

I appreciate that that this presentation may be different from the majority of talks here, however, we feel that the concepts being put forth here are important to this group, the Geochemical Knowledge Experts

For this presentation, we're going to take a more business oriented look at how we maximize the value of data in the development of exploration programmes. We do this by focusing on how high-quality geoscientific data, together with the appropriate software technologies can raise the productivity and success rates for mineral exploration companies. Yet this can only occur if the software technologies are well integrated into the company's exploration workflow which incorporates the company's best practices while minimizing (if not eliminating) inefficient data chores.



Successful exploration programs rely on high quality data. Mineral exploration companies typically spend millions of dollars on the acquisition of geochemical, geological and geophysical data to support the discovery process.



(click 1) The drive to maximize exploration data value is based on the industry's business needs: to strengthen prospecting capabilities, to improve productivity and to increase efficiency. Ultimately it's about making better decisions faster to achieve higher discovery success rates.



Knowledge is the key to productivity and from that boosting profits and reducing costs

(Click 1) Starting from a sound exploration strategy, people (being the Knowledge Experts), workflow processes, technologies and data are all essential contributors to a successful knowledge-based exploration programme

There are three themes that come to light here being:

•Data forms the foundation for all decision making

•Workflow processes need to incorporate the best practices of an organization

•The role of software is to help the Knowledge Experts to unlock the maximum potential information contained within the data while minimizing the inefficiencies in the workflow process



In exploration, corporate objectives remain focused on profitability and cost effective exploration. Achieving these objectives, however, has been a growing challenge in the face of reductions in personnel, increasing market pressures and less available funding.



Given the increasing scarcity of Knowledge Experts, due to attrition and downsizing, productivity has become a key issue in exploration. Especially when you consider the increasing challenges, demands and responsibilities facing today's Knowledge Experts.



Productivity comes from maximizing the time spent on building knowledge for decision making.

Even with growing time pressures, the need to work with increasing volumes of data can cause a significant portion of time being spent on unproductive data chores.

This in turn compromises ones ability to focus on the productive component being understanding the geology/mineralization.



Well defined workflows enable organizations to be more knowledgeable and productive – providing competitive advantages even in dynamic and uncertain environments like mineral exploration

Within each phase of the workflow there are varying means for the Knowledge Expert to interact with the high volume, multi-disciplinary data.

One way we can look at this is by comparing an exploration project to manufacturing a "product". To remain competitive and obtain the greatest return, a manufacturer optimizes the process in an attempt to provide a better "product" at a lower cost.

For exploration , it's then important to recognize which aspects of the workflow can be made more efficient to leave more time to be spent on building knowledge and acting on that knowledge



Data chores within the workflow can create knowledge gaps - and knowledge gaps delay or contribute to faulty decision-making.

We can see where data issues can become a key barrier to exploration efficiency.

The majority of project delays, rework and wasted drilling can be traced back to data chores related to access, quality or data manipulation.



Software and the supporting hardware technologies must help with inefficiencies in the workflow. In the end, the aim of using software technologies is to:

•Let the geologists spend more time interpreting the data

•Focus on cross-functional collaboration, enterprise wide data sharing and best practice deployment

•Help to create lean operations (little room for errors) with the need to keep the project going (cost of project-drilling)

When looking at software to support the workflow, the challenge facing an organization is to:

•Minimize the number of software packages and related formats without losing information or analytical ability (more software = more formatting)

•Maximize the amount of information from the exploration data

•Minimizing the software packages from a training, usage and cost issue recognizing that one can't do everything well



Emerging technologies – such as customized 'data models' for exploration, data access and publishing technologies, the integration of data processing and analysis with GIS and improvements in visualization and mapping– have enabled dramatic improvements in the way we access, manage and interpret exploration data.



Taking a look at data management - there is a direct link between data integrity and the quality of decision making. Data validation is critical for both the process of discovery and for assessing the magnitude and suitability for development.

Given this, an Exploration Data Management (EDM) system serves two essential functions:

1) to provide the organization with a validated receptacle to store all their original earth science data.

2) to provide a methodology for optimizing the processes and techniques associated with the collection of geologic, geochemical, geotechnical, geophysical and other applicable data.



