Business Case

Substantial productivity gains and better grade control on mining sites.

Both EY and PWC have identified “Digital Effectiveness” or “Technology and Cyber” as the number 1 or major business risk facing mining and metals with productivity as one of their CEO’s main concerns. This article covers substantial productivity gains and better grade control on five mining sites located in New-Caledonia (nickel), Gabon (manganese), Guinea (bauxite) and Canada (ciment quarry), using CORALIS software applications dedicated to mine planning, monitoring and grade and reserve management on producing mining sites.

Using mining data from various sources

In order to get mining operations data in real time and to give management the tools to make sound decisions, CORALIS’ technical functions (topographic modeling, cartography, survey data management, resource estimation, production planning, etc..) are combined with databases that continuously monitor production data (GPS, production equipment, geochemical profiles, etc.) from different brands of equipment and software.

Substantial Productivity Gains

While it is fairly easy to quantify a gain provided by a particular mining equipment, it is more difficult to quantify what a digital transformation can bring to a mining operation. Consider the following areas of progress noted in these five companies:

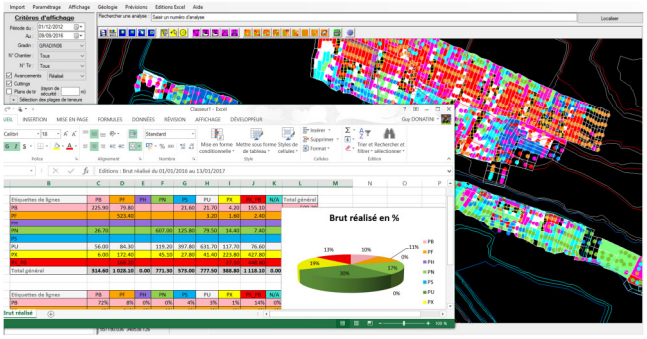
- **Time gain by using tablets on site**.

  The development of communication networks (Wifi or cellular) now allows bringing certain applications directly on site. Geological monitoring is a perfect example. In New Caledonia, geologists equipped with tablets record front sampling data in real time. The information is saved directly on the server and the updated map is immediately available by other users. In addition to a **significant gain in terms of reliability** (because of up-to-date data), the absence of office work when coming back from the site has resulted in a **15% time gain, therefore increasing productivity.**.

- **Time gain and sustainability.**

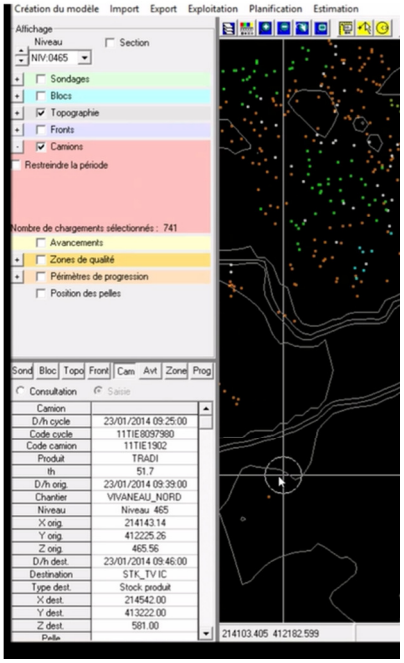
The *CORALIS Production Planning and Monitoring* module is responsible for creating ore batches that meet the required grade for a specific time frame. The application is adapted to the company's production process (open pit or underground, mechanical extraction or blasting, knowledge level of the deposit).

On some sites, the ultimate knowledge of the deposit is a 3-dimensional block model calculated from exploration surveys. The planning module allows the operator to interactively calculate the batch being prepared by combining several extraction zones. In other cases, the ultimate knowledge of the deposit comes from blast-holes cuttings information. The geochemical analysis results are imported from the laboratory services (text files, Excel, XML, etc.) The planning operator groups possible blasts zones into grade zones and can then combine the different zones available to form the required grade batch.



In both cases, thanks to 3D graphical display options, the user immediately views the analytical results of his decisions as well as the corresponding technical and economic impacts (transport distances, deposit recovery optimization, etc.)

Productivity gains can be measured in different ways. **Planning time gains** are noted thanks to the software's interactivity and the calculation speed. **Reaction times are improved** in case of unexpected change (blast unavailable, momentarily impractical access, etc.). **Production time savings** are possible through ore extraction optimization based on transportation distances or other technical and economic factors. And the **deposit recovery optimization** makes it possible to subscribe to sustainability principles thanks to the perfect mix of rich and poor grades.



- **Efficiency gain at the processing plant.**

Using the *CORALIS Production Planning and Monitoring* module combined to an **interface** between this module and the mining equipment location system (FMS or *Fleet Management System*[1]), the operators can manage the production and calculate the actual volume and quality

[1] In these cases, CORALIS applications are interfaced with LOGIMINE and MOD

generated.

