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Natural Resources: Projected Investment, Reality and Aspirations

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Advanced Technologies in digital 3D-Surface, -Deposit und -Mine-Modelling

Abstract

Nowadays digital data management in the mining industry becomes more and more important to optimize the modelling, planning and operation process. New developments, increasingly efficient hardware combined with professional database- and web-technology open new opportunities in several mining segments. The lecture will give some practical examples from surveying, deposit and mine modelling to show advanced technologies in the aggregate and oil shale industry.

UAV Survey

The surveying of quarries is increasingly being carried out by drones. Due to the rapid development of Unmanned Aerial Vehicles (UAV) and photogrammetry software solution, this modern surveying technic is becoming also interesting for the raw material industry.

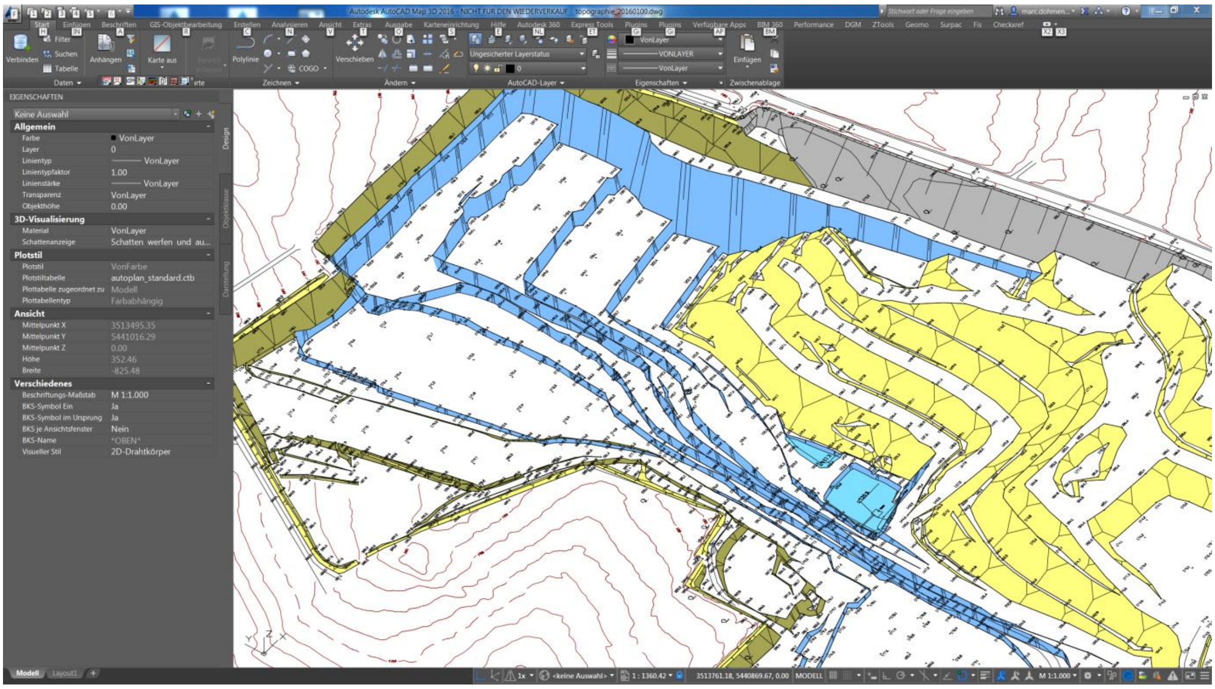
With a ground resolution of up to 3 cm point distance and a flight time of less than one hour it is possible to measure even large-scale areas quickly and accurately. Especially inaccessible areas of the quarry or difficult outside conditions can be easily detected. Moreover a better documentation with geo-referenced aerial photographs of the mining area and progress compare to conventional GPS surveying is possible.

A detailed calculation of a digital terrain model (DTM) is carried out on the basis of a dense 3D point cloud calculated by the photogrammetric application. It should be mentioned that the photogrammetric application depicts the total surface of the image-recorded areas. Therefore, points in areas of high and dense vegetation as well as buildings and installations will be calculated as well. These points can not be used for terrain modeling and must be removed manually or with special point filters.

The most important challenge today is the re-presentation of the survey data as a topographical layout in maps. The results of the photogrammetric evaluation consist, in addition to the aerial image, of a three-dimensional point cloud. This point cloud has to be transferred to a topographical string model with slopes lines, roads, buildings boundaries and other terrain objects such as pathes and water areas.

