Digital geoTwin Vienna

What does *geo* with the Twin?

Hubert LEHNER, City of Vienna, Surveying and Mapping – Department 41, Austria
Sara Lena KORDASCH, City of Vienna, Surveying and Mapping – Department 41, Austria

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Virtual 3D city models usually evolved from other geodata sets and were not set up from scratch. As traditional geodata used to be only 2D and 2.5D for a long time, 3D city models started naturally with 3D building models. On the one hand, this has a technical aspect, because buildings, especially when being modelled in a higher level of detail, can be described neither in 2D nor in 2.5D. On the other hand, this is because buildings form the identity of a city. This can clearly be seen when looking at the sights of a city, which are usually historic or modern buildings, such as cathedrals, palaces, skyscrapers, etc. In many cases, the 3D building models themselves were called 3D city model, because they are so essential for a virtual 3D city. A common way to create a 3D city model beyond the buildings is to combine them with 2D (i.e. city map) and 2.5D (i.e. digital terrain model) GIS data sets. In case the models are used for visualization purposes only, the city map is normally used in a raster format as texture on the terrain model. In case semantic 3D models are aimed for in order to use them for analysis, 2D city map vector data are raised, e.g. to a terrain model or a 3D point cloud. Continuative steps to enrich the virtual scene are often adding 3D bridge models or vegetation created by a set of template tree models and point-based tree information with height and tree top diameter as attributes to the point information. Problems usually occur due to temporal incoherence of the data sets. While for visualization purposes, these problems might be neglectable, they have to be tackled in case the resulting 3D city model should serve as basis for a city information model. In this contribution, a new strategy in producing the 3D city model as well as other geodata products of Vienna, which completely rethinks and reverses the geodata workflows currently in use, are discussed.[1]

The centre of the strategy is to use the existing three-dimensional surveying and mapping data and potentially further input data to directly model a Digital geoTwin (see Fig. 1)—a virtual, semantic 3D replica of all elements and objects of the city.[2] Digital twins are an upcoming concept of digitizing

[1] Lehner, H. and Dorffner, L. (2020). 'Digital geoTwin Vienna: Towards a Digital Twin City as Geodata Hub', *PFG – Journal of Photogrammetry, Remote Sensing and Geoinformation Science* 88, p. 63. doi:10.1007/s41064-020-00101-4.

[2] Lehner, H. and Dorffner, L. (2020). 'Digital geoTwin Vienna: Towards a Digital Twin City as Geodata Hub', *PFG – Journal of Photogrammetry, Remote Sensing and Geoinformation Science* 88, p. 63. doi:10.1007/s41064-020-00101-4.

elements, processes and systems of physical entities in order to create living digital simulation models as collaborative platform for many disciplines. The prefix **geo** was integrated in the neologism Digital **geo**Twin to emphasize the focus on the geodetic, geometric aspect of creating semantic geo-objects for a digital twin. This Digital geoTwin should allow to derive other needed GIS data sets from it, which in corollary ensure full temporal and contentual coherence for all derived products.[3]

