

# GeoDesign Apps and 3D Modeling for the Smart City Cologne



Stadt Köln



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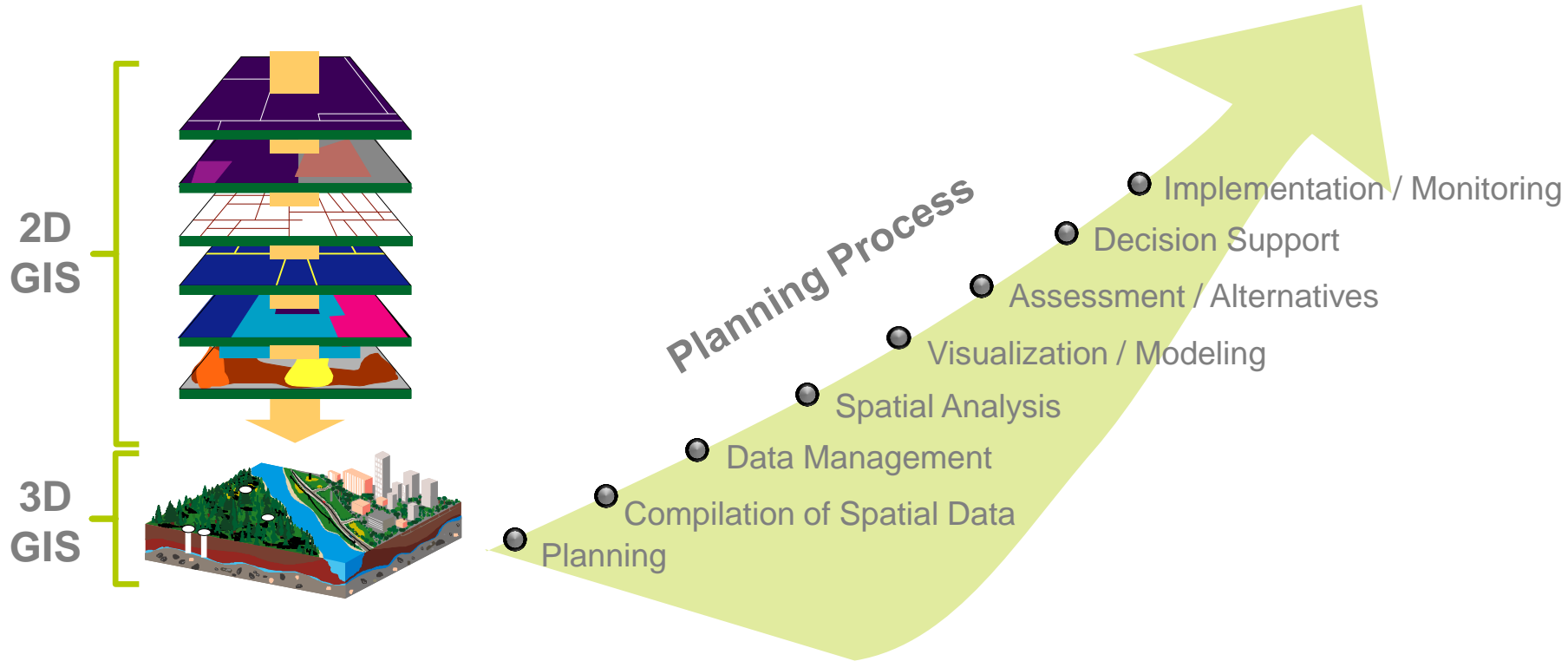
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# Agenda

- The GeoDesign Concept
  - The GIS Concept
  - The BIM Concept
- Smart City Project Morgenstadt
  - Status quo
  - Development scenarios
  - Analysis and GeoDesign advanced application examples