Depending on the industrial process, either an online analyzer connects a set of grades to each truck, or the "actual grades" are calculated from the block model according to the loading point of each truck. It is also possible to consider that the "actual grades" are obtained from the samples lab analysis from the blast-holes which were mapped using a tablet. The system ensures ore batches traceability, either directly (from the crusher to the customer), or using the stocks de-stacking function.

In addition to the reporting **clarity and accuracy gains** (such as reconciliations, final results, and estimated vs actual comparisons), **efficiency gains** can also be measured **at the processing plant** (since it is fed with ore of constant quality), and on customer satisfaction.

- **Information System Optimisation**

Through data exchange files[2], CORALIS mining applications integrate data from these five companies existing software. Data can also be imported and exported to and from different types of equipment and services. These five companies' needs were studied and a CORALIS standard software suite was chosen to complement their existing solutions. Customized tools were designed and parameterized according to specific needs, and the interfaces created between several functions or software make it possible to **distill the most relevant information possible at each decision stage**. Graphical functions are very useful for locating operations on a map and for analyzing at a glance the various stages of the process.

The five companies and their customised solution

Nickel mine in New Caledonia, client since 2009;
CORALIS' TQMS module is used by the geology department for production planning and grade control. The software uses the following external data:

- ✓ Survey data: imported directly from the existing ACCESS database.
- ✓ Block model: imported through a CSV file from *Isatis*.
- ✓ Topography: data is imported from a *Surpac* DTM file.
- ✓ *Modular* FMS: production planning data is exported in DXF format to excavators ; data is also imported from loaders to CORALIS production monitoring.

Nickel mine in New Caledonia, client since 2011;
CORALIS' GEKO module helps production geologists with mine planning to balance grade between the mining site and the stock piles. It also ensures production monitoring and calculates the final results. The following data is used to do so:

- ✓ Survey data: imported directly from AcQuire software's SQL database.
- ✓ Block model: imported through a CSV file from *Isatis* (previously from *Surpac*).
- ✓ Topography: data is imported from a DTM file.
- ✓ Faces sampling: imported through a CSV file from *Trimble*
- ✓ Samples laboratory analysis: EXCEL files import
- ✓ Data is exported to the FMS through a DXF file, and to Surpac through a STR file.

Bauxite mine in Guinea (Conakry) client since 1992;

[2] CORALIS applications can use data from SURPAC, ISATIS, GEMS and more.

CORALIS' FRIA module helps mining engineers to plan production on the different sites according to the alumina mill's requirements, using this data:

- ✓ Survey data is read directly from CORALIS' Survey module database.
- ✓ Samples laboratory analysis: EXCEL files import.
- ✓ Block model: calculations are made with CORALIS' Resource Estimation module.
- ✓ Topography: data imported from surveys done with LEICA equipment and processed with CORALIS' Topography module.
- ✓ Faces sampling: imported through a CSV file from *Trimble*

Manganese mine in Gabon client since 2008;.

CORALIS' CQMS module is used by production geologists for grade control and production planning according to the mill's specifications, using the following data.

- ✓ Survey data is read directly from CORALIS' Survey module database. Data entry is done directly on site with a tablet..
- ✓ Block model: imported through a CSV file from *Isatis* and adjusted using CORALIS' benches calculation method.
- ✓ Topography: data is imported from a DTM file.
- ✓ Samples laboratory analysis: EXCEL files import.
- ✓ *Logimine* FMS: production planning data is exported in DXF format to excavators; data is also imported from loaders to CORALIS production monitoring.

Cement quarry in Quebec, Canada, client since 2016;.

Production geologists use CORALIS' APEX module for grade control and production planning to meet the mill's specifications while minimising costs compared to a classic stock pile system. A production management feature records each production resource's performance (equipment and personnel) and provides analysis reports which indicate grade produced, volume extracted and production resources efficiency. The system uses the following data:

- ✓ Survey data is read directly from CORALIS' Survey module database.
- ✓ Block model: calculations are made with CORALIS' Resource Estimation module
- ✓ Topography: data imported from DXF files from GPS or drone surveys and processed with CORALIS' Topography module.
- ✓ Blast samples laboratory analysis: XML (LIML) files import.
- ✓ Blast holes: cuttings are analysed to calculate a precise mix to answer the mill's requirements as well as optimising the deposit's recovery.
- ✓ Production resources: Activity reports are exported to a SQL server database.

Embracing digital effectiveness

These five cases illustrate how management has tackled the productivity challenge by embracing digital effectiveness and taking a few more steps towards mining 4.0. They are saving time while making the best use they can of their resources (ore, equipment and personnel) and contributing to sustainable development.