Creating, Managing and Utilizing a 3D City

Craig McCabe, Thorsten Reitz, Seán William Morrish
Outline

1. Introduction (10 min)
   1. What is 3D Cities for?
   2. Why does it matter to developers?
   3. Overview of the Information Model

2. 3D Base Map Initiative (10 min)
   1. The 3D Base Layers
   2. 3D Cartography
   3. Procedural Generation in ArcScene and CityEngine 2013 (10 min)

4. Solar and Zoning Analysis (10 min)
5. Interoperability & Wrap-Up (5min)
ArcGIS – The 3D GIS Platform

- Multiscale 3D Models
- 3D Geodesign
- Share 3D scenes
- ArcGIS for 3D Cities
- Surface modeling
- Native lidar support
- 3D Analysis
- Integrated 3D
ArcGIS for 3D Cities

- Based on Desktop and Server Software
  - ArcGIS Desktop
  - CityEngine
- Workflows
  - Map docs, Scene docs, CE projects
  - Online resources
- Tools and Extensions,
- An information model

...for a specific community.
3D Cities for Developers

• Exploit the 3DCIM and related patterns throughout platform
  - Scene Service – LoD, Aggregation, Special Tools available...
  - Procedural tools in ArcGIS Pro, ArcScene, CityEngine
  - Procedural Library

• Partners use information model as core for their models
  - SmarterBetterCities develops RPKs and Services
  - IES and other base Green Masterplanning tools on it

• Improve the tools!
3D Cities Information Model: Themes

**Built Environment**
- Created and actively managed by people
  - Structures, utilities, transportation networks, installations

**Legal Environment**
- Defines restrictions on land use
  - Land use zones, property ownership boundaries, regulations

**Natural Environment**
- Naturally occurring features on, above, or below the earth’s surface
  - Land cover, subsurface geology, atmosphere/climate/weather
Buildings

Connecting 2D and 3D Buildings

- The **Building** (Footprint object) carries most of the attributive information.

- **BuildingShell** represents the complete outer shell in 3D.
  - Procedural
  - Modeled

- **BuildingShellParts** can be used when separate processes for roofs/walls/ground plates are needed.
Building Interiors

Seamless usage of interior/exterior data

- Building interior data:
  - Building
  - Floor
  - Space
  - Structure
  - Entrance

- Used in analysis:
  - Query (where/who)
  - Routing
  - Asset allocation
Installations

Managing Portfolio of City Installations

- Street Furniture
  - Fire hydrants
  - Benches
  - Bike racks
  - Trash cans
  - Kiosks
  - Poles

- Vegetation
  - Trees
Utility Networks

Discover the underground potential of your city

- Water
- Sewer
- Stormwater
- Gas
- Electric
The Legal Environment

- AdministrativeDistricts organize territories into logical areas.
- ZoningDistricts describe current or planned Land Use.
- Parcels provide address and ownership information and represent the unit that zoning rules have to be applied to.
The Natural Environment

- Land cover
- Subsurface geology
- Wind, weather and atmosphere
The 3D Basemap Initiative

Craig McCabe
The ArcGIS 3D Basemap

Hosted on ArcGIS Online
Free with Online Account
Fully Immersive
Multi-Scale
In Browser
No Plug-In Required
On Desktop
On Devices
ArcGIS 3D Basemap
multi-scale global 3D map

Global

- Weather & Climate
- Oceans
- Transportation & Trade Routes
ArcGIS 3D Basemap
multi-scale global 3D map

Global Landscape

Demographics
Hydrology
Vegetation
Elevation
ArcGIS 3D Basemap
multi-scale global 3D map

Global
Landscape
City

Buildings
Development
Zoning
Urban Design
ArcGIS 3D Basemap
multi-scale global 3D map

Global
Landscape
City
Campus

Interiors
Space Mgmt.
Facility Mgmt.
ArcGIS 3D Basemap

multi-view 3D map

Realistic
ArcGIS 3D Basemap
multi-view 3D map

Realistic

Canvas

Thematic
ArcGIS 3D Basemap
multi-view 3D map

Realistic

Canvas

Thematic

Analytic
ArcGIS 3D Basemap

Provides Users With:

