley 3D City GIS

3D Analysis and Design

Natural Disaster Mitigation

Public Relationship Management
Architecture
Geospatial Desktop

MicroStation, Bentley Map, Bentley Descartes, + partners
Bentley Map in 3D City GIS

- 3D Data Creation tools
  - Model and edit smart 3D Objects
  - 3D texturing for added realism
  - 3D mathematical modeling
  - Automated 3D Building creation from LIDAR (using TerraScan from Terrasolid)
Geospatial Desktop in 3D City GIS

- 3D Interoperability, data integration
  - Viewing point cloud data from LIDAR
  - Direct editing of spatial databases
  - Import/Export to multiple 2D and 3D formats
  - Direct connection to FME for access to hundreds of data sources
  - Georeference 3D Designs
Interoperability with Oracle Spatial

- Bentley Geospatial Server
  - Bentley Map via Two-Tier Direct Connection
  - Bentley Map Enterprise Connection
  - Bentley Industry Applications via Two-Tier Direct Connection
  - Bentley Industry Applications Enterprise Connection
  - Other GIS Systems Compliant with Oracle Spatial
  - Any PL/SQL Client
Terrasolid's solutions for laser point cloud handling
Terrasolid

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Agenda

- Terrasolid update
- What is LiDAR?
- Why LiDAR for city model creation
- Automatic building vectorization
Terrasolid Oy

• Founded in 1989 – 20+ years of software development on MicroStation
• Point cloud software development and sales
• Revenues in 2008 ~ 3,5 M€
• Customers in 80+ countries
• Global market leader in airborne and mobile laser scanned point cloud processing software
• Market share around 85%
• Based in Finland
What is LiDAR?
Laser scanning

- **Wikipedia – Lidar**
  - LIDAR (Light Detection And Ranging) is an optical remote sensing technology that measures properties of scattered light to find range and/or other information of a distant target. The prevalent method to determine distance to an object or surface is to use laser pulses. Like the similar radar technology, which uses radio waves, which is light that is not in the visible spectrum, the range to an object is determined by measuring the time delay between transmission of a pulse and detection of the reflected signal.
  - The primary difference between lidar and radar is lidar uses much shorter wavelengths of the electromagnetic spectrum, typically in the ultraviolet, visible, or near infrared range. In general it is possible to image a feature or object only about the same size as the wavelength, or larger.
Laser scanning

- Terrestrial
  - Static tripod
- Airborne
  - Aeroplane
  - Helicopter
- Mobile
  - Car
  - Train
Airborne laser scanning

Laser scanner and digital camera mounted into an aeroplane or helicopter

• Upto 250,000+ points per second
• Scanner mirror rotates and creates a scanning pattern
• Digital photographs every 1 to 3 seconds
• Precise location and position tracking with GPS and IMU (Inertial movement unit)
Why use LiDAR to create city models?

- Airborne laser scanning is very effective and precise remote sensing technique
  - Precise – Even from 2 km you can achieve 5 cm precision on hard surfaces
  - With helicopter from 300 meters centimeter precision can be achieved

- It is also very cost effective data collection method
  - A typical cost for a helicopter scan from 300 meters is around 1000 € / sq.km
  - A typical cost for a aeroplane scan from 600 meters is around 400 € / sq.km
Applications of a 3D Urban Model
Geospatial Desktop in 3D City GIS

- 3D Data Analysis and Visualization
  - View 3D data
  - Produce 3D thematic maps
  - Realistic rendering and animation
  - Solar Studies
  - Export to Google Earth
  - Clash Detection
  - Review attributes, produce reports
  - Produce 3D PDF
Other Geospatial Desktop Tools

• Spatial analysis and overlay
• Thematic mapping and labeling
• Data cleanup tools
• Topology maintenance
• Interoperability
  – GML, SHP, MapInfo, Oracle Spatial
• Print Preparation
• GIS Development Platform
Applications of a 3D Urban Model

- Shadow Studies
- Visualization
- Thematic Mapping
- Interoperability
  - Google Earth
  - 3D PDF
  - Other analytical software
- Clash Detection
- Animation
Shadow Studies

• Determine affect of new development on neighbouring properties
  – Parks
  – Residence
  – Heritage sites

• Set longitude, latitude

• Date and time

• Single images or animations
Visualization

• Show defined view corridors

• New developments within existing buildings

• Advanced rendering
  – Image draping over terrain
  – Reflections
  – Shadows
  – Transparency
  – Image mapping
Thematic Mapping

- Display model color coded based on properties
- Show all buildings where roof type is flat
  - Possible candidates for green roof or solar panels
Export to 3D PDF

- Illustrate reports
- Convey design intent
- Interactive rotation
- Multiple shading and lighting models
- Coordinate readout
Export to Google Earth

- Show model in context of existing imagery and buildings
- Universal visualization tool
Clash Detection

• Determine where new buildings intersect pre-defined zones
  – View sheds
  – No fly zones
  – Radio towers
Realistic Animation and Rendering

• View Corridors
• New development proposals
• Skyline views
• Walkthroughs, Drivethroughs
Now is the time...

...to start your 3D City GIS

Improve the quality of your GIS and Infrastructure projects
Improve your communication with your stakeholders
Leverage your years of investment in CAD and GIS
Improve service to the public

Technology is ready and mature
Affordable and efficient