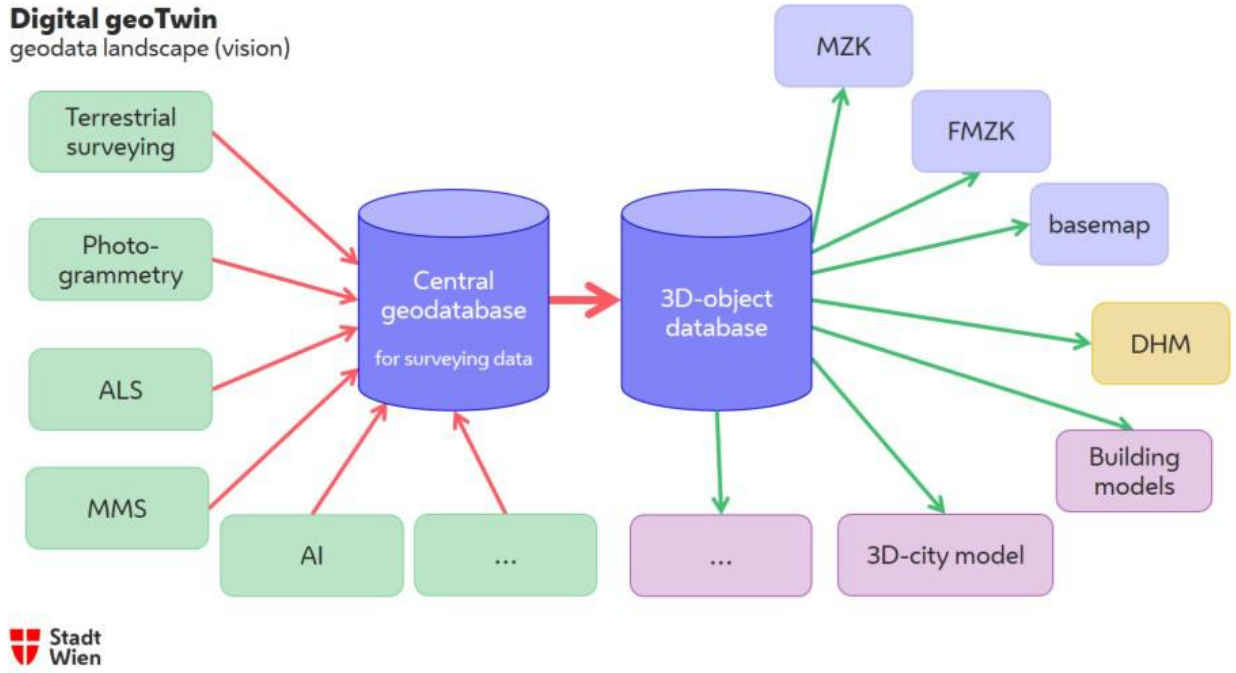

Fig. 1. Geodata landscape (vision) (© City of Vienna, Surveying and Mapping – Department 41)

Fig. 2. Linking of databases (CIM) (© City of Vienna, Surveying and Mapping – Department 41)

[3] See footnote 2.

To ensure the embedding of the Digital geoTwin in the Digital Twin of the City of Vienna, several use cases were defined within the project. By linking the objects of the Digital geoTwin with further data and information, e.g. census data, socio economic data, energy consumption data, maintenance management data, etc., a city information model can be built up to serve as basis for a living digital twin of Vienna.[4] (see Fig. 2)

The second use case deals with 3D planning data, which is often generated during planning processes. In the course of the process the models are refinded. Thus, the level of detail rises from block models (see Fig. 3), which are used in the early stages of the process, to detailed architectural models. A wide range of data formats might be used in the process and the especially the more detailed 3D-models are often not georeferenced. By storing the data in a central planning database, advantages such as various simulations in advance can be achieved. Furthermore, the integration of planning data into a Digital geoTwin contributes to public relations and citizen participation.

