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CALENDAR

- ***Mineral Exploration Roundup 2006***
  January 23–26, 2006
  Westin Bayshore Resort & Marina
  Vancouver, B.C., Canada
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- ***National Western Mining Conference and Exhibition***
  February 7–9, 2006
  Grand Hyatt
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- ***INDABA 2006: Investing in African Mining Conference***
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Data Management in the Minerals Industry (Part 2)

This month's article for Pincock Perspectives is the second in a two part series concerning data management in the mining industry and its implications with respect to the management of mining and minerals operations.

Last months article in Pincock Perspectives introduced some key data sources, types of data, and strengths and weaknesses of different types of data management systems in use in the minerals industry and business in general, as well as some of the trends brought about by the Sarbanes-Oxley legislation. This month's article will focus on sources of data, utilization of that data in the mining business environment, and the strategic advantages that can be obtained by integrating data and information sources properly into your business processes. The article will also introduce some terminology, concepts, and systems associated with data management and information technology that may be unfamiliar to all but those on the cutting edge of information management. Some of these information management tools have, or are currently being implemented and utilized, by some of the larger minerals organizations and are becoming more common throughout the industry.

Most minerals organizations have used data management and information systems for conducting business for nearly 50 years now and different trends have dominated during specific eras. Early information management systems were based on main frame architecture that utilized a mix of proprietary software that was often custom written and developed within the organization. These systems dominated until the early 1980s when many of these centralized computer systems were replaced with desktop systems with the introduction of IBM's Personal Computer (PC) which brought significantly more computing power to a users desktop and later became mainstream. The computing power that used to require a large air conditioned room and multitudes of punch cards and operators to make it work now could sit on a users desk. This era decentralized information and made collaboration more difficult until the advent of networking and the transition to the client/server architecture that dominates the business world today. The client/server architecture brought back some of the collaborative advantages that were somewhat lost in the transition to the desktop computing environment. The current and future of business computing lies with the Internet and the use of distributed systems and the delivery of software and complete information systems on demand via Internet technology. No longer do most companies develop the software and systems used to run their organizations. Most mainstream business applications have been developed and optimized by multiple software vendors. Very little justification exists for developing software in-house unless it is for a very specialized proprietary purpose not readily available in the market place. If an organization requires a new Enterprise Resource and Planning System (ERP), all that is required is to contact one of the many vendors that develop and sell ERP software, such as Oracle, SAP, etc. and have a system implemented specific to their business needs and with minimal customization, fairly efficiently and at an acceptable cost. Today it would be absolutely ludicrous to consider developing your own accounting system with internal resources when an off-the-shelf product could be obtained and implemented at a fraction of the cost. The same can be said for most minerals industry software and information systems such as resource evaluation, mine planning, production management, or process control systems.

As companies' information requirements and business needs have grown, most companies have implemented "best of breed" applications and systems specific to their business environment and organizational size. Although these software applications and information systems have given companies almost equal access to the best systems for managing data and producing information they have in turn again decentralized information within departments and operations. It is the decentralization of business information and the absence of knowledge sharing across an organization that is separating those that excel from those that become extinct.

The aggregation of information from many different operational sources into a "single source of the truth" has become the holy grail of information management and has spawned a growing information industry called Data Warehousing and Business Intelligence.

Business Intelligence

The area of information technology called Business Intelligence is not a secretive organizational

department developed to keep track of who is playing solitaire when they should be doing something more productive, it is in essence, the aggregation of information from the dozens of operational data repositories that exist in most mining/minerals companies, each of which is a fundamental piece of the business process, and using those pieces proactively across the organization enable companies to quickly, and more reliably make decisions that give them a competitive advantage within their business environment. The more operations a company has and the more geographically diversified they become the more important it is to integrate the information generated by the various locations into a cohesive decision making environment. This is not to say that a single site operation can't benefit from Business Intelligence tools and applications, in fact just the opposite. A very well run mining operation would be highly integrated and have near-real time information available to make key strategic decisions as quickly as possible. It is safe to say though that a company with 10 to 20 geographically diversified operations each with 10 to 20 Operational Data Stores at each location must utilize some form of Business Intelligence tools in order to compete and survive today and in the future.