With regards to data access – on a daily basis Knowledge Experts are required to find relevant data and information, usually via an Intranet or Internet, evaluate its usefulness, and then retrieve the data and information for use in the exploration project – we can call this the 'Data Experience'.

Internet and Intranet data-sharing technologies can improve this "Data Experience" by allowing for the 'self-serving' of data/information without the need to worry about data projection, windowing, security, file formats and server loading.



Data Processing and Analysis (DPA) systems are designed to actively work with the original data to extract the maximum amount of information, using a variety of processing and analytical techniques.

DPA processes include capabilities to remove cultural and geological noise; allow for examining relationships in the data; to extract particular aspects of the data; create continuous 2D field or representation of the data; and other functions for the verification of quality.

DPA analysis includes histograms, correlation coefficients, scatterplots, principal component, classifications and modeling.



GIS systems are designed to work with information and provide the ability to spatially relate various types (layers) of information in order to test a Knowledge Expert's hypotheses. Within the GIS, geoscientists can effectively assemble, maintain, publish, query, and analyze information according to their geographical location.

A main advantage of the GIS approach is, the electronic light table concept, where the user can determine complex relationships between all of the stored information



Regardless where we are in the workflow, there are two methods from which we can "connect" with our data and information being visualization and mapping.

(Click 1) Visualization is how Knowledge Experts interact with their data and information

(Click 2) Mapping is the way we convey our thoughts to others and also, provides us with an ideal medium to summarize all our information.



So, the optimal solution is one which supports the exploration workflow - providing Knowledge Experts with instant, desktop access to all the data and information. The system should incorporate in the organizations' best practices and provide for workflow efficiencies.



Now to our foundation, data which forms the basis of all decision making

Recognizing for the Knowledge Expert:

•There is a minimum amount of data that forms the framework of one's hypothesis on the geology and/or potential mineralization (i.e., starting from scratch and picking an area).

•Additional data helps to refine one's hypothesis in a manner that is both quick and cost effective, but also keeping in mind that this is a reiterative process.

And for the organization:

•Data can be considered a leveraged asset, part of the shareholder value that can be utilized to enhance the value of a property.

•Data can be a strategic differentiator, by giving an organization's Knowledge Experts the ability to enhance their project generation and exploration capabilities.

•Data can provide the basis for project generation in areas of limited knowledge



Yet, today's Knowledge Expert is challenged by the need to work with increasing volumes and complexity of data. The data chores can consume weeks of time, reducing productivity and the quality of decision-making.



Supporting exploration with one user-friendly system that hasa reliable data foundation....a standard software toolkit and a sound workflow is increasingly seen as an optimal solution by companies driven to find new efficiencies within this dynamic and challenging market.

A truly integrated environment is one that maximizes work efficiency and productivity. It also provides the exploration team with a common platform that facilitates information sharing and collaboration.



Having an integrated system enables organizations to make better decisions faster. The workflow efficiency improvements deliver savings through productivity gains and reduced project life-cycle costs. Ultimately, the cumulative people, workflow process and strategic advantages contribute to improved discovery success rates and sustainable competitive advantage.



To demonstrate our concepts, we are going to refer to 54km² project area of the Yilgarn Craton in Western Australia.



The exploration project contains numerous drillholes, multi-element surface geochemical samples, aeromagnetic surveys, and other related data and information.

For our workflow, we are going to look at three levels that are reasonably distinct being: Regional Exploration, Target Testing and Economic Resource (Advanced Projects).



For regional exploration, the challenges we face here are:

•Synthesizing a lot of data

•Dealing with data sets that are large and disparate due to number of companies exploring in similar areas, and not necessarily for the same commodity

•Historical (1980s) drilling that has not been fully tested to see if it drilled through the leach zone



From the regional exploration data sets, we want to work up the data to evaluate its usefulness and to develop hypothesis

Click 1 – as structure is important control on mineralisation, we can use the grey scale 1 vd magnetics as there is insignificant surficial geology

Click 2 – We then drape on our tenement outline to see our ground holdings

Click 3 – The soil and hand auger sampling gold results can be viewed as thematic point samples, to get an idea of the distribution of gold in the surface layers

Click 4 – Gold in soils can be viewed as a gridded image (using min curv, 2 std dev stretch) and then draped over the magnetics to better identify gold mineralisation targets where they are coincident with structure

Click 5 – from this simple analysis, we can auto highlight "targetable" areas



Form the drilling dimension, we can with the with analysis

Click 1 –all collar locations have been plotted as a collar shape file: It would seem that the targeted areas appear to be reasonably tested, but are they?