# The classical GIS Concept



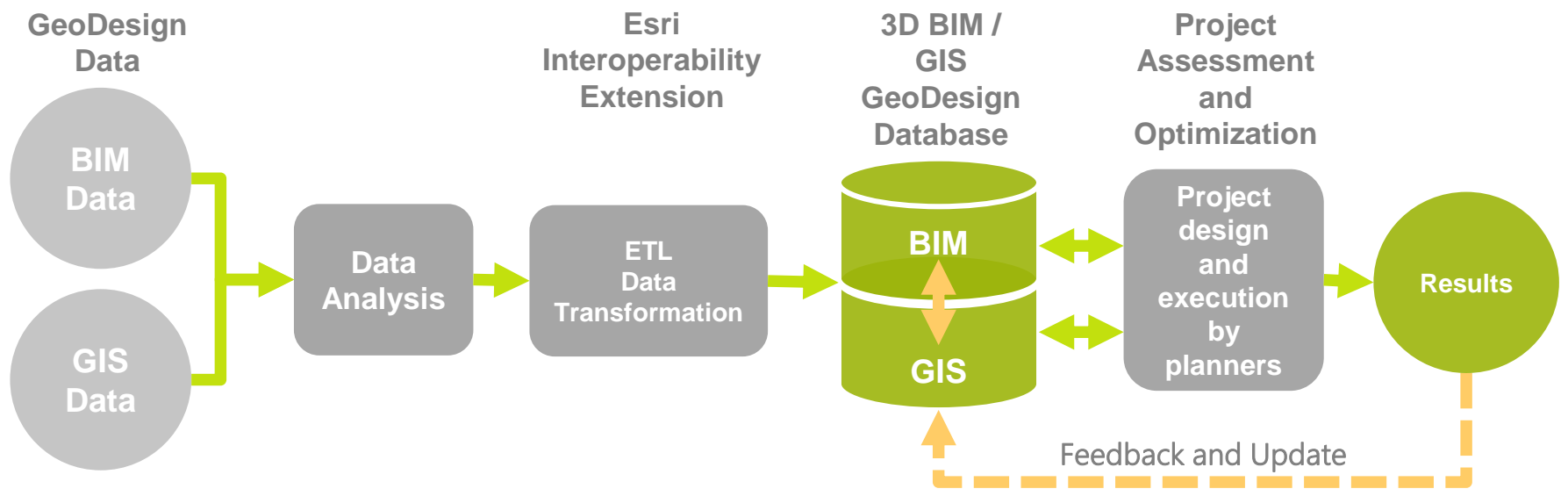
# The BIM Concept

- „... Continuous use of a 3D digital CAD building or infrastructure model over the entire life cycle of a construction project - from design, through planning and execution, to operation and decommissioning of the project”



Source: Borrmann et. al, 2015

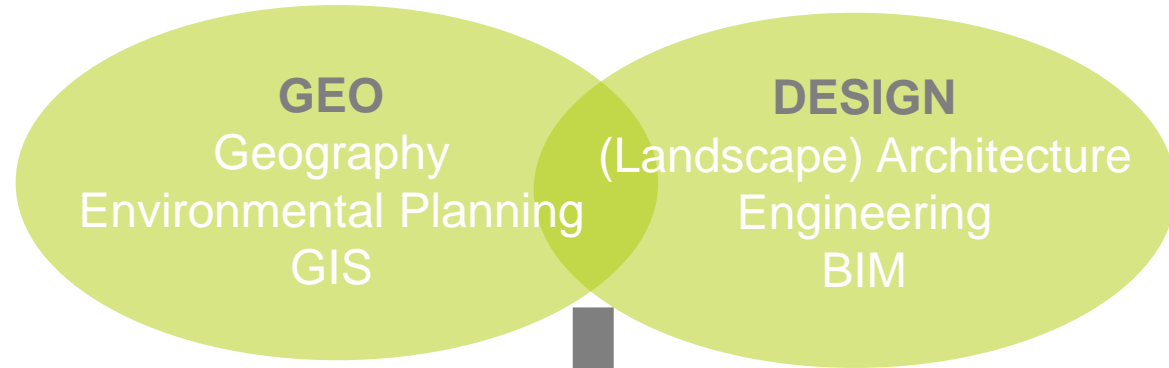
# The integrated GeoDesign Concept



PLANNING AND IMPLEMENTATION PROJECT

→ → → → Project Phases → → →

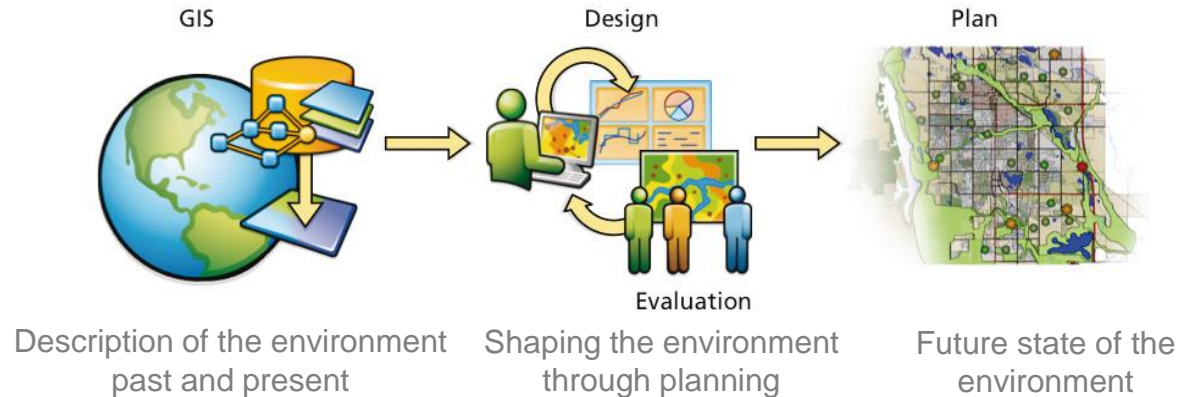
# The GeoDesign Concept – GIS and BIM Synopsis



## GeoDesign Concept

“Creativity is the synopsis between two normally independent ways of thinking”

... Arthur Koestler



# The GeoDesign Concept

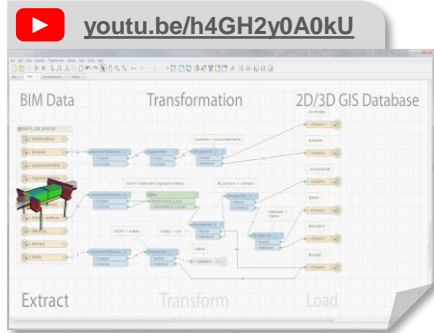
## GeoDesign Requirements

- 2D / 3D / 4D Geo-Reference System  
Context / Content
- Attribute Management  
Context / Content / Relations
- Topology  
2D / 3D
- Geo-Spatial-Temporal Analysis  
2D / 3D / 4D