"Business intelligence is one of the few forms of sustainable competitive advantage left. Why? Deep down, any two well-funded competitors in a market have near equal access to capital, technology, market research, customer data, and distribution. people and the quality of decisions that they make are the primary competitive differentiators in the Information Age. The proprietary implementation of standard Business Intelligence components is the key to sustaining long-term competitive advantage." (Vitt, et al 2002)

Business Processes

Most organizations have developed methodologies or ways of doing business that are often unique to their company or operation. These are called business processes. An example could be acquiring production information from an open-pit mining operation. In a mining company with several open-pit operations the process of acquiring daily production data may differ dramatically from operation to operation. One site may use a fleet production management system to monitor and report daily mining production. Another operation may manually use paper timesheets that tabulate truck loads and are summarized by a mine operations foreman or clerk and maintained in a MS Excel spreadsheet. Both are the same process, but are achieved in completely different ways at each location and both represent different challenges when trying to create a "single source of the truth"

The issue that arises in most mining/mineral operations is that although both processes achieve the same end they are essentially different processes and represent different challenges from a Business Intelligence and information integration perspective. First, due to how the data is acquired, either through a fleet production system or through manual entry in a spreadsheet. Second, what data is actually acquired, and third, what is the meaning of the individual pieces of data that are acquired (the metadata) Do tons hauled at one operation mean the same as tons hauled at another operation? Are they wet tons or dry tons? After all not all tons are created equal, if they were, fewer mines would have less trouble keeping track of them.

Business Rules

The process of creating business rules goes a long way towards acquiring and integrating information within an organization and can often be a contentious issue among departments, sites, and different management levels. What is the best way of doing something for one group may not be the best way of doing it for another group. It is in the development of business rules where many organizations get sidetracked and just agree to disagree on key business areas, which derail an otherwise good effort to create a better information environment. This is an opportunity for management to provide direction for the organization.

Business rules are a clearly and explicitly defined set of operating parameters within which an operation or organization has agreed to operate. An example business rule may be that in the conversion of gold production between grams to troy ounces for reporting purposes the factor 0.03215 is used and not just 0.032. The purpose of this business rule is to maintain consistency in reporting and prevent variations in reported numbers due to the level of precision being used in calculations. The lack of clearly defined business rules creates inconsistency and brings data quality, operating performance, and management into question often because a company or operation is not "comparing apples to apples."

Key Performance Indicators or Operational Metrics

Every industry, business, and operation has performance metrics or indicators that are used to measure how it is performing both from an internal corporate perspective and from an external industry or investment perspective. These key performance indicators (KPIs) or metrics as they are sometimes called are standard measures of how the business or operation is performing and are used as indicators of areas that may represent management opportunities for improvement.

Corporate Metrics

The measures of how a mineral company is performing are those applied to most publicly traded companies and are generally financial measures. These metrics give corporate management insight into how the business is performing financially and give the investment community an indication of how the company is performing relative to its industry peers. These metrics can included:

- Market capitalization
- Price to earnings ratio
- Cash and total cost per unit of production
- Share price
- Reserve replacement rates

Operational or Site Metrics

These metrics are used to evaluate how a particular site or operation is performing relative to developed budgets, plans, or other similar operations. In an open pit mining operation these might include:

- Cost per tonne of ore
- Cost per unit of product produced
- Cost per tonne processed
- Tonnes per man-shift or man-hour

Departmental Metrics

Departmental metrics are related to the functional areas of the operation and can be broken down into sub-departments at larger operations. These metrics provide feedback on how a specific piece of an operation is performing. For a mineral processing operation these metrics might include:

- Tonnes per hour throughput rates
- Cash cost per tonne processed
- Percentage product recovery
- Power consumption per tonne processed

The issue that often arises with departmental metrics is that "silos of excellence" develop where one department maximizes the metrics related to their functional area to the detriment of the entire process or overall desired outcome. A processing operation whose primary measurement is plant throughput may maximize that indicator to the detriment of product recovery and overall cost, which de-optimizes the primary purpose of the business. Transparency in information and an understanding of how one department's KPIs affect another's department's KPIs are important in optimizing the overall results of the business.

The important point about KPIs is that within any organization or operation they should be well defined, well advertised, and a part of the organizational culture in order to be a useful as a management tool. KPIs should be kept to a manageable number usually about 5-7 of the most important measures of the operation that can be easily tracked and monitored by those responsible for their outcomes. Although having a larger number of measures can be useful for managing smaller pieces of an organization if too many KPIs are used then the details obscure the major indicators of the operation's success. The most important issue with KPIs in relation to data

management is that they are the primary indication of what data is important to track and what information needs to be developed from that data in order to effectively manage the business or operation. KPIs or metrics form the foundation of a good information management system and are the primary areas to focus on when integrating information to support business intelligence initiatives.

