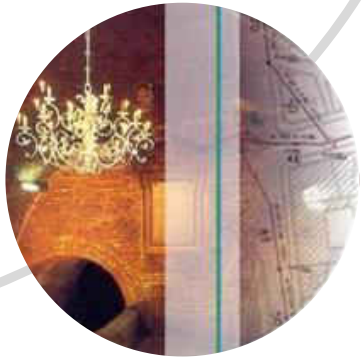
Simplifying the Management of your 3D Data with automatic and scalable Workflows

Stephan Plabst

M.O.S.S. Computer Grafik Systeme GmbH



Agenda

- Introduction
- Data Management
  - Storage
  - Update mechanism and consistency
- Application
  - Change detection
- Examples
  - City of Leipzig
  - ZSHH
- Lessons learned
  - Performance
  - Data quality
- Conclusion

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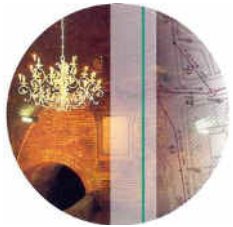
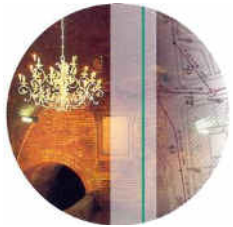
Company Profile



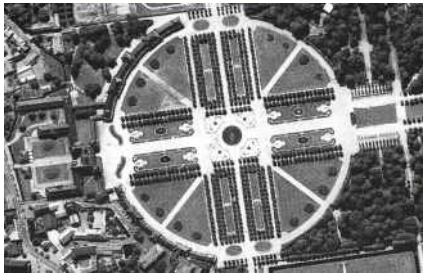
- Solutions provider
- Founded 1987 in Munich
- CEO Hans Braun
- About 60 employees in the areas software development, consulting, sales, marketing, help desk and training
- Main focus on
  - Spatial data server and SDI 3D
  - Environmental data management
  - Planning of wind farms
  - Spatial web services and web GIS
  - Sewerage management

Business Divisions



- **Geotopography & 3D**
  Management and distribution of spatial data including 3D spatial infrastructures, GIS solutions for industries and public services
- **Environmental Management**
  GIS based data and planning management for interdisciplinary environmental analysis and environmental information systems
- **Renewable Energies**
  Support for planning of wind farms
- **Industrial Applications**
  Spatial data and GIS based process management, spatial information in business processes
- **Urban Water Resources**
  GIS solutions for sewerage system management

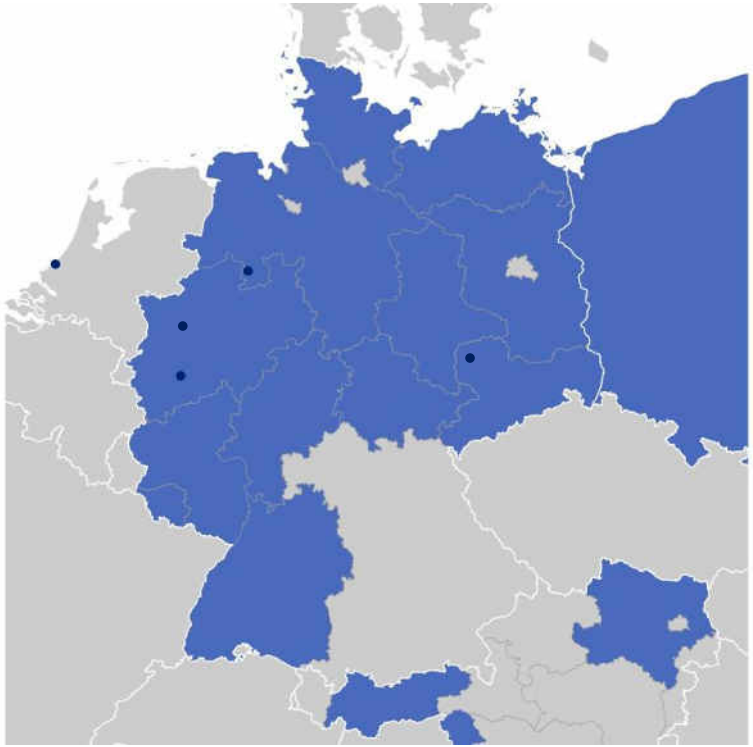
Spatial data server & SDI 3D



novaFACTORY 3D

- Process management from production to SDI
- Automated generation of 3D building models in level of detail 1 and 2
- Previews
- Quality management
- Supported formats CityGML, KML, 3D SHAPE, PDF
- Automated workflows for preparation of 3D web mapping solutions

