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What is driving the development of integrated technical enterprise systems in the mining industry?

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Geologists, engineers, technicians and surveyors have successfully utilized technical software in the mining industry for over 30 years. Software for processing survey, geology, mine engineering and planning information make these functions more efficient by automating repetitive tasks and reducing data processing errors. While these systems have been improved incrementally over time, new systems that represent giant leaps in technology have been introduced to help mining operations increase productivity and reduce costs. However, their widespread use within the industry has left individual companies without a competitive advantage. Additionally, the ability of these applications to provide the productivity improvements required in today's uncertain market conditions has since peaked.

The next wave of technology—integration of independent software applications—is just starting to emerge and will have a significant effect on the productivity of mining operations. To reap the productivity gains required to remain competitive, mining companies must exploit the collective knowledge and experience of every employee in the organization. Integration of independent software application allows companies to leverage information from all activities, enabling staff to make better decisions to improve productivity.

This paper outlines the importance of integration as productivity enabler. Key performance indicators, strategic mine planning, resources management and mine-to-mill integration are discussed as processes that enable productivity. The Gemcom Enterprise Mining System (GEMS) is introduced as the industry's first integrated solution that enables these productive processes. The paper concludes with a comment on the level of change required to realize the benefits of integration.

Introduction

In almost all modern mining operations around the world today, highly specialized and professional teams of Engineers and Mineral Resource Managers are invariably making constant use of the information that has been made available to them to relentlessly make a broad and sustained range of simple and convolute decisions and to forward advice and instruction to operational activities. Feedback from the operations and comparative analysis of actual against planned, ultimately drives both technically orientated adjustments to the extraction of the resource through better understanding of the orebody as well as driving and supporting the non-technical departments and services into a range of expensive supplier commitments, stores inventories, human resource deployments and a host of contingency and logistics planning and deliveries.

It appears thus a sad irony that these operational or technically based decisions (and the many hours of work invested in those decisions) are in fact either incorrect or not as accurate as the operation's profitability demands and relies on. This situation is not due to the fact that they are incapable of doing the work, or a comment on their ability as professionals or work teams but rather due to the fact that in most mining operations today, the workflow relies on a series of hierarchical and complex series of data-flows, all interdependent on each other. By revealing the current and generally accepted nature of the flow of data in a mining operation it becomes alarmingly apparent that no matter how good the application is, how fancy the optimization routine is, how good the engineers, samplers, surveyors and geologists and miners are, the operation will simply not be capable of delivering true key performance indicators and above all be able to afford insight and business intelligence.

The net result of the scenario depicted above is that all too commonly, the individual technical departments seem to be operating with high levels of efficiency, utilization and productivity, but the business has no idea how efficient it is, how productive the operation is and how effectively the operation is utilizing its operational resources. In reality, the operation is more than likely under-performing due to the continual delivery of anonymous, unreliable and unsupported information between broad functional areas of the operation. The conclusion is best summed up by the old adage—The operation is working hard, but is it working smart? The reality today is that in order to measure the true productivity, true efficiency and measure true utilization, simply becomes too much effort for management to be bothered about it. In order for mining companies to be able to react to ever-increasing pressures to produce 'better, faster, quicker', the operation invariably responds by traditional 'treat the symptoms' management styles and the potential real causes of the operational inefficiencies are simply carried along, safely hidden away in pervasive propriety data formats, poor communication channels and the hierarchical structures of the operation.

IT alone, will not be the solution to improving shareholder returns, however, what is driving changes in the IT sector that primarily serves the mining industry today is an acceptance and an appreciation by a growing number of both business and technical people that in order to maintain long-term sustainable growth, to stay alive in the down cycles and to deliver unparallel returns for the shareholders in the up turns, a far more holistic approach to IT solutions is required. Based on this business model or strategy, appropriate technical information technology can deliver real knowledge management and business intelligence and can play a major role in addressing the inefficiencies currently seen on most operations. The information age is here to stay. The smart mining companies are beginning to see such IT as an investment that can deliver previously unimaginable returns, rather than the cost that it is currently perceived to be.

This paper is all about information technology in the mining industry and is given in the hope that the industry picks up on some of the issues regarding the technology that is serving them, the technology that could be serving them, the users and the suppliers of such and to perhaps give an opinion on what some of the problems, issues and envisaged solutions might reveal what the technical IT industry will look like over the next couple of years. This paper builds on a presentation delivered to the South African Institute of Mining and Metallurgy Conference on Mining held at Mintek on the 29th August 2001.