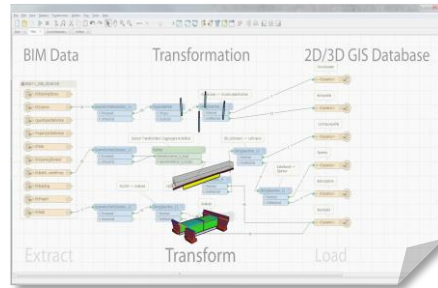


# The technical BIM and GIS Integration ETL – FME Transformation from BIM to GIS

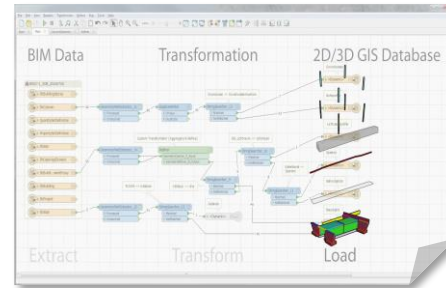
- Esri Data Interoperability Extension



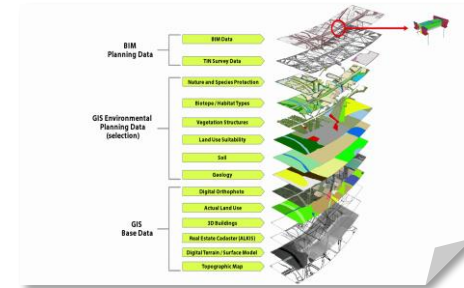
Extract



Transform



Load



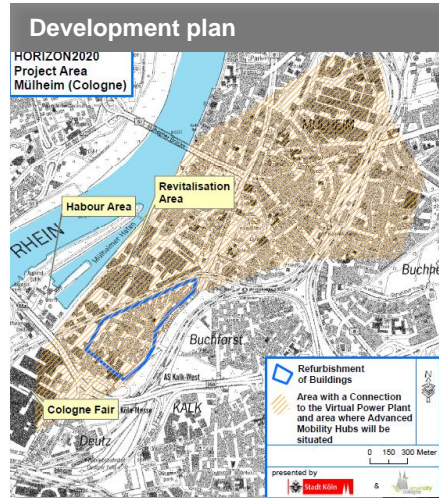
GIS Layer Stack



# Project Morgenstadt: 3D City Engine Models and Applications for the Smart City Cologne

- Objectives:
  - Integrative approach to sustainable urban development
  - Modernization of the district, including residential and business areas: How can sustainable and smart technologies (buildings, energy, mobility) be implemented in a specific social environment?
  - Visualization of the current state as well as modeling of development scenarios
- Approach:
  - 3D GIS analyses
  - 3D BIM data integration
- Products for the Smart City Cologne:
  - Applications of the 3D model for e.g. urban planning, public participation, civil defense, energy and environmental balances

# Project Area – Cologne Mülheim South



Project area at current state



[youtu.be/Z8yK7hDIWG4](https://youtu.be/Z8yK7hDIWG4)

Project area overview

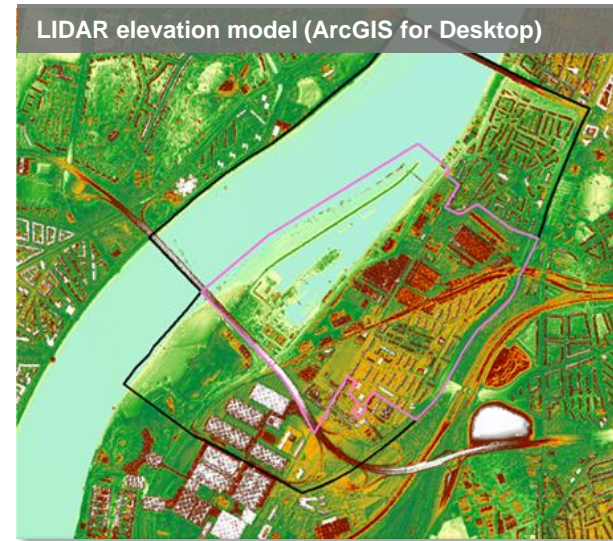


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## Data provided by departments of the City of Cologne (examples)

- Digital Terrain Model (DTM)
- Digital Surface Model (DSM)
- 3D Building Models [BIM]
- Data from the official cadaster information system (ALKIS)
- High resolution ortho images / aerial images / facade photos
- Energy report of the building stock (BEST-tables / EnEV-certificates)
- Master and development plans, architecture competition, workshop procedure
- Environmental data and models (traffic noise, energy and water management etc.)
- Statistical data

# Cologne Mülheim South Source data examples





# Esri CityEngine 3D Model: Status Quo

Visualization option #1 of the status quo model



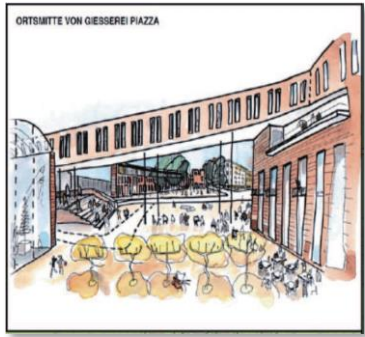
Visualization option #2 of the status quo model



# Development Scenario Cologne Mülheim South



Details  
BOLLES + Wilson / ksg



Workshop procedure Mülheimer Süden / Plans: BOLLES + Wilson, ksg architects and town planners, KLA kiparlandschaftsarchitekten