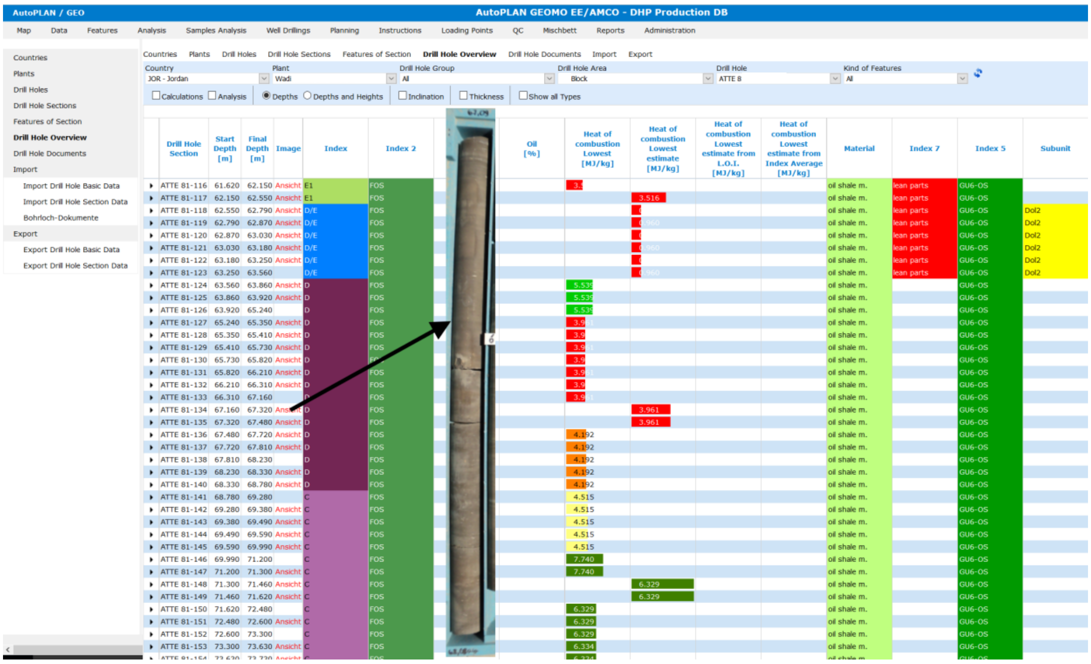
A fast automated edge detection of slope top and bottom edge with signature calculation is not included in many photogrammetric software products. Therefore elaboration and manual post processing on the PC is required. But there are new developments for automatic slope detection algorithm.

In addition to terrain surface modeling, point clouds can also be used for the three-dimensional digitization of geological structures and peculiarities, as far as they are open and visual on the slopes/benches to update the deposit model.