What is driving change

The development of the next wave of technology in the mining industry will be driven not simply by technology itself (i.e. not driven by technological advances and the benefits derived from them), but more importantly by a more fundamental and basic shift in the mindset and resulting requirements of the industry, and what it can offer its increasingly demanding shareholders, staff and suppliers. It will happen as a result of a deeper more philosophical understanding of the need to change in such a way that the organization itself is able to offer something new and compelling to these entities and ensure that the organization's ability to be more competitive, deliver more innovative processes and products and above all, ensuring the commitment of all employees, is enhanced.

In other words if there is no need to change, why change the way things are? With that said, technological advances will still be made as they are right now, by what the software developers themselves decide what the industry needs (what sells), on an *ad hoc* basis, from extremes where individuals who are faced with a problem will help develop the advancement of the applications they use, by working with and funding their preferred suppliers, to major integration exercises such as the industry is starting to see for the first time. Internally motivated advancement of the way work is done and what is commonly referred to, as the upstream and downstream effects of workflow will also continuously improve through better management and appreciation of IT. However, the next wave of change will only happen when mining companies fully appreciate what it is that is causing a revolution in every other industry worldwide, and that is the phenomenon or concept of the learning organization and through effective knowledge management (KM).

The learning organization

Organizations such as mining companies can and should create dynamic and effective places to work, where human talent can be optimized and aligned with the goals of the organization. During the first 85 years of the last century, the range of tasks and associated skills asked of employees were generally limited and often accompanied by high levels of supervision and control. In many ways, aspects of the global mining industry (especially in South Africa) are still locked into this approach. Since then, organizations have recognized that higher levels of skills are required to cope with new technology, new forms of work organization and demands of quality and customer service. Such new thinking organizations are known collectively as 'Learning Organizations'. An organization's concerns for achieving increased competitiveness, staff commitment and innovation, can be addressed through action designed to establish the organization as a learning organization. Learning organizations are those that have in place systems, mechanisms and processes that are used to continually enhance their capabilities and those who work with it or for it, to achieve sustainable objectives, for themselves and the communities in which they participate. The learning organization is one that learns and encourages learning among its people. It promotes exchange of information between employees hence creating a more knowledgeable workforce. This produces a very flexible organization where people will accept and adapt to new ideas and changes through a shared vision.

If lifelong learning is to become a reality, policies and practices are required to embed the concept into the fabric of schools, colleges, universities, workplaces and the voluntary sector. Creating organizations that support the learning of their employees will be an important factor in a lifelong learning era. However, the concept of the learning organization has generated a great deal of interest not simply because of its apparent focus on the individual. The key to the vast interest in the subject is that it provides a positive framework for organizational change and that change is designed to improve organizational performance through learning. In addition, the pace of change in industry has become so rapid that individuals require an adaptive capacity that can only be satisfied through learning.

Although many authors offer some criteria for defining learning organizations, it is the process of learning which is the key ingredient and by definition it may not be possible to establish a point of arrival. Learning organizsation development and implementation is a journey and not a destination. Organizations can improve through maximizing human talent and potential.

Building an organizational memory is useful in order not to lose the learning of individuals and teams. After so many years of 'downsizing', how much learning has been lost to the organization through initiatives such as early retirements? Organizational memory can be facilitated through the use of information technology systems but can also be captured in traditional paper formats, books, reports, etc. The key to this is to create effective storage and retrieval systems so that material can be accessed at the right time, by those who need it and in a format that enables easy understanding. This generates the need to consider the processes of knowledge management alongside those of organizational learning.

Knowledge management

Knowledge is the ultimate tool that gives individuals the ability to interact with the world around them. In the digital economy, knowledge has become the Holy Grail that will

let companies fully understand all aspects of their environment in order to make appropriate decisions. But the sheer overload of information, together with increasing competition, new aspects to consider in customer relationships and opportunities presented by the global internet have all contributed to making knowledge more elusive than ever before. The trick is to manage both the incoming information and the dissemination of knowledge to the right people at the right time—mining companies in particular are finding out the hard way that this is an awesome task.

Information can be defined as the usable data output from various internal and external sources in the organization. Individuals then base their decisions on this information, the result of which is knowledge. Knowledge gained over time provides people with the expertise and information necessary to appropriately assess and act upon opportunities.

Knowledge management is dependent on the information available, the environment and intellectual capital in the organization. Knowledge mManagement is dependent on the establishment of an environment within which employees can build upon the knowledge of others as well as having systems that facilitate access to information.

Decisions made at the operation and management levels are dependent on many data sources and applications. Data flow is generally not possible with the current level of 'connectivity' that exists between many commercially available systems. Better data integration and use of modern IT systems facilitates the timely and accurate collection of key information from all activities on the mine, enabling staff and management to make informed business decisions and improve productivity.

