MINESIGHT AXIS GRADE CONTROL

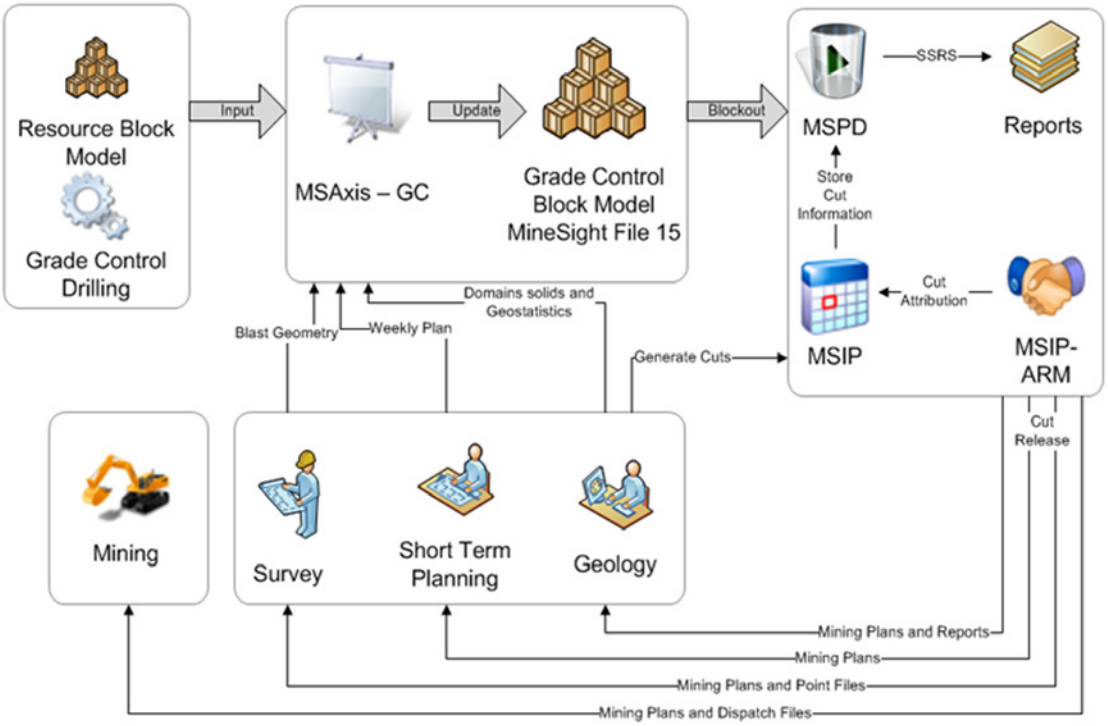
Achieving Operational Excellence

Proper grade control is crucial to the success of any operation. It's the last opportunity to optimize the material's grade and shape before it's extracted and sent to the stockpile, mill, or waste dump. Mistakes here are costly and can lead to excessive dilution or misclassification. Given its importance in the mining value chain, grade control should be treated like a service industry, with suppliers and customers.

A proper grade control system needs the following:

- **Speed.** Grade control is usually needed yesterday! From the drilling of grade control holes to marking up a pattern on the pit floor, grade controllers are always under pressure to complete the process quickly.
- **Auditability**. It's important to see what data was used and who did the work at any stage in the grade control process.
- **Flexibility.** Most grade control systems are poorly understood, inflexible "black boxes". This is one of the most important yet least considered aspects of a grade control system.
- **Ease of Use.** Workflow is important to both the process speed and to getting meaningful results.

For a grade control geologist or engineer, understanding and controlling the process is as important as good sample quality, and good mining techniques. Grade control data flow is dynamic. It demands a versatile system that adapts to each site's requirements without needing customized tools. Most grade control systems lack the capacity to make changes and accommodate new information. MineSight Axis Grade Control makes it a priority.



← *Figure 1*

Figure 1 MSAxis Grade Control workflow

Simply put, the grade control process comprises:

- Block model update
- Material Classification

Block model updates involve several steps to process raw information:

- **Blasthole Import**. This data is typically stored in MineSight Torque, but other third party relational database products can also be used.
- **Compositing**. Generation of point grade data for estimation.
- **Coding**. This could be coding of blastholes, composites, or model blocks using solid or polygonal geological domains.
- **Estimation**. All interpolation methods from polygonal and IDW through to MIK and Conditional Simulation.
- **Calculation**. Generally post estimation calculations for values like NSR, but this could happen at any stage (e.g. calculating drillhole SG based on metal grades).