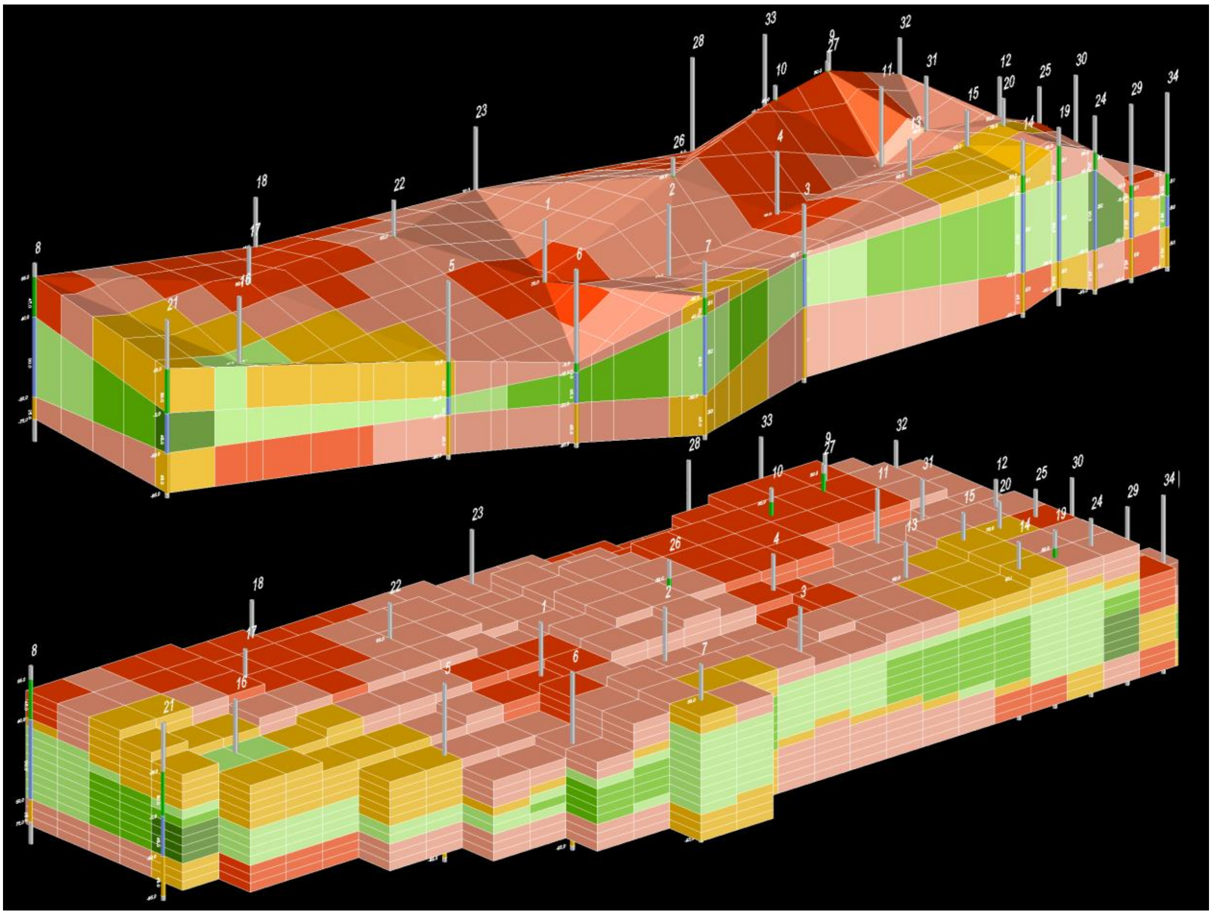


Deposit Modelling

——The deposit is the base of the raw material extraction and production. Therefore the deposit modelling process for quantity and quality is very important to get realistic values for the planning process. Modern software applications like AutoPLAN collect first all description and analysis data of exploration boreholes and other geological information in a central SQL-database. The data import, editing, visualization and reporting can be managed by a web browser. Based on this data a 3D geometric model will be developed by different interpolation methods.

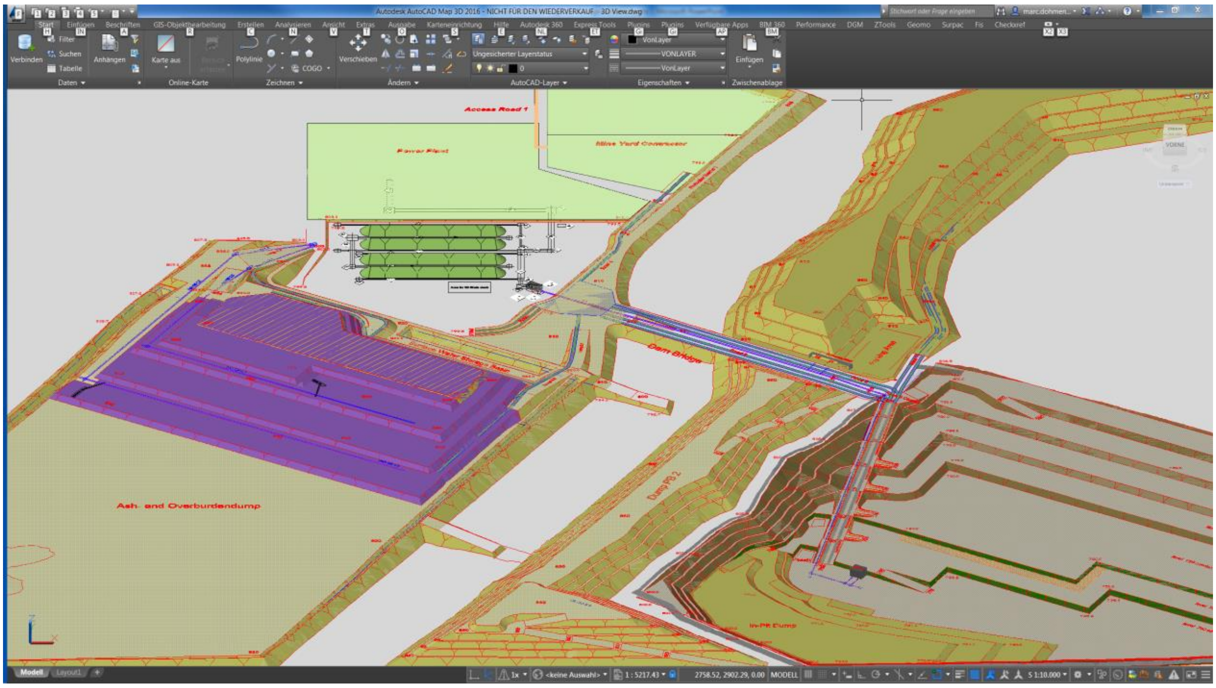


The type of the modelling methods becomes important and depends on the nature of the deposit. For sedimentary deposits like limestone and oil shale a layer-bound/stratigraphic block modelling is suitable. Contrary to conventional block models the stratigraphic block model considers arbitrary formed layer boundaries and thus simulates the real deposit conditions which have been developed during sedimentation of the material bearing seams.



Mine Planning

Based on the topographical survey and the geological deposit model the mine and dump design will be developed by the mining engineer. To calculate the mined quantity and quality a full 3D mine model has to be developed. Additional engineering parameters such as mining levels, slope inclination/heights, primary crusher positions, conveyor belt relocations or ramp systems are topics which have to be considered during the mine and dump planning.



One of the key topic for inhomogeneous deposits is the optimised blending calculation of different loading points to ensure the quality supply and economic efficiency of the short term mining operation which can be solved by a derived mine block model from the geological block model.