References spatial data server



- State of Brandenburg
- State of Saxony-Anhalt
- State of Saxony
- State of Thuringia
- State of Hesse
- State of Rhineland-Palatinate
- State of Saarland
- State of Baden-Württemberg
- State of Lower Saxony
- State of Tirol
- State of Lower Austria
- District council of Cologne
- City of Leipzig
- City of Osnabruck
- City of Gelsenkirchen
- Vattenfall Europe Mining AG
- GUGIK Warsaw
- City of Den Haag

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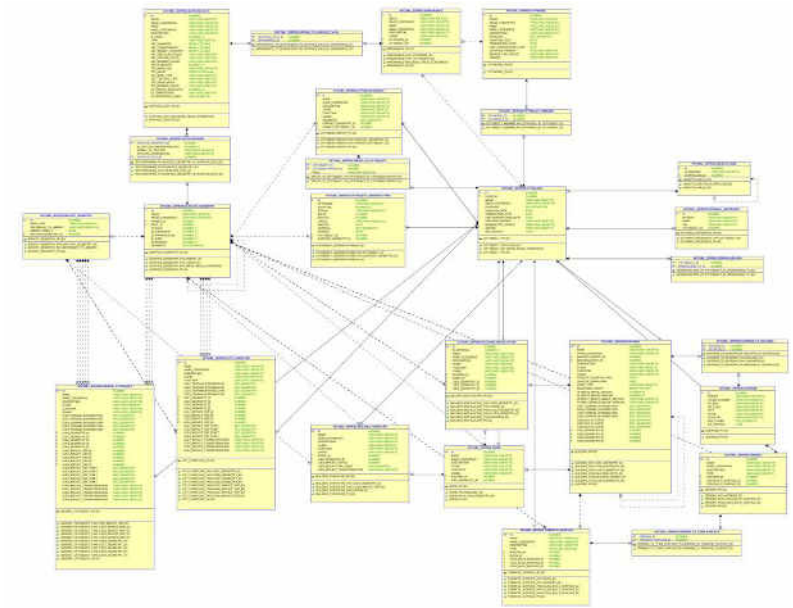
Data Management

- Using a relational database for storing spatial data
  - Multi user
  - Backup
  - ACID principle (Transactions)
  - Seamless data retrieval
  - Native data types
  - Available from Open Source and commercial vendors
  - From Small to huge enterprise level
- Different data formats as input
  - For 3D: CityGML as international standard
- How to store CityGML in the database?

Data Management



3D-CityDB

- Maps XML data structure to a relational database model
- Uses native spatial types for storing the geometry
- Available for different database vendors
- Data model, libraries and programs available as open source software

Data Management

Updating

Data Maintenance

- Identify the object
- Different Update modes
  - New
  - Delete
  - Update
- What?
  - Complete object
  - Presentation (LoD)
  - Attributes incl. geometry
- Follow relations to all parts of the objects
- Stored Procedures

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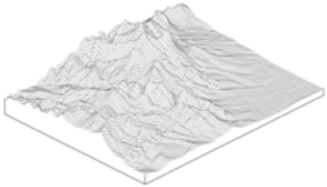
Change Detection