The site's setup and workflow can be controlled and managed through user-defined templates. To compare and test different modeling methods, multiple grade control templates with varying parameters can be quickly created and updated.

The user-configurable **Process Manager**, shown in Figure 2, conducts this workflow. But while it establishes parameters for general users, the **Process Manager** can also empower authorized users, such as managers, to edit and update in response to new information. It dates other methods of grade control modeling. For instance, the **Process Manager** is configurable and will not proceed until each step is completed without errors. It is password protected to prevent accidental change and it generates an audit file.

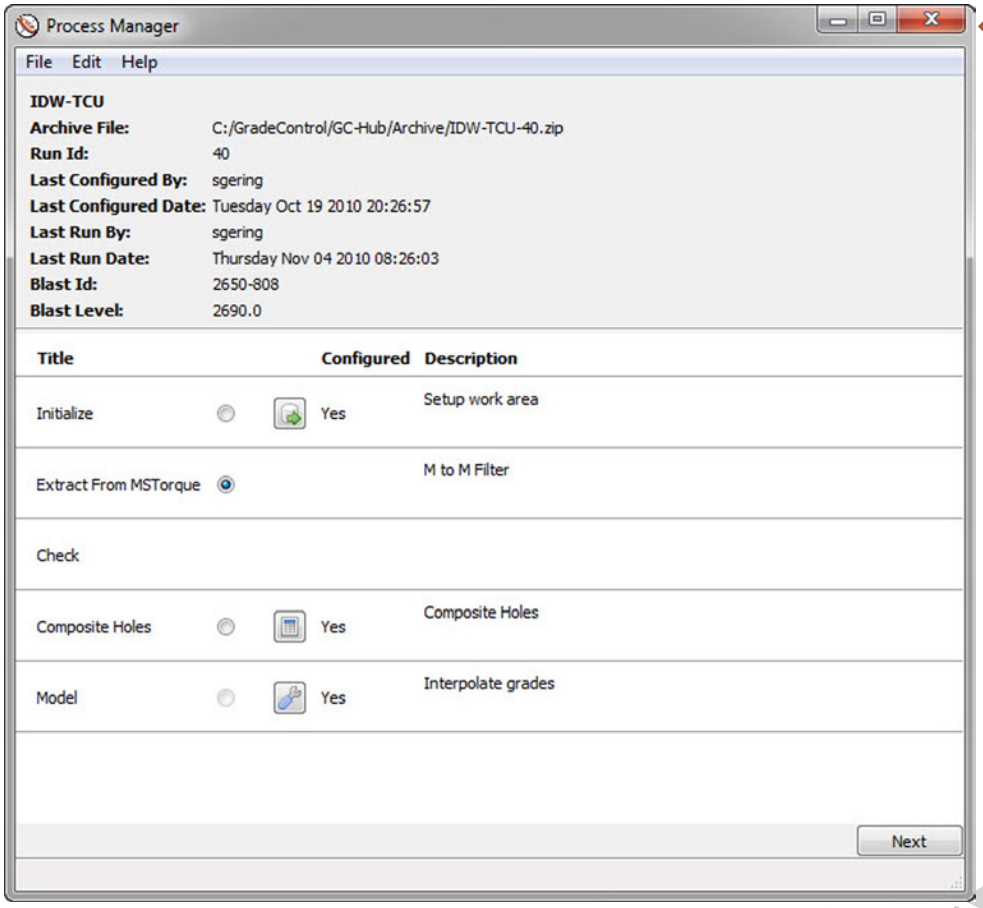


Figure 2

Figure 2 Process Manager

Several configurable utilities are key components of MSAxis Grade Control. These utilities were developed specifically for use in the **Process Manager**. The **Process Configuration** tool, shown in Figure 3, specifies the utilities sequence of execution. The process link is designed to prevent exclusion of required functions.