- Foundation for work in 3D
- Context for 3D Projects
- Canvas for Analysis
- Share with a Global Community
3D Basemap Tour
ArcGIS 3D Basemap - City Scale Layers
Designed to support the understanding of cities

3D Buildings

Mixed Levels of Detail
Non-Textured
ArcGIS 3D Basemap – City Scale Layers
Designed to support the understanding of cities

3D Buildings
ArcGIS 3D Basemap – City Scale Layers
Designed to support the understanding of cities

3D Buildings
ArcGIS 3D Basemap – City Scale Layers
Designed to support the understanding of cities

3D Buildings
ArcGIS 3D Basemap – City Scale Layers
Designed to support the understanding of cities

Participate in Analytics:
Solar, Shadow, Visibility, etc.
ArcGIS 3D Basemap – City Scale Layers
Designed to support the understanding of cities

3D Buildings
Trees
Water Bodies
ArcGIS 3D Basemap – City Scale Layers
Designed to support the understanding of cities

3D Buildings
Trees
Water Bodies
2D Basemap

World Topographic Map now
New basemap coming...
ArcGIS 3D Basemap - City Scale Layers

Designed to support the understanding of cities

3D Buildings
Trees
Water Bodies
2D Basemap
Terrain

2 Meters or Better
ArcGIS 3D Basemap – City Scale Layers
Designed to support the understanding of cities

- 3D Buildings
- Trees
- Water Bodies
- 2D Basemap
- Terrain
ArcGIS 3D Basemap
because the world is not flat

Esri will support our users by:

1. Compiling + hosting the 3D Basemap
2. Providing premium layers
3. Empowering distributors + partners to provide additional premium services
4. Providing best practices for users to build their 3D layers
Procedural Generation
Thorsten Reitz
Rule Packages

Rule Authoring

CityEngine Rule Package

Publish

Use

ArcGIS Online

Features from CE Rules

ArcScene 10.2.x

CityEngine

Rule Packages

Residential Office Kiosk Sports Gas Station Wind Turbine

CE 2013.1
CE 2014.0

ArcGIS Online

Features from CE Rules

ArcScene 10.2.x

CityEngine Rule Package

Publish

Use

ArcGIS Online

Features from CE Rules

ArcScene 10.2.x

CityEngine Rule Package

Publish

Use

ArcGIS Online

Features from CE Rules

ArcScene 10.2.x

ArcGIS Online
The Procedural Library in CityEngine 2013, 3D Cities...

- **Buildings**
  - “International City“
  - Facade texturing with more than 400 textures

- **Vegetation**
  - 75 common genera covered

- **Zoning**
  - Envelopes
  - Development Potential
  - Representative Mass Models (*upcoming*)
...on ArcGIS Online

http://resources.arcgis.com/en/communities/city-engine/01w90000000r000000.htm#s=0&n=30&d=1&md=cte-ce-version:100_crete-resource-type:0000000001
Procedural Generation
Model Loading, Zoning & Solar

Seán William Morrish
Building Model loading

- Buildings
  - COLLADA
  - SketchUp
  - OpenFlight
  - VRML
  - Studio Max

- Automatic Loading
  - Model Builder
  - Python Scripting
Zoning Analysis

- 3D Zoning Regulations
- Evaluation of development potential
- Review of compliance
Solar Analysis

- Solar Analysis Toolbox
- Solar potential calculation
- Modeling of true roof form
Solar Analysis

- Solar Analysis Toolbox
- Solar potential calculation
- Modeling of true roof form
Solar Analysis

- Solar Analysis Toolbox
- Solar potential calculation
- Modeling of true roof form
Interoperability & Wrap-Up

Thorsten Reitz
CityGML and ArcGIS for 3D Cities

- Lossless I/O ETL Tools
- Covers ~15 most common types from CityGML 1.0/2.0
  - Buildings & Interiors
  - Vegetation & LandCover
  - Streets & Street Furniture
- Optimization & Repair
- Implemented via Data Interoperability Extension
Summary

The *3D Cities Information Model* is the base for a wide range of activities:

- Rule Library
- Web Scenes
- Base Layers
- Analytics
- Import/Export
- 3D Cities Web Apps