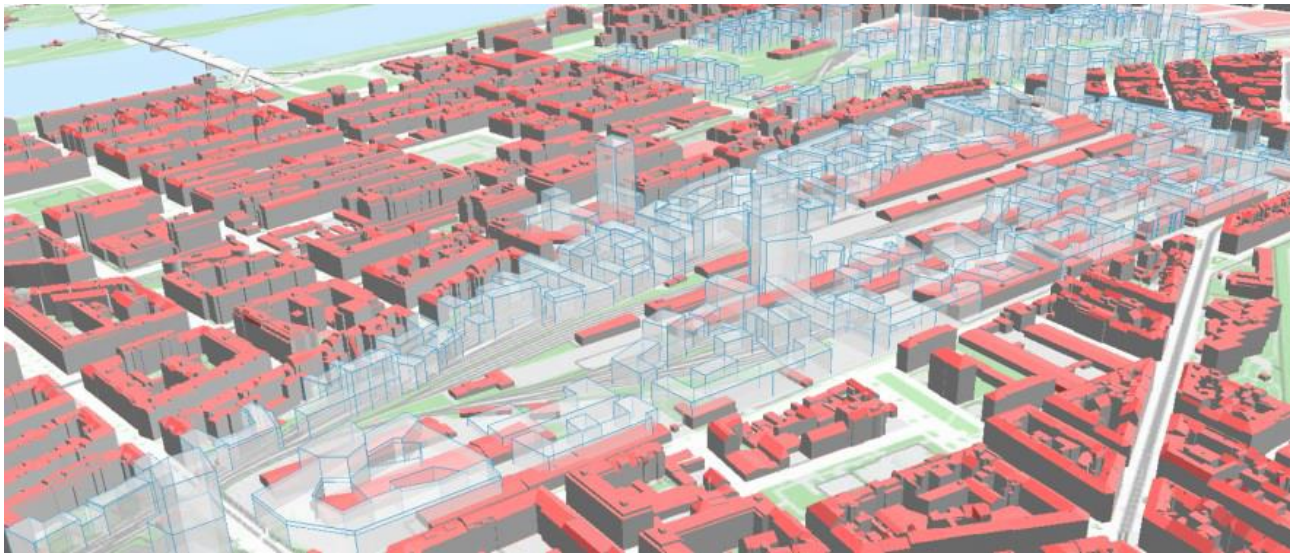

Fig. 3. Interactive urban planning – north/northwest railway station Vienna (© City of Vienna, Surveying and Mapping – Department 41)

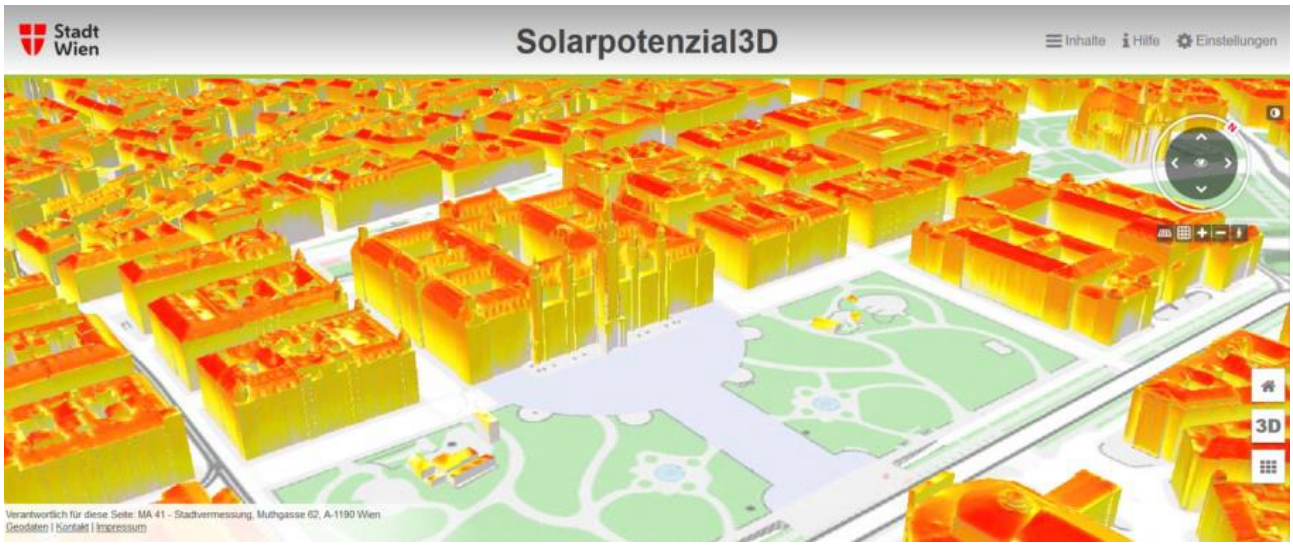

Fig. 4. Simulation solarpotential Vienna (vcMap) (© City of Vienna, Surveying and Mapping – Department 41)

[4] See footnote 2.

Due to the great interest in the effects of events in urban living spaces, in both small scale and citywide analyses, simulations form the third use case. Based on the Digital geoTwin various simulations, e.g. solar potential (see Fig. 4), flood scenarios, disruptive events etc. can be carried out. Thereby effects of planning can be calculated in advance and considered in decision-making processes. By using relationships between linked databases and simulation results, analyses and calculations can be executed on each 3D-object of the city.

Summary

Within the project “Digital geoTwin” a semantic, virtual 3D replica of Vienna is developed. The main goal is to automatically derive temporal and contentual coherent geodata products from the Digital geoTwin. Furthermore, use cases have been defined to incorporate the Digital geoTwin into a future Digital Twin of the City of Vienna.

References

Lehner, H. and Dorffner, L. (2020). ’Digital geoTwin Vienna: Towards a Digital Twin City as Geodata Hub’, *PFG – Journal of Photogrammetry, Remote Sensing and Geoinformation Science 88*, pp. 63–75. doi:10.1007/s41064-020-00101-4.