Figure 3 →

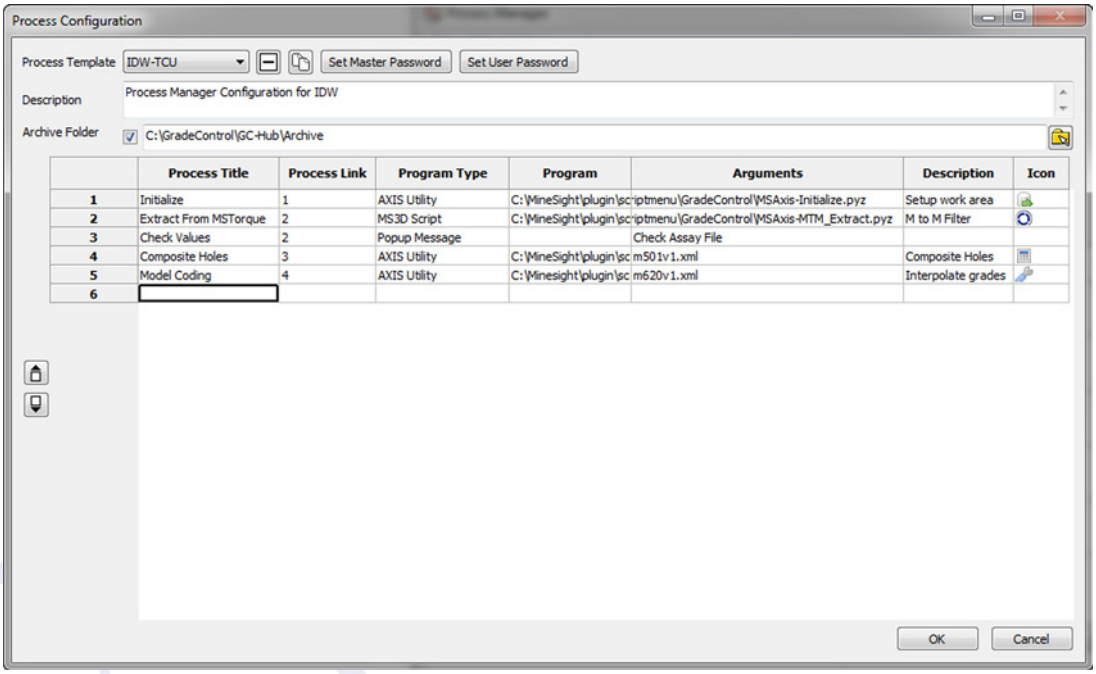
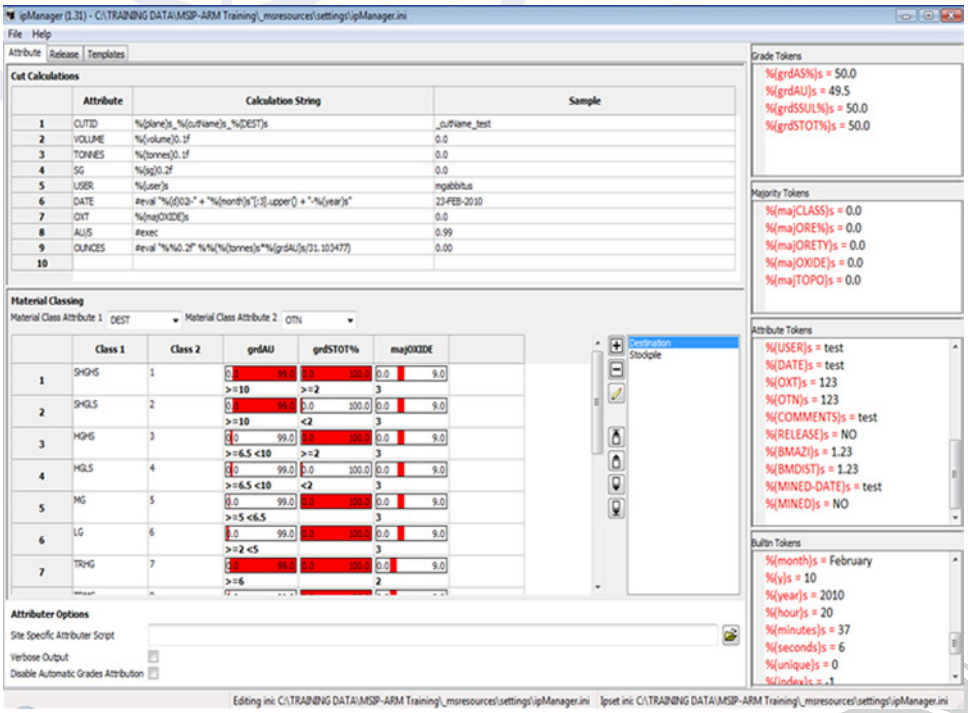


Figure 3 Process Configuration

To classify material, MSAxis Grade Control exploits the versatile MineSight Interactive Planner. MSIP classifies material based on two-dimensional benches, mid-benches, planes, or three-dimensional solids.