Click 2 – the RAB holes seem to provide reasonable coverage and theoretically should test to bedrock;

Click 3 – yet looking closer at the data shows there is either

Click 4 - there is no data intersecting bedrock or

Click 5 – lots of data. It is fairly clear that testing below the leach zone is sparse or unknown in many of the areas where, at first glance, there seemed to be sufficient drilling information.

What deeper drilling exists? Aircore drilling tests just below the cover sequences (click 6), with RC (click 7) and diamond (click 8) demonstrating that the more obviously anomalous areas are better tested at depth.

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Import validation is very important. Wizard like front-ends can simplify this process while ensuring quality data



We can validate our drillhole data either through reporting (click 1) as well as [next slide]



through visualization. Cross sections and plans (click 1); in this case, erroneous survey information results in incorrect positioning of drillholes at depth.



Target Testing

End goal

• Test targets by RC and/or diamond drilling with techniques like downhole geophysics

Challenges

- Daily requirement for geologists to pull data, do sections and plans, including cross or long sections, and interpretations on sections
- Detailed sections required integration of geophysics (i.e., IP, magnetic, EM modeling) and available multi-element geochemistry
- Dataflow crucial to support daily drilling
- Time lag to get data into database (from field collection to assay turn-around from lab) can be up to 2-3 weeks
- Data versioning an issue as geologists create personal databases without updating the main database

For target testing, the challenges here are that:

•On an on-going basis, the geologists need to pull out the data and do more sections and plans

•Create and interpret more detailed sections and integrate, if available, multielement geochemistry and geophysics

•Minimize the time lag to get data into the database from field collection to assay turn-around from lab

•On-going access to collar and downhole information for designing specific geochemical and geophysical programmes

•Versioning becomes an issue as data can become disparate and errors creep in



Click 1 – here we identify an advanced project area and the location of a cross-section of interest



For target testing, we combine downhole information such as (click 1) Regolith, Lithology and Gold grades; with (click 2) geophysical and (click 3) geochemical datasets displayed as profiles from gridded datasets and then interpret (click 4,5)



The challenge for resource development is that this can be a time consuming process that includes:

•More detailed drilling to delineate the potential resource and test potential extensions to mineralization

•Do more geophysics for structural and geological understanding, as well as mineralisation signatures

•In-fill drilling to convert resource to reserve

This is where significant time is spent in the 3D realm



The 3D environment is the best way to view data in this advanced stage of processing, analysing and interpretation. We can (click 1) manoeuvre through (click 2) and around (click 3) to best visualise the datasets



(Click 1) Knowledge being people, data and the technologies that support the Knowledge Experts are the most valuable assets in any organization.

(Click 2) For maximum value software technologies must be designed to incorporate and support exploration workflows.

(Click 3) The challenge of the organization is to minimize the inefficiencies around the data handling and integrity issues of the workflow and to maximize the time spent on knowledge development. Maximizing an organization's knowledge resources is the key to better decision-making and better discovery success rates.

(Click 4) Software technologies play a fundamental role of connecting the data and the Knowledge Expert. Software should be assessed on the ability to achieve this "level of connectivity"

In the end, the reality is that no software can replace the expertise of the Knowledge Expert. Software technologies remain tools that ease the job at hand, and help us to build, develop and improve our knowledge base.



Thank You

"Making use of the technologies to advance our knowledge, organise it, manage it, disseminate it and extract the value from it is likely to prove an increasingly important source of competitive advantage for companies in the mining industry and an increasingly important attribute of professionals working for them."

GEOSOFT

David Humphreys Chief Economist Rio Tinto, London 2000