Data Integration

In order to track and utilize key performance indicators within an organization or operation a certain level of data integration must occur at some point in the process in order to develop a complete picture of the overall performance of the organization. At the most basic level this is usually the mining department sending the accounting department a spreadsheet at the end of the month with the production numbers. At the other end of the spectrum complete data integration is near real-time access to production and cost information in a readily accessible environment for all key stakeholders that enables them to review the operational performance at a specific point in time. This would enable quick, highly informed decision making based on reliable data and all relevant information.

The bases for a good data integration initiative are some of the items previously mentioned.

- Best of breed functional applications
- Common industry standard database platforms
- Key performance indicators or metrics for all levels of the organization
- Well defined business processes and business rules
- A shared understanding and "buy-in" to the benefits of a highly integrated information environment and support at all levels of the organization. Information technology initiatives forced down from the top without significant input from end-users are doomed to fail.

Data integration is achieved in several steps that start with a complete business review of how an operation currently operates, where the informational and process deficiencies exist, and a general understanding of what data is being acquired in the course of doing business. Generally, one of the key findings of this process is a good understanding of the deficiencies, as well as strengths, that exist in the organization. Among the many issues that will surface during this initial phase, and are typical of information systems and data collection in general, are quality, data integrity, consistency, and systems limitations. It is this business review process that is one of the biggest benefits of a data integration initiative because it requires you to examine in detail how you really do business and what the limitations are to developing an integrated "single source of the truth" operating environment.

Once the issues that exist with the current operational sources of data are identified and actions taken to remediate those issues, the processes of developing a system to bring the key pieces of data together in an integrated environment can begin.

The Integrated Data Environment

Different levels of data integration can be achieved and exist within an operation depending on budgetary resources, priorities, or the level of IT expertise that exists within an organization. One fact is undisputable; the development of an integrated data environment should not be approached as a single big bang corporate initiative to be undertaken as quickly as possible to get our "systems to where they need to be." It is a well documented fact that an extremely high number of IT projects fail due to trying to do too much too quickly with too few resources and not utilizing good project management principles just as you would with any other significant capital project. The best approach is to work toward an integrated environment in a systematically phased process that allows time for learning, feedback, and changes in approach if necessary.

Any approach to integrating information must start with a view of what the end result should look like or where the most "bang for the buck" can be achieved with the resulting product being an architected plan for bringing together key pieces of data from disparate Operational Data Stores into a single Data Mart from which information can be developed and utilized for reporting and management purposes.

The integration of data from operational data stores such as accounting databases, fleet production systems, and process control systems into a single architected and integrated environment is commonly referred to as Data Warehousing. Although differences of opinion exist about the technical differences between a Data Warehouse and a Data Mart, in general the Data Mart is a subject specific dimension of a larger Data Warehouse. In general the larger Data Warehouse can be made up of multiple Data Marts specific to different areas of the business aggregated at the corporate level. One of the key commonalities is that they are dimensional and modular in nature where common dimensions can be used and reused in other Data Marts because they have been standardized across the organization. An example would be the time dimension which could be minute by minute operating data that has been aggregated to different levels and could be used in a mineral processing Data Mart, a production Data Mart or as a dimension of the larger Data Warehouse at the corporate level.

Because Data Marts and Data Warehouses are dimensional in nature they are constructed to facilitate analysis as opposed to reducing data redundancy or maximizing storage efficiency as is the case with most operational databases. In fact one of the steps in constructing the Data Mart is to de-normalize, or undo the normalization process used in creating the relational database where it originally came from. Instead the data fields are grouped into subject specific dimensions (or tables of data) such that when combined with other dimensions will support analysis and decision making instead of the relational structure it originated from, which is not very efficient for analysis.

Operational Data Stores are designed to be efficient at storing and creating transactions. Data Marts and Data Warehouses are designed to facilitate quick analysis and decision making from, what can in some cases be, hundreds of millions of records from multiple different systems.

This basic description of Data Marts and Data Warehouses should not dissuade the reader from investigating the use of Data Marts or Data Warehouses within their organizations due to a perceived complexity. The process of developing a simple Data Mart can be very simple if the quality of data is good in the source system and does not necessarily require special hardware. With the right tools and the right knowledge a simple Data Mart can be constructed on a laptop and in a matter of a few weeks give insight into areas of an operation that most could not even imagine at the onset. Although, realistically a good database server designed and optimized for data warehousing is not expensive or technically difficult compared to the analytical value they add to an operation.