# Development Scenario Implementation Workflow

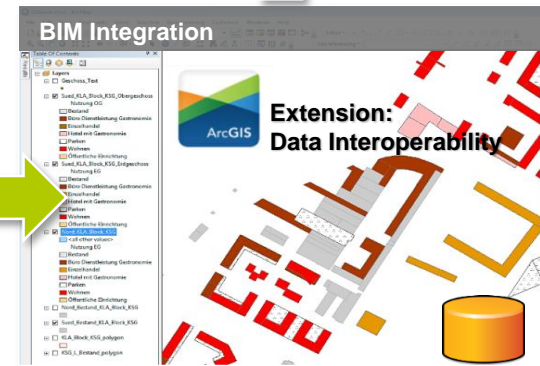
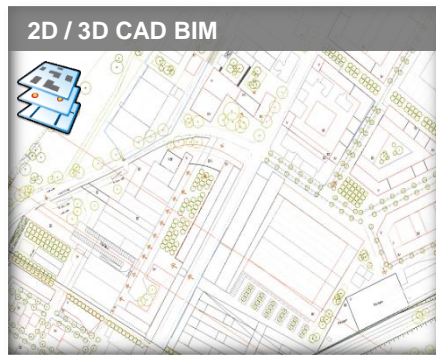
## Data and information



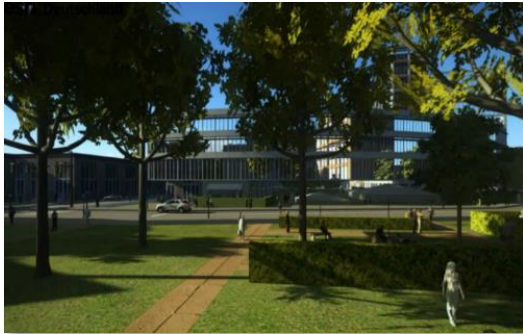
## Implementation + Processing



## Intelligent 3D Model

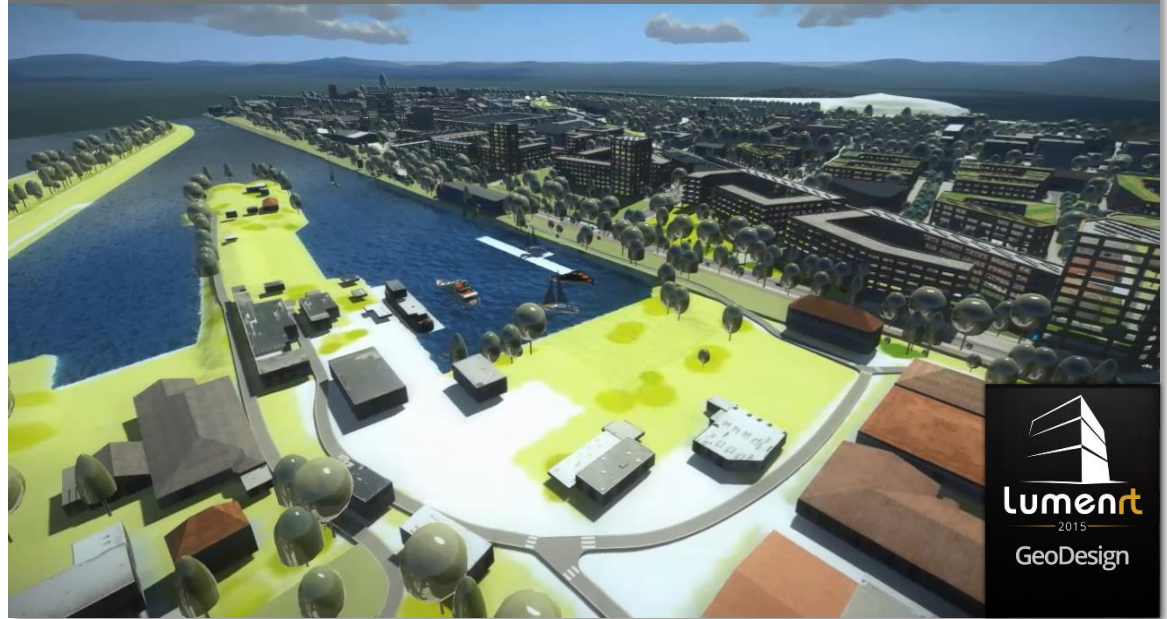


# Esri CityEngine 3D Model: Development Scenario



 [youtu.be/HIWvjS5kfVw](https://youtu.be/HIWvjS5kfVw)