Team organization in the mining industry

'Corporate efforts today are aiming to replace the traditional hierarchical structure with a team-orientated organization in many industry sectors, including the mining sector. This is mainly due to the fact that communication and collaboration has become increasingly important and is being propelled by technology advances and availability of information'. *Taken from published literature by David M. Spatz (formerly with BHP— World Minerals Inc.)*

Early reference has been made to that fact that the South African mining industry remains caught in a situation of high levels of supervision and control. In such hierarchical organizations, multiple tiers of middle managers function largely as communication links and supervisors (interface analogy in IT speak). Increasingly the industry is starting to see the first real examples of team based approaches where high-level managers become team organizers and integrators and in the case of mining, management may potentially merge all functional divisions of a broad discipline such as ore-extraction (integration analogy in IT speak). Cross discipline, cross functional, cross unit and cross regional team work will be a result of this approach, with members reporting to different managers (under the management of a cross functional team manager for example).

Simply put, IT systems that enable multiple user access using single source databases, client server technology and remote access will ultimately serve to maximize the effectiveness of such team based initiatives as multiple users (team members) will be ensured of being able to work on data that are in a consistent format, valid and ultimately facilitate decision support.

Information technology in mining

Mining operations require a diverse set of information technologies to help run their operations, ranging from commercial and business applications to plant process control systems, to mine production systems.

Typical technical IT implementations in mining

At a typical mine a number independent, application-specific, software packages would be used in the geology, mine planning, survey and production departments. These applications come from two main sources: they are purchased from commercial software vendors or developed in-house by the mining companies themselves. Whatever the source, the systems are designed to automate specific tasks and are evaluated in terms of their fit with the requirements of each specific activity. Broadly speaking, the applications can be categorized as:

- *Generalized mining packages*—These systems include applications such as geological modelling, resource modelling, mine design, mine planning, mine scheduling and surveying. There are a number of companies (including Gemcom) that are leading providers of these types of system
- *Specialized mining applications*—These systems cover specialized applications that are not well covered by the generalized mining packages. Typical applications here would include pit optimization, production scheduling, blasting, ventilation, geotechnics, environmental management, and so on. There are a large number of these systems, which are produced by niche developers, in-house IT departments of mining companies or research establishments.
- *Production monitoring systems*—These products are combinations of software and hardware that are used to monitor mining production on a real-time basis. Typical applications are truck dispatching, truck monitoring and drill monitoring systems. The number of companies providing these systems is small, and there are two leaders in the open pit arena—Modular Mining Systems and Wenco. The Caterpillar-Mincom alliance is another new player entering this field.
- *Production recording systems*—The real diversity is with systems that maintain production records and produce management reports. Without exception mining companies have developed these systems in-house (although some are now being made available on a commercial basis). There is very little consistency in the approach used for these systems, and often a mixture of spreadsheets and desktop databases are pieced together by a computer literate engineer to address specific site requirements.

