Location-based 4D-Reconstruction

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Abstract. Architects do not only need 3D-models for the planning process, but as well for the process of visualizing information. In this projects we as architects were asked to show the lifetime-process of an industrial complex (a colliery - now used as industrial museum) over a period of more than one hundred years: the growth of the complex, the demolition of certain buildings, the network between the collieries in the neighbourhood. Google Earth as software platform allows recipients from all over the world to get an insight in four dimensions: the location based context including the time axis. For showing the world under the surface interactive animations or films are included.

Keywords: 3d-model; 4d-model; city-model; timeline; location-based.

The project: ‘time-travel ruhr’

Architectural history normally deals with certain periods, styles influence, which normally extend to greater regions or countries. Our approach is different: we look at a certain region and try to visualize ‘different’ histories and developments: geographical alterations, botanical changes, social and technical development and as one of the best researched fields, the history of settlements, cities, buildings.

What we try is to show the development of the Ruhr Area (one the most densely populated areas in Germany) in different layers. Some years ago it was only possible with special software or expensively produced films to show this development with other media than books and maps. Only a few years ago it became possible and popular to visualize the planet earth with online media like Google Earth. Nowadays everybody can generate interactive journeys round the globe and zoom onto certain places and buildings.

This possibility enables even children at school a new sight to their own city or region. Additionally the way of visualizing information has changed. It is no longer necessary to look into a encyclopedia (printed or online) according to alphabetical or chronological order (figure 1), it is also possible to use the location as an access to information. Several media (Google Earth, Wikipedia, but also tv-stations and newspapers use the geographical access to show ‘location-based’ information (figure. 2).

But it is not only possible to have a look at the world of today - it is also possible to change the layer of time to the past or even the future. Both is attractive for architects: to show the development of a site or a building, of a city or a region as well as to visualise future scenarios or planning alternatives with instruments like Google Earth. And it changes the
access for ‘architectural information’: it is no longer necessary for recipients to be an expert or being able to ‘read’ plans - everybody can have a look at 3D-models in Google Earth to see alternatives for future planning as well as having a look back into history.

Our project has its main focus on visualizing the history of the Ruhr Area - in a wide range of aspects and disciplines. This needs a network between information of different disciplines and different scientists like archaeologist, historians, sociologists etc. and to transport it to layman (adults and children, visitors of museums and visitors of websites, Google Maps, Google Earth and similar geography-oriented science-access.

The Zollern colliery (‘Zeche Zollern II/IV’)

As an example for visualising the history of a site we choose the Zollern colliery, an ‘anchor point’ of the European Route of Industrial Heritage (ERIH; www.erih.net). This colliery was founded in 1898 as a prototype for new forms of functional architecture as well as an example to use steel-construction for industrial buildings and electrical power for the engine house (the first electrically-driven winding engines in the world).

Zollern II/IV means, that not far away from the site in Dortmund there was another colliery: Zollern I/III. After a few years there was even a cooperation with the Germania-colliery.

When the first colliery Zollern I was founded in 1854, there was no railway, no river and no canal - the coal had to be transported on the road.

Showing the context in 2D

Just to show the relationship between the collieries it is enough to use twiodimensional maps - in this case superimposed to Google Earth (figure 3). Even if is very important to show the geographical context, we from our position in the 21st century need another dimension to get an understanding for the time, those coleries were founded: at 1854 there was no railway. When the next collieries were built, the mining companies chose the sites close to railway tracks or even the new canals.
The result of finding historical material in form of plans often shows illustrations from books or historical documentation. The problem is the isolated information without geographical or functional context (figure 4) - maybe typical for different ways of scientific work processes in different disciplines.

In this case books, documentation and research about historical sites are mainly produced by historians for certain reason, e.g. anniversaries of one of those collieries. Bringing together the information (for the first step in 2D, extended by a time axis) it is possible to generate a contextual impression. Google Earth delivers the tools: superimposing 2D-plans and offering a time axis.

After that it makes sense to show the next dimension: the z-axis:

**Modeling 3D**

The experience with cad-modelling in architectural planning shows, that you need different data-structures in a visualisation-process than in a planning-process. But even in the visualisation-process it depends on the end-user, if it makes more sense to use a rather simple, but fast model for the internet (e.g. a Sketch-Up-model with reduced geometry and photographic textures for Google Earth or a more complex model, e.g. 3D-max for complex simulations and films). The platform for visualising the history of a building or a situation normally is one of the fast, not too complex ones like Sketch-Up/Google-Earth for online-use (as ‘appetizer’) and in addition a more professional one like 3D-max for presentations inside a museum).

The process of visualising existing buildings is clearly structured and can be done even by students in the first year (figure 5):

- acquiring a drawn plan of the site, alternatively an aerial photography from Google-Earth, where dimensions are precisely enough
- using sections and elevations to generate the vertical dimensions
- taking precise photographs and equalize them

The next and difficult step is the reconstruction of buildings, which no longer exist. Sometimes it is possible to find documents from the planning process, sometimes only postcards. To show the fact, that there are only rudimentary informations and
documents, we sometimes use historical elevation-
drawings instead of photographs as texture for 3D-
models (Fig. 6).

In addition to only showing the building process
(including demolition of certain parts) it is possible
to show processes of transporting materials (in this
case coal), but also the settlements of the workers
and their limited world - some of the settlements
were built by the mining companies to keep their
workers in a supervised area and away from other
firms, providing them with stores, gardens and med-
ical treatment.

The fuzziness of information

In case, there are is not enough historical informa-
tion, there are two solutions:

- not showing anything (some historians prefer
  this way with the argument: “instead of showing
  incorrectness we do not visualise anything”)
- the moderate alternative is to say: “even if not
every facade is historically proved, it is better to
show a kind completeness”.

A good example for the latter version is the recon-
struction of the roman settlement in Xanten / Ger-
many (www.apx.de), where an interactive, virtual
‘magnifying glass’ operates like an x-ray (figure 7)
and shows the real excavations and the extrapolation

Figure 7
3D-reconstruction of non-
existing buildings, extended
to the fourth dimension by a
sliding bar in Google Earth
that allows to choose a cer-
tain year or a certain period.

Figure 8
The ‘x-ray-spot’ shows the
sites of excavations.

Figures 9, 10
The network between the
collieries underneath the sur-
face can not be visualised in
GoogleEarth.
Figure 11
The process of erecting, growing, demolishing - and reerecting for a new use as museum

(generating a complete roman city). In our case we visualise only existing buildings with photo-textured facades. Buildings which do not exist anymore are visualised as gray boxes (in case there is no historic source) or textured with historic facade-elevations (figure 8).

**Conclusion**

The role of the architect in this field is the role of a moderator between several disciplines and of the role of a visualizer - asking the right questions to historians, sociologists and transforming their information into a 4D-model - in respect of recipients in museums, schools or on the internet. The project ‘Time-travel Ruhr’ has already had a lot of positive resonance - under scientists as well as under recipients and will be developed further on.

**References**

The International Committee for Documentation of Cultural Heritage (CIPA), http://cipa.icomos.org.