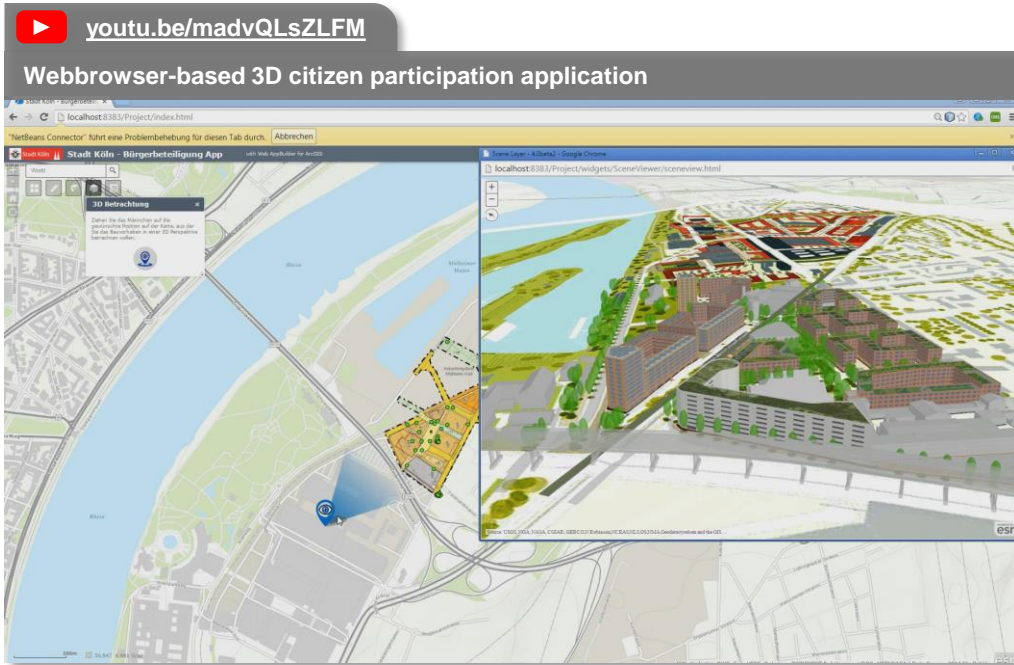
Rendering of a development scenario embedded into the status quo model



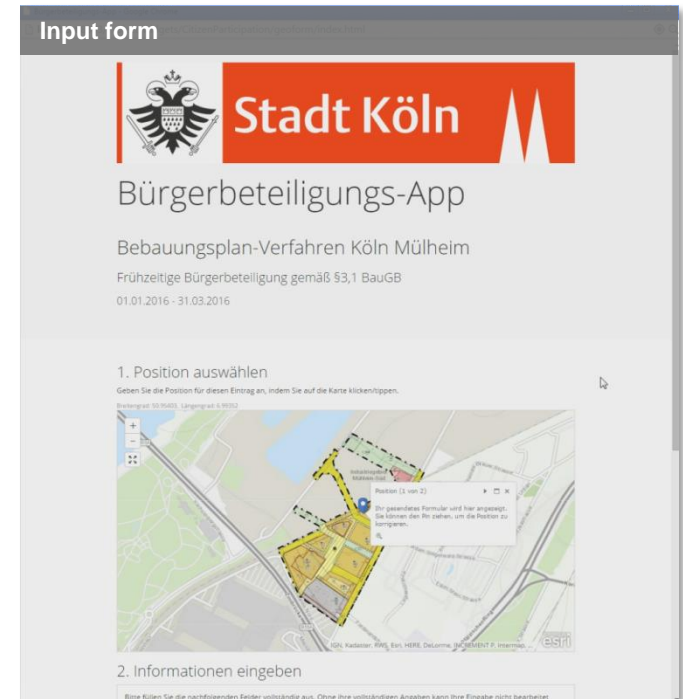


- The digital 3D District Development Plan and the Citizen Participation application
- 3D flood visualization, analysis and BIM integration
- 3D traffic noise propagation and BIM coupling
- 3D building energy demand scenarios
- Integration of subsurface utility BIM construction data

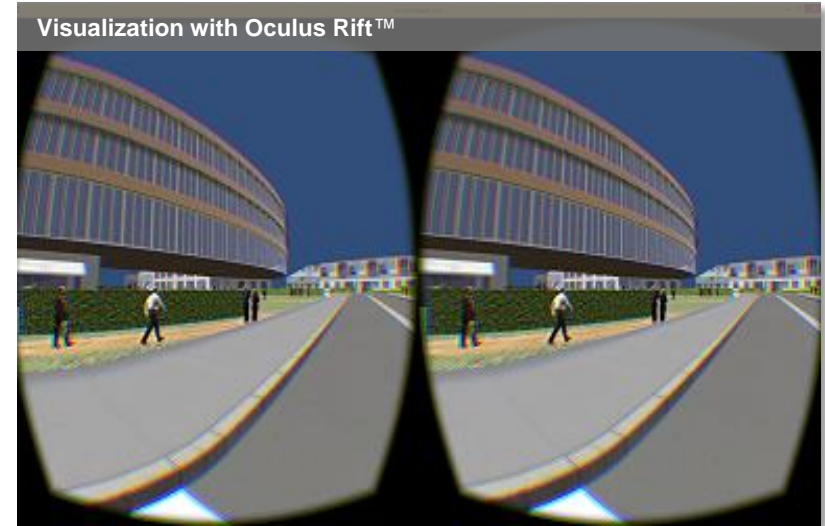
# 3D Citizen Participation App including Web-GIS Urban Land-Use Planning




2D version of the app has recently been released:  
<https://goo.gl/wQvXab>



# Presentation Possibilities for Citizen Participation



- Direct export from CityEngine to WebGL-based Webbrowser Viewer
  - Free navigation from bird's eye view
  - Comparison of scenarios using slider tool
  - Attribute query

- Further use of the models in additional applications, e.g.  unity
  - Virtual Reality applications
  - Augmented Reality apps
  - First Person tours