Original data

Actual reference data



Current remote sensing data

Determine the need for updates

Change detection

Data provision

Building detection

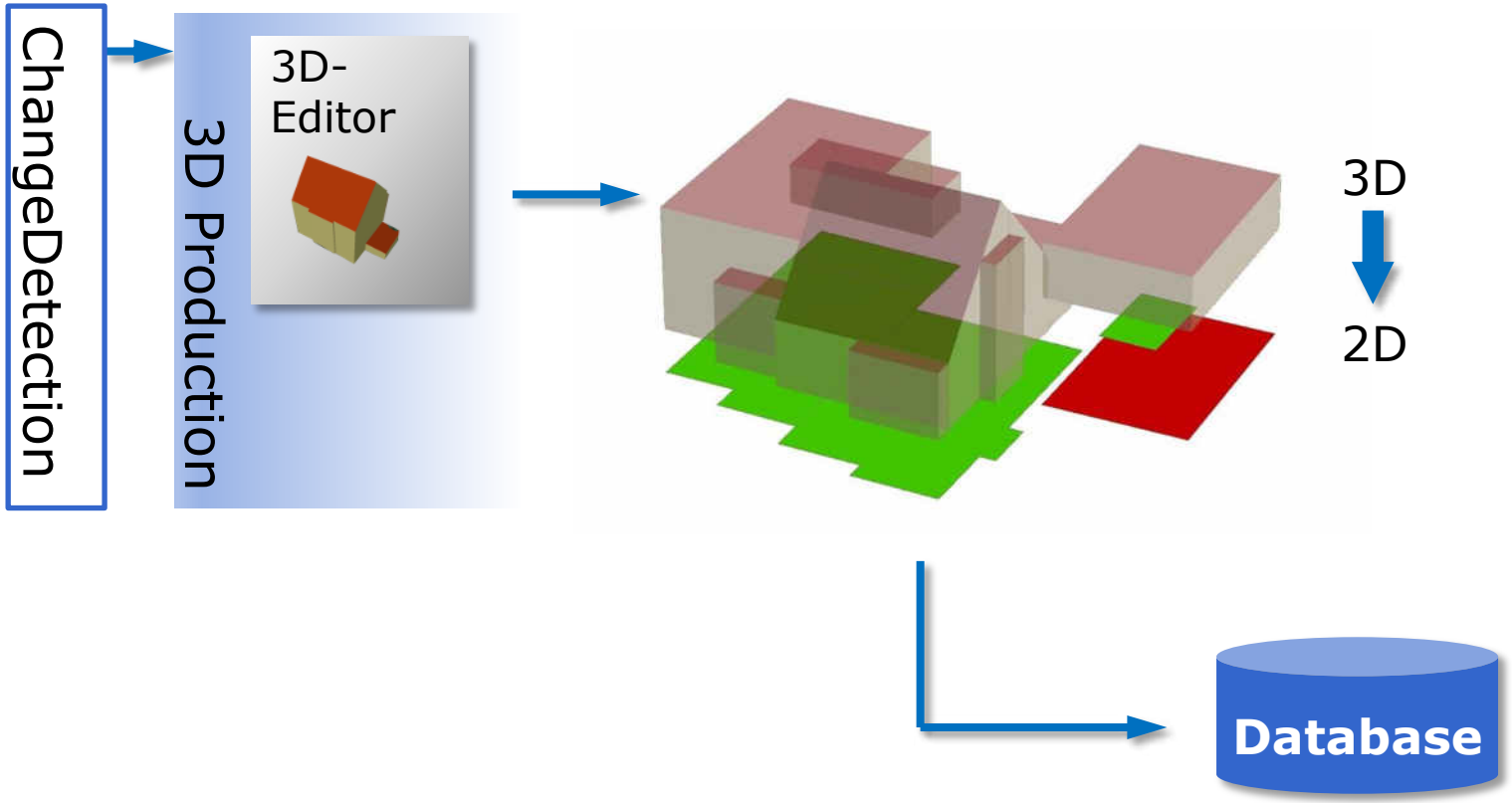
Difference detection

Store result

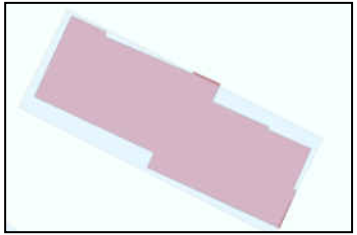
3DCityDB

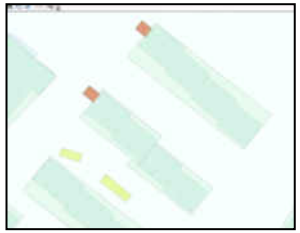
3DCityDB

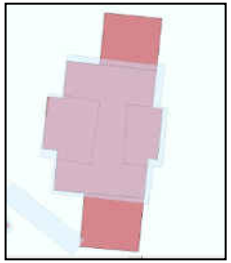
Change Detection



Change Detection







What is a difference?