Data Reporting

The last area we will touch on in this article is the area of data reporting which is often an area of difficulty in obtaining useful information from any database system be it an Operational Data Store, a Data Mart, or a Data Warehouse. If you can't efficiently access the data in your systems they are of little use in the decision making process and often lead people to go with their "gut instinct" in making decisions because the real information they require is locked up in the multitude of different databases that exist in the organization and the default reporting system becomes MS Excel which is a poor practice because it leads to unreliable reporting, corrupted information, and the creation of desktop databases that are analyzed and modified by the user but never become part of the organization's body of knowledge.

There are very good Business Intelligence tools and reporting packages available in the market that if the time and effort is taken to learn how to use them even at the most basic level can open up a whole new level of management possibilities. Some of the impediments to the acceptance of these tools is the belief that "we already have Excel" and "I know how to use it already" instead of finding the right tool for the job, remediating system limitations, and teaching employees how to use

those tools properly, organizations continue to take the easy route and end up with less than optimal results.

There is a general trend with most software and systems implementations to overlook the importance of user training. Neglecting this aspect of a new system will almost ensure a new system will fail. People need to know how to use the tools important to their function and rarely have time for on-the-job training. Continuous frustrations in getting a monthly report out of a new system will soon result in the return of MS Excel reporting.

Some examples of Business Intelligence tools and systems are Business Objects, Cognos, ProClarity, Crystal Reports, as well as integrated offerings from many of the major database vendors such as Oracle, Microsoft, etc. These tools offer good features that allow you to "get at your data" and make it usable to even a novice database user. Even MS Access, which many people have on their PCs, but rarely use, can be used to connect to many data sources to create good reports; although, it is not really a substitute for a good reporting tool.

Conclusions

So what does a utopian business information system look like if there is such a thing? In summary these are some key components:

- Well defined business rules and processes that are completely documented for all areas of the business. A manual on how "we do business" that can be used to maintain continuity even in an organization with high turnover.
- A basic set of Key Performance Indicators (KPIs) for the organization as a whole as well as for individual areas of an operation or department. This is what we believe is important to measure, why it is important, and how we will use it to monitor and improve our business outcomes and identify what data in our systems is or is not important.
- A common software and database platform that is easily integrated using off-the-shelf tools. Minimal use of proprietary software applications that require special interfaces in order to "get at the data" and enforcement of data standards.
- Best of breed applications and systems that support the core functional areas of your operations and overall organization
  - Mine Planning and Resource Evaluation
  - Mine Scheduling
  - Mine and Mill Production Information Systems
  - Laboratory Information Systems
  - Maintenance Planning Management
  - Inventory Management
  - Accounting, Budgeting and Forecasting
  - Human Resource Management
- Development of small local Data Marts leading to a centralized Data Warehouse with experience.
- Business Intelligence Tools and a Data Portal (Dashboards, Reports, Charts) that are readily available, understood, and utilized at all levels of the organization
- Comprehensive end-user training and understanding of the importance and buy-in to the process.

Although this article only begins to explore the areas of data management, analysis, and the growing areas of Data Warehousing and Business Intelligence, hopefully it serves as a catalyst to encourage you and your organization to explore how better data management can improve all areas of your business and help produce a sustainable competitive advantage for your organization.

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Glossary of Terms

Business Intelligence – An approach to management that allows an organization to define what information is useful and relevant to its corporate decision making. Business Intelligence is a multifaceted concept that empowers organizations to make better decisions faster, convert data into information, and use a rational approach to management. (Vitt, et al 2002)

Data Mart – A data warehouse that is limited in scope, whose data is obtained by selecting and summarizing data from a data warehouse or from separate extract, transform, and load processes from source data systems. (Hoffer et al, 2002)

Data Cleansing – The process of standardizing data from various sources in order to make it conform and be consistent with defined or accepted definitions or expectations. This may involve a multitude of process such as deletion of duplicate data, combination data elements, insertion of missing data, or formatting of numbers, text, or graphics.

Data Warehouse – A collection of integrated subject-oriented databases designed to support the DSS function, where each unit of data is relevant to some moment in time. The data warehouse contains atomic data and lightly summarized data. (Inmon et al, 2001)

Decision Support System (DSS) – A system used to support managerial decisions. Usually, DSS involves the analysis of many units of data in a heuristic fashion. As a rule, DSS processing does not involve the update of data. (Inmon et al, 2001)

ETL Tools – An acronym that stands for Extraction, Transformation, and Loading. ETL tools or software are used to transfer data from one data source to another and can be used to schedule data transfers, cleanse and modify data for loading to another database and load the data into appropriate tables in the destination data repository.

Operational Data Stores – A generalized term that describes any system or process that collects data from a specific part of an operation or business. Examples are accounting data, inventory data, or laboratory assay data in a spreadsheet, but usually in the form of a relational database or flat file.

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