

Use Case 10: Quantity Take-Off

Purpose

Quantity take-off is an important basis for

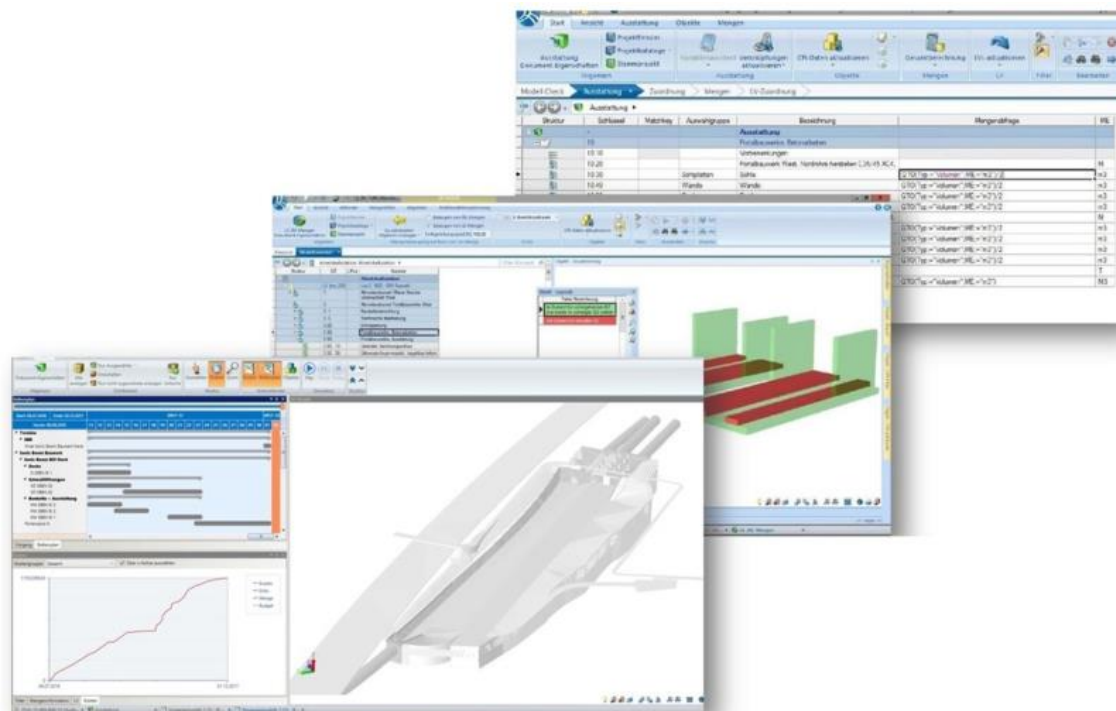
- cost estimation,
- tendering,
- billing,
- logistics planning

in tunnel projects. This use case is based on as-planned tunnel models created in the design phase. These models typically involve assumptions and estimations, in particular with respect to the geotechnical conditions. The models may include probabilistic models for improved risk management.

To support this exchange scenario, an appropriate geometric description is required as well as the applicability of a suitable classification system.

This use case is related to:

- Use case 2b: The geotechnical model is an important input for the QTO of excavated rock/soil and the necessary classification.
- Use case 12a: Design to tender (QTO provides the basis for tendering)
- Use case 15a: Progress monitoring
- Use case 15d: As-built progress determination



Quantity take-off for cost estimation (© RIB)

Exchange scenario

The exchange scenario that IFC-Tunnel must support is from the tunnel design application (aka BIM authoring software) to the quantity take-off application (very often part of tendering applications).

Requirements for IFC-Tunnel:

The most important requirement is the precise geometric description of both, the tunnel construction components as well as the excavated rock or earthwork. Particular attention deserves the fact that the precise sub-surface conditions are a-priori unknown. This relates primarily to the geological/geotechnical situation but also to some of the constructive elements (e.g. shotcrete). Accordingly, a clear separation between as-designed and as-built models must be provided. The former must be interpreted (and potentially associated) with the uncertainty involved.

Typically, uncertainties related to excavated material are expressed by means of ratios of different rock/soil classes expected (material distributions). They are associated with excavation spans.

Typically, the design model takes into account the uncertainties by defining limit surfaces (theoretical over-profile) resulting in corresponding volumes in the model.

Rock/soil classification is the major basis for estimating costs and tendering for both, excavation and stabilization/support measures. They have an influence on the excavation span and round length.

Billing is based on capturing the real geometry of the excavation and the thickness of shotcrete, often performed through laser-scanning. This typically results in a mesh geometry.

For logistics, expansion (swell) factors must be taken into account for the different materials.

Geometry: It can be assumed that the existing geometry descriptions for volume objects (IfcSolidModel), in particular triangulated face sets, but also sweeps and extrusions are sufficient. It must be investigated how boundaries between **soil/rock layers** can be appropriately described. Surfaces must be modelled for membranes etc.

Semantics: Quantity take-off requires the application of a (national) classification system on the basis of the IFC type system. The application of the classification systems for tunnel construction components is expected to be straight-forward. The extension of the IFC type system is part of the IFC-Tunnel project. A deeper investigation is required for the application of **rock/soil classification** systems, in particular in combination with the geometric description.

Specific requirements exist for mechanized tunneling (Use case 10a) and Conventional Tunnels (Use case 10 b).