- Roof overlap
- Building blocks (e.g. row houses) are detected as one building
- Heterogeneous roof forms are detected as different buildings

The application needs tolerances and semantic knowledge

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Examples

City of Leipzig

- About 300 km² and 150.000 buildings
- Produced from cadastral data (building foot prints), aerial images and the DEM
- Available in LoD 1 and LoD 2
- Surfaces are texturized
  - Oblique aerial imagery
  - Terrestrial pictures of the facades
- Automated workflows for building production and data management
- Continuous updates (2D-Update causes 3D-Update)

Examples

Examples

Gebäude und Bauwerke	
Bundesland	Anzahl
Baden-Württemberg	5.889.117
Bayern	8.587.067
Berlin	534.759
Brandenburg	2.436.879
Bremen	253.868
Hamburg	365.916
Hessen	4.921.256
Mecklenburg-Vorpommern	1.205.884
Niedersachsen	5.705.678
NRW	10.130.354
Rheinland-Pfalz	3.123.113
Saarland	575.803
Sachsen	2.018.564
Sachsen-Anhalt	1.721.925
Schleswig-Holstein	2.150.348
Thüringen	2.187.503
Summe	**51.808.034**

Status ZSHH 2015

ZSHH (central office for building coordinates, building footprints and 3D building models)

- All buildings of Germany in LoD 1 (LoD2 in the future)
- 51.8 million objects stored in one database
- Data providers are the 16 German states
- Annual updates
- Defined data format based on a CityGML profile
  - ETRS89
  - Tiling structure
  - Object categories and attributes
- Data can be ordered in CityGML and Shape

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Status ZSHH 2015

Challenges

- Integrating 16 data providers
- Cross-border data fusion
- High performance for data storage and data retrieval
- Automated workflows for format and schema conversion
- A tiling schema causes empty tiles
- Quality assurance

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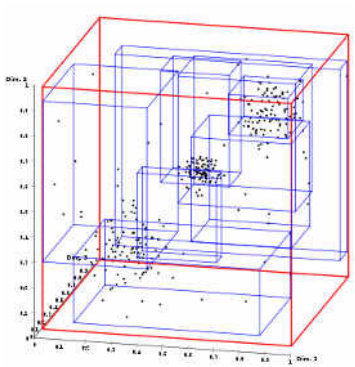
Lessons learned



Performance

- The more data you have, the more you have to think about performance
- Millions of spatial objects are a challenge
- In the database
  - Indexes are key
  - Deactivate them for bulk loading large data sets
  - Activate them for fast data retrieval
  - Reimporting whole data sets may be faster then updating a large number of objects
- Look at your application