# 3D Flood Visualization and Analysis – Workflow



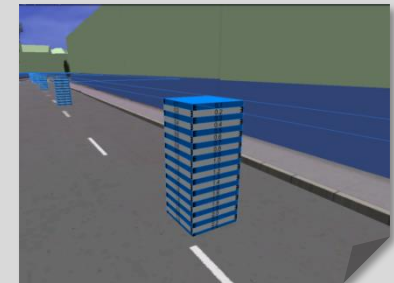
Preparation of water surface rasters from flooding levels and DTM



Vectorization and tiling of the raster



Display of flooding levels as layers in CityEngine



Additional indication of flooding levels on the streets and at the building facades

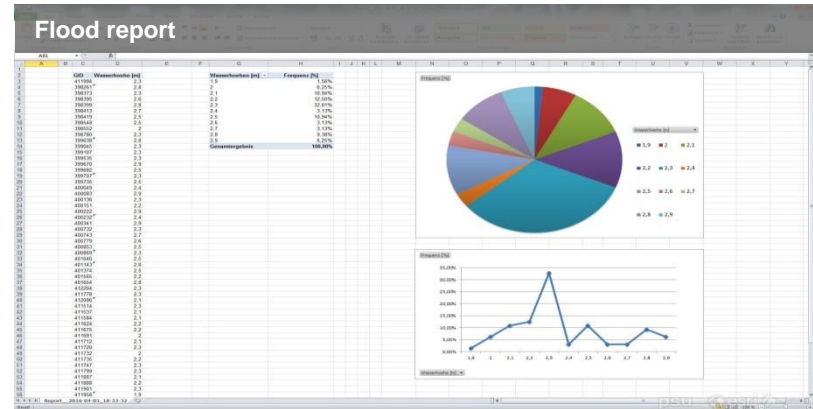
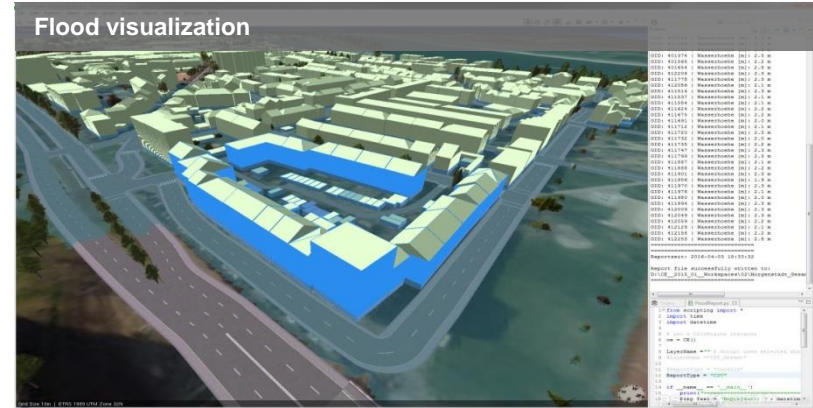




# 3D Flood Visualization and Analysis

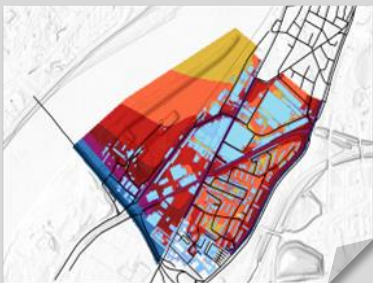
Flood Visualization and Analyses:

[youtu.be/MrByDSaC2vg](https://youtu.be/MrByDSaC2vg)

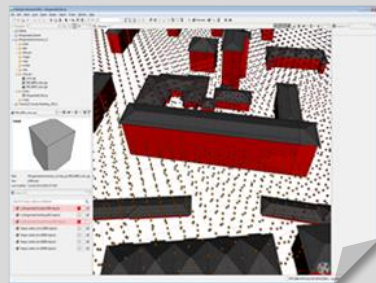


- Building attributes may be used for emergency activities as well as for expected flood damages or protection measures

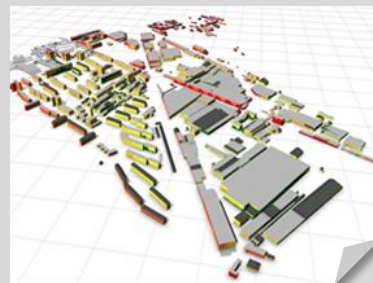
# 3D Traffic Noise Transmission Model – Workflow



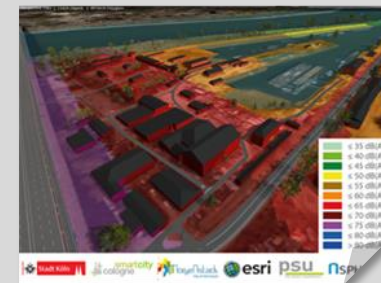
Scenarios: day and night traffic noise  
2D noise grids in gradation levels of 3, 6, 9 and 12 meters



Creation of three-dimensional point raster with noise levels in CityEngine



Interpolation of the noise levels from the noise points onto the facades of the BIM building models



