MICA
Minerals Intelligence Capacity Analysis

FACT SHEET

3D Modelling (Block)

3D geological modelling is the creation of 3 dimensional geometrical models of the earth's subsurface. A block model is a type of 3D model used to analyse the distribution of ore in a deposit.

Scope (conceptual model & main characteristics)

3D geological modelling is the creation of 3 dimensional geometrical models of the earth's subsurface. A model is the 3D equivalent of a 2D geological map. Block modelling refers to a subset of 3D models. Normally, the blocks or cells are measured *x* by *y* by *z,* in metres. In a block model, geological zones are divided into blocks and the tonnage and grade of contained mineral is estimated for each block. The shape of blocks (either cubes or rectangular cuboids) and the estimation methods vary according to the specific requirements of a project.

Contexts of use, application fields	-> contexts (e.g., environmental, economic, social assessment) -> which types of stakeholder questions are concerned? -> link to published studies that implement the method

Block modelling is an essential tool within the mineral industry during the generation of a resource estimate where the geometry of an orebody must be well constrained. It provides a method of aggregating the tonnage and grade of a mineral resource while retaining a required level of granularity within the model. A 3D conceptual model is combined with geostatistical estimation to establish a more accurate model focusing on the grade and tonnage of the mineral deposit. It is used:

- To provide an estimate of the grade (or other measure of quality) and tonnage of a mineral deposit.
- In mine planning to determine where mine infrastructure will be developed.
- To develop a schedule for the working of the mineral deposit.

Input parameters	-> which parameters are needed to run the method

Intercept grades, borehole location, geological model. The information gained from geostatistical analysis is the base data for ore resource calculation, mine planning and grade control.

Type(s) of related input data or knowledge needed and their possible source(s)	-> which types of data are needed to run the method, from which sources could they come… -> could be qualitative data or quantitative data, and also tacit knowledge, hybrid, etc.

All available data regarding a deposit is used to generate the best model. This is primarily based on the spatial location of boreholes and the intercepted grades within.

Model used (if any, geological mathematical, heuristic…)	-> e.g., geological model for mapping -> e.g., mathematical model such as mass balancing, matrix inversion, can be stepwise such as agent -based models, dynamic including time or quasidynamic specifying time series… -> can also be a scenario

A geological model is used together with a 3 dimensional geometrical model to which greades and tonnages have been estimated through some appropriate means. The grade values are usually interpolated from data generated from drill holes or sampling within the deposit.

–

System and/or parameters considered	-> **the system can be described by its boundaries**. These can refer to a geographic location, like a country, or a city, the time period involved, products, materials, processes etc. involved, like flows and stocks of copper, or the cradle-to-grave chain of a cell phone, or the car

	fleet, or the construction sector, or the whole economy… -> **parameters** could possibly refer to geographic co-ordinates, scale, commodities considered, genesis of ore deposits and others…

Block modelling is typically carried out on potentially mineable mineral deposits.

Time / Space / Resolution /Accuracy / Plausibility…	-> to which spatio-temporal domain it applies, with which resolution and/or accuracy (e.g., near future, EU 28, 1 year, country/regional/local level…) -> for foresight methods can also be plausibility, legitimacy and credibility…

Block models are static conceptual models of a specific mineral deposit. They are subdivided into appropriately scaled blocks for the extraction methods proposed. They are often used to examine the precision of resource estimates and to indicate where further work may be needed to improve the confidence level of the estimates. Grade in each block is calculated by statistical methods appropriate to the style of mineralisation (e.g. kriging).

Indicators / Outputs / Units	-> this refers to what the method is actually meant for. Units are an important part but that is most of the time not sufficient to express the meaning. For example, **the indicators used in LCA express the cradle-to-grave environmental impacts of a product or service**. This can be expressed in kg CO_2-equivalent. But also in €. Or in millipoints. Or in m^2year land use. -> for foresight methods the outputs are products or processes

The output is a three dimensional model, subdivided into blocks of to which tonnage and grade are assigned. The tonnage and grade of each block may be aggregated to produce a global resource estimate for the mineral deposit. This model can be used to identify shortcomings in the understanding of the orebody and to assist in mine planning and scheduling for potential extraction.

Treatment of uncertainty, verification, validation	-> evaluation of the uncertainty related to this method, how it can be calculated/estimated

Ore body validation is covered by the various international reporting codes for mineral resources, e.g NI 43-101, JORC and PERC under the CRIRSCO umbrella.

Main publications / references	-> e.g. , ILCD handbook on LCA, standards (e.g. , ISO) -> can include reference to websites/pages -> references to be entered with their DOI

Annels A. E., 2014 Mineral Deposit Evaluation

Wellmer F-W, Dalheimer M, Wagner, M. 2007 Economic Evaluations in Exploration

Related methods	-> List of comparable methods, their particularities… -> link to one or several other existing fact sheet(s)

Geological Mapping, 3D Modelling. Geostatistical Estimates.

Some examples of operational tools (CAUTION, this list is not exhaustive)	-> e.g., software… Only give a listing and a reference (publication, website/page…) -> **should be provided only if ALL main actors are properly cited**

Standard CAD software for generating 3D models. Most GIS programs also include a 3D component.

Specialist mining software, e.g. datamine

Key relevant contacts	-> list of relevant **types** of organisations that could provide further expertise and help with the methods described above.

Consultants. Software vendors. European Federation of Geologists.