Lessons learned

```
<?xml version="1.0" encoding="UTF-8"?>
- <core:CityModel
  xsi:schemaLocation="http://www.opengis.net/citygml/appearance/1.0
  http://www.citygml.org/citygml/appearance/1.0/appearance.xsd
  http://www.opengis.net/citygml/building/1.0
  http://www.citygml.org/citygml/building/1.0/building.xsd
  http://www.opengis.net/citygml/generics/1.0
  http://www.citygml.org/citygml/generics/1.0/generics.xsd "
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:xAL="urn:oasis:names:tc:ciq:xsdschema:xAL:2.0"
  xmlns:gml="http://www.opengis.net/gml"
  xmlns:gen="http://www.opengis.net/citygml/generics/1.0"
  xmlns:grp="http://www.opengis.net/citygml/cityobjectgroup/1.0"
  xmlns:bldg="http://www.opengis.net/citygml/building/1.0"
  xmlns:app="http://www.opengis.net/citygml/appearance/1.0"
  xmlns="http://www.opengis.net/citygml/1.0"
  xmlns:core="http://www.opengis.net/citygml/1.0">
      <gml:name>LOD1_488_5793_1_NW</gml:name>
    - <gml:boundedBy>
      - <gml:Envelope>
          <gml:lowerCorner srsDimension="3">488000.000 5793000.000
            0.000</gml:lowerCorner>
          <gml:upperCorner srsDimension="3">488999.999 5793999.999
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  </core:CityModel>
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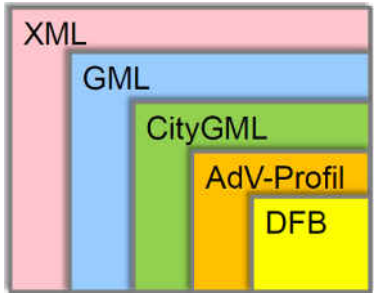

Data quality

- For being able to update, you need unique identifiers
- Predefine your CityGML model
  - The standard allows every object to look different
  - The database model allows to store that
  - Your application may have problems
  - Data integration and format conversion become a hassle
- Data from 3rd parties should always be checked
- Automate the processes for quality management specialized for your application (e.g. CityDoctor with own test plan)

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Conclusion

3DCityDB is ready for production use

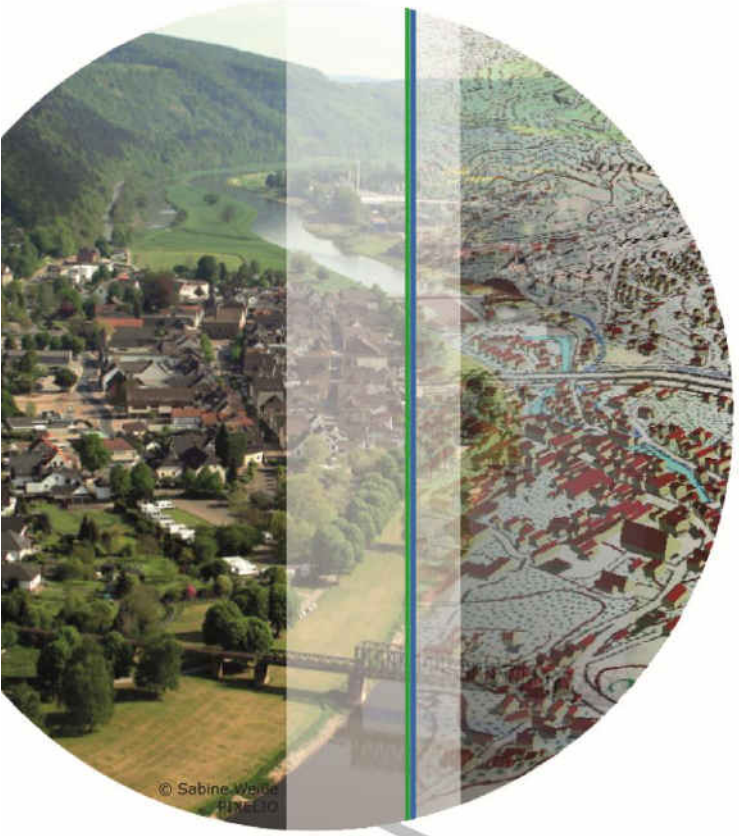
- Field-tested
- Tried at various customers

Integration

- Available as Open Source Software
- Available in commercial products

Capable for large data

- In use with millions of data object
- From project to city to state to country



Thank you
for your
attention!

M.O.S.S. Computer
Grafik Systeme GmbH
Hohenbrunner Weg 13
D-82024 Taufkirchen
Phone +49 89 66675-100
Fax +49 89 66675-180
info@moss.de
http://www.moss.de

Herausgegeben von:

M.O.S.S. Computer Grafik Systeme GmbH

Hohenbrunner Weg 13

D-82024 Taufkirchen

Fon: (089) 66675-0

Fax: (089) 66675-180