Alignment of the facades to the DTM  
2D noise grid as DTM overlay

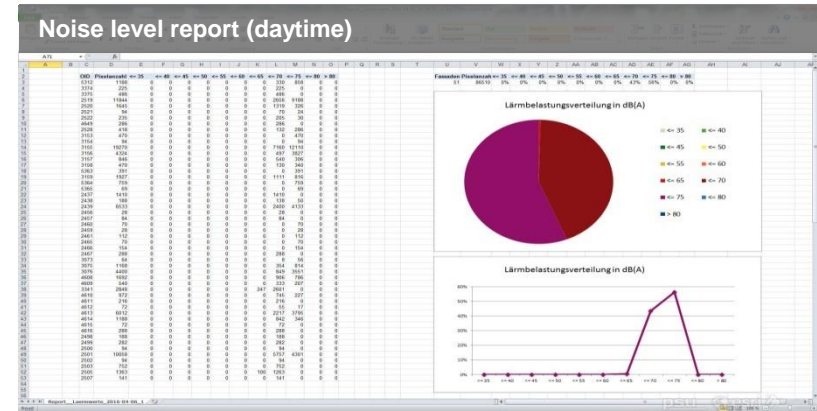
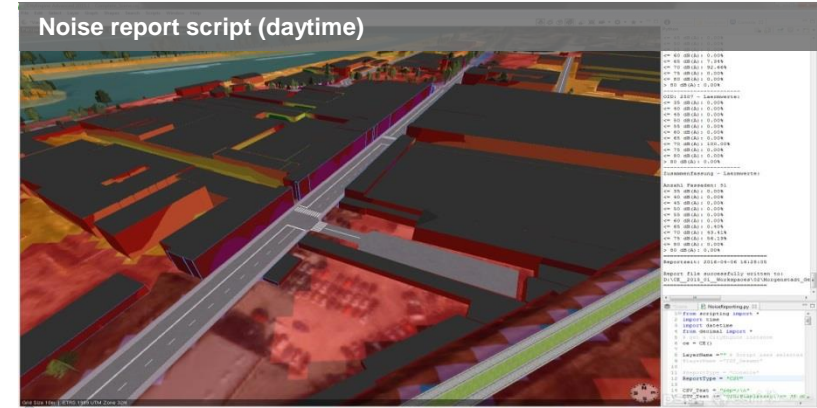


# 3D Traffic Noise Transmission Model

## Emissions Analyses:

- Noise exposure of buildings at different times, assigned as building attribute

[youtu.be/D3KqBWsJSHw](https://youtu.be/D3KqBWsJSHw)





# 3D Building Energy Scenarios – Workflow



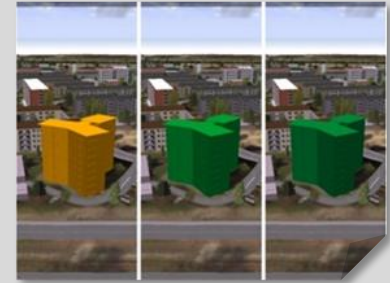
Procedural modeling of buildings in CityEngine



Allocation of values from external sources using scripts



Classification according to energy efficiency classes



Visualization of efficiency alternatives using rule switch

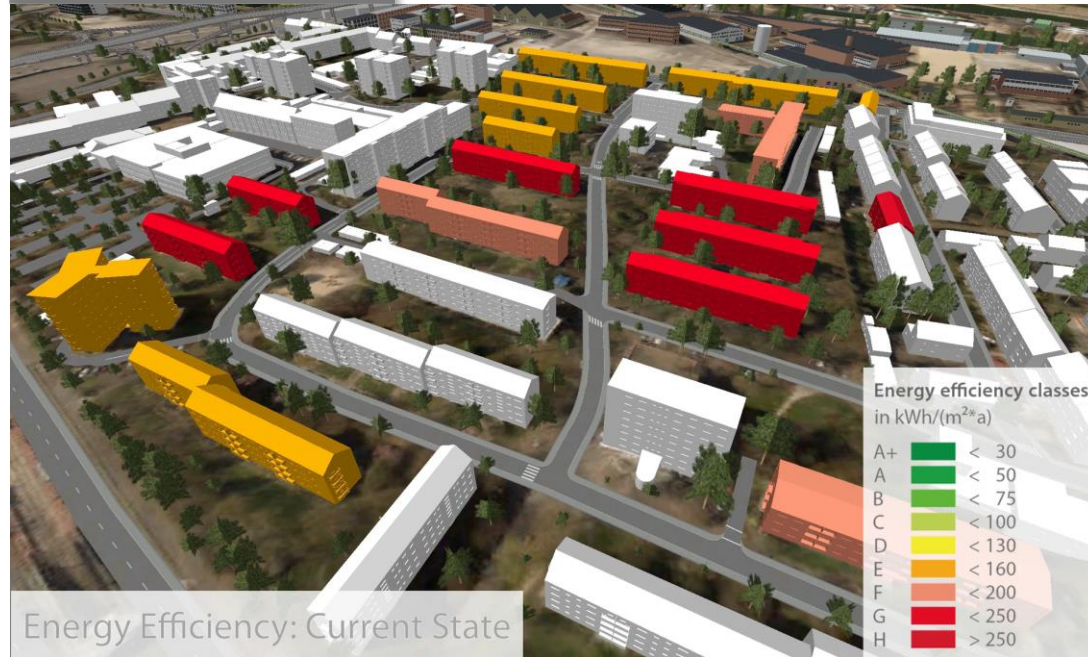




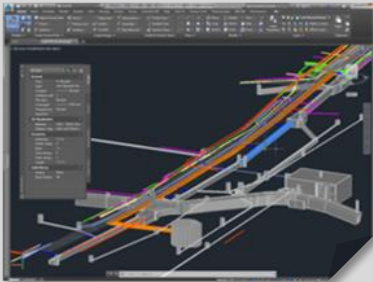


# 3D Building Energy Efficiency Scenarios based on *Building Energy Specification Tables* (BEST)

 [youtu.be/5tCnsmMJBIA](https://youtu.be/5tCnsmMJBIA)