The Attribution and Release Manager, otherwise known as MSIP-ARM, completes material classification by attributing calculated or derived values to material classification cuts. Guided by MSIP-ARM's powerful manager interface (Figure 4), production and planning staff can take the calculated or assigned data from these cuts and control how and when it is released to data clients.

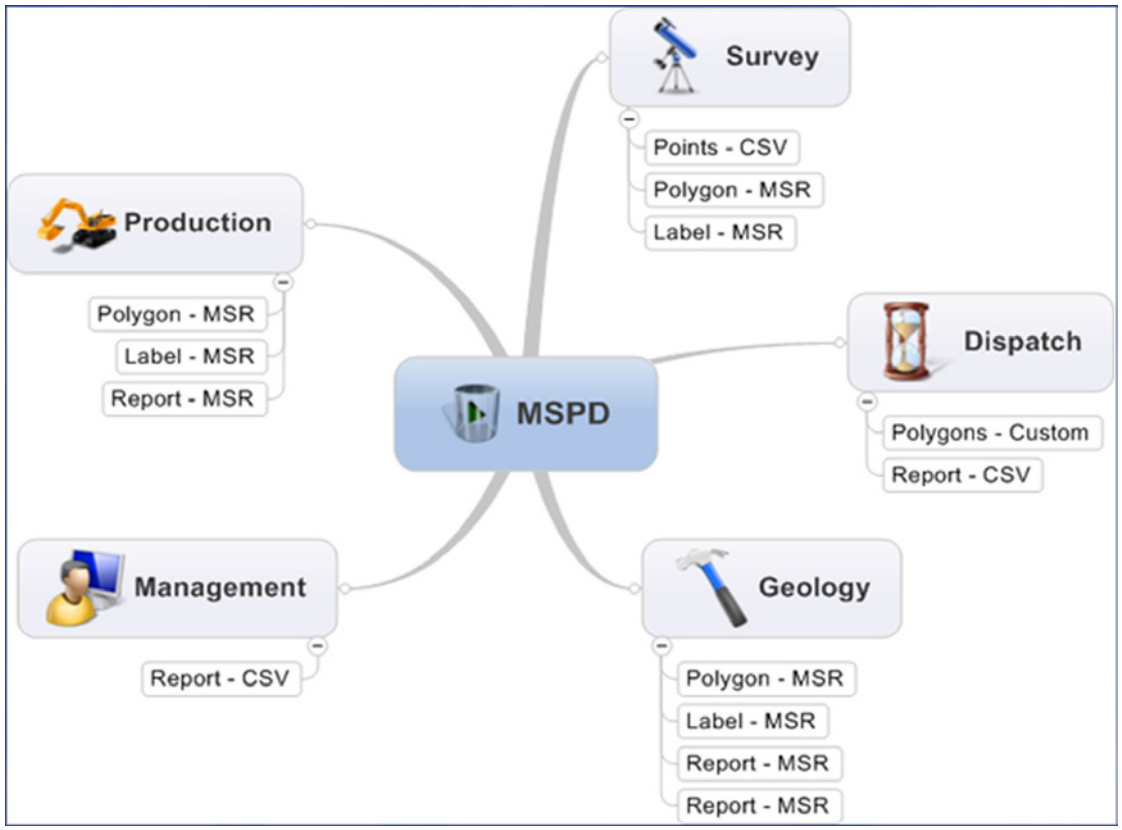
Ever flexible, MSIP-ARM can create new and unique site-specific parameters, calculations, and attributes, using a virtually unlimited number of attributes. Older MineSight Operations implementations required up to five site-specific scripts to accomplish the same tasks as MSIP-ARM.



← *Figure 4*

Figure 4 MSIP-ARM Manager

The type and manner of release to data clients is limitless as illustrated in Figure 5. Multiple release templates can be configured and used to supply the data clients with their required format and content.



← *Figure 5*

Figure 5 MSAxis Grade Control Data Clients

The more standardized look and feel of MSAxis Grade Control makes cross training of mine personnel much easier. The concept of configuration versus customization ensures the flexibility to perform the work unique to each site, while using the same tools from site to site.

Several add-on tools can be used if MSAxis Grade Control is in place. These tools are also standard and can be configured based on site requirements.

- Reconciliation
  - Model-to-model
  - Model-to-grade control polygons
- Production Material Reserves
  - Mined material
  - Broken material
- Blast Cut Adjust
  - Material classification vertices location using movement vectors
- Digline Optimizer
  - Material classification polygon using loss-profit function to maximize ore production and minimize dilution