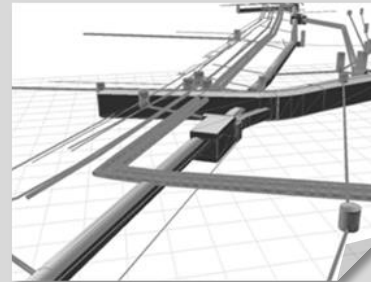
# Integration of 3D subsurface infrastructure BIM data - Workflow



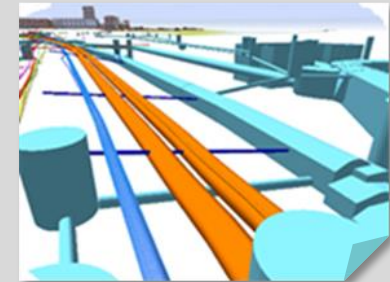
BIM data source:  
3D CAD



Conversion from BIM / IFC into 3D GIS Format using Esri Data Interoperability Extension



Import into Esri CityEngine



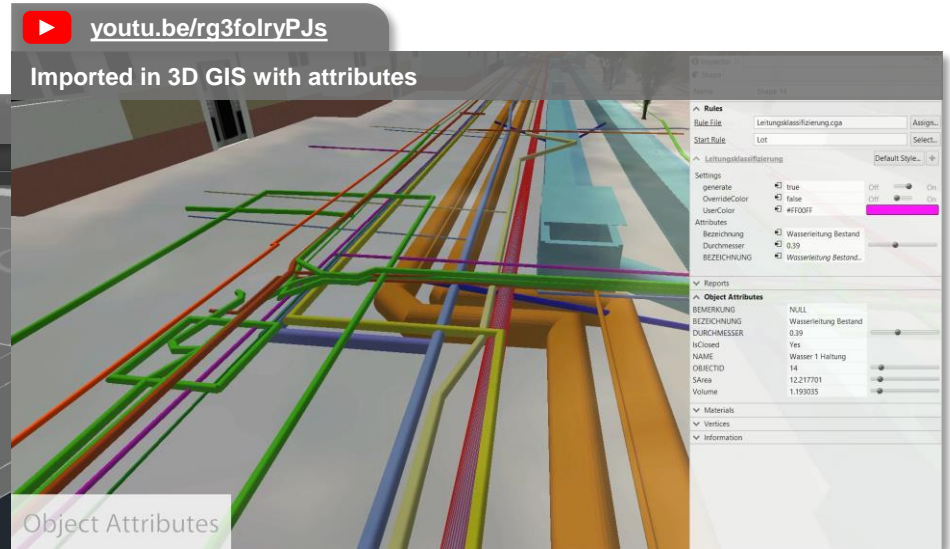
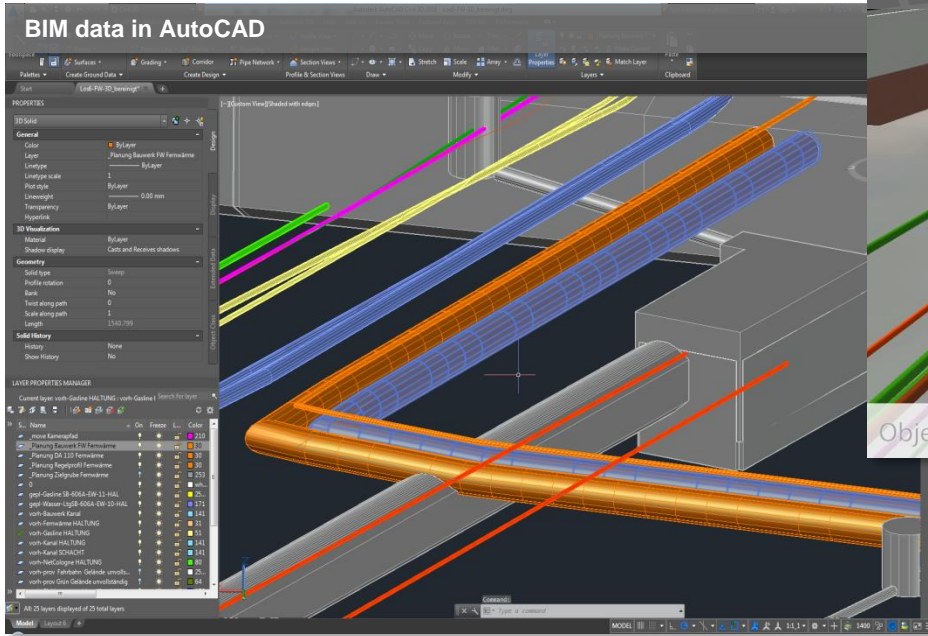
Classification in the 3D GIS database according to Object Type





# Integration of 3D subsurface infrastructure BIM data

3D BIM utility planning datasets:



- The integration of technical BIM planning and GIS is currently being developed in the A99 motorway BIM and GIS pilot project. For more information visit [www.psu-schaller.de](http://www.psu-schaller.de)

# Project Partners and Project Realization

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# Thank you for your attention!

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