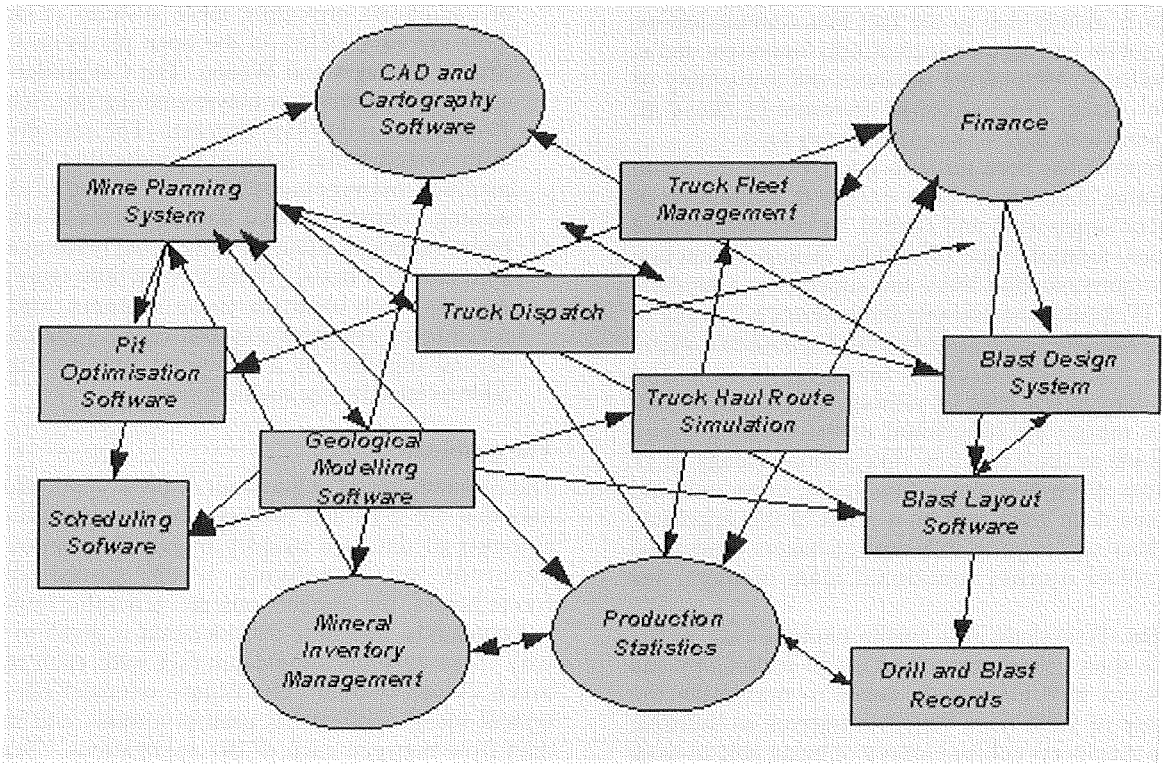
The problems

The common thread between all of these applications is the data that are used and managed by the applications. The amounts of data are usually huge; often amounting to hundreds of megabytes when stored digitally. Nevertheless, the applications are generally implemented independently, and little consideration is given to how and why these systems should interact with each other in a much closer manner. The Figure overleaf illustrates a typical set of applications used at a mine, and shows the data flow between each of the applications. Clearly, this illustration represents a disordered or chaotic flow of information that serves only the immediate needs of each of

the individual applications. Information that may be critical for the overall operation of a mine is invariably buried deep within proprietary data formats at a number of locations throughout each application. This type of configuration is inefficient for gaining access to important information and is a major cause of poor productivity, and, more importantly, uninformed decision making.

The principal problems with existing approaches are:

- *Islands of technology*—The manner in which the technologies are used and implemented has led to the creation of many independent and inefficient 'islands of technology' where a variety of diverse products from different vendors are used to address different, but related problems. These products all have inconsistent data standards and methodologies. Over time, much attention has been placed on improving these systems, however, little effort was placed on fitting these applications to the overall business model at a mine. Hence, these systems have become 'islands of technology'.
- *Multiple data formats*—As data passes through each application or 'island', it is added to, modified and expanded upon. Each application stores data in a different form, usually in proprietary file formats that are inaccessible other than through the application itself. When the data are required for use in another application, they invariably require some conversion or exporting to ASCII format, then re-formatting in preparation for import into the other application. In some extreme instances one application may require the re-entering or recapturing of the data because of the difficulty and time required to transfer the data from one format to another.
- *Data duplication and redundancy*—As data is passed from application to application it is reformatted and modified to fit the business needs of each activity. In most cases, this process creates multiple copies of the same data on a number of computers at a mine. In addition to unnecessary consumption of disk space, having the same data stored on a number of computers creates confusion over which computer contains the most up-to-date set of data. For some processes, like keeping track of a pit survey status, this can have a huge impact on the productivity and accuracy of work in other departments. This lack of data integrity often leads to the loss of mission critical information at multiple stages in the mining operation.
- *Lack of centralized and common reporting and information access*—Having multiple copies of data in different formats and locations makes it impossible create a centralized data access or reporting process.
- *Communication*—Communication between departments is an important aspect of any mining operation. As a process, mining relies on information to be productive. Effective communication implies that departments receive and convey the right information in a timely manner. However, many mining operations experience delays in communication because business processes are not designed for the efficient flow of information. Operators at one activity may needlessly wait for information from another activity, even though that information is readily available at a different location. This lost time can be measured in terms of productivity, and when multi-million dollar equipment is involved the problem becomes critical from an overall cost perspective.
- *Critical decisions made using partial and/or incorrect or incomplete information*—Day-to- day decision making by mine management is hampered as engineers and technicians spend a large portion of their time searching for, extracting, re-formatting and transferring data between applications, rather than analysing and



Typical IT implementation at a mine

using the information that could be derived from the data. Operations end up being slow to react to significant situational changes, as they do not have sufficient or appropriate information. The net result of these problems is a surfeit of data but a significant lack of useful information.

- *Incomplete technical audit trail*—The various processes involved in creating resource models, plans and mine designs are complex, requiring the definition of multiple parameters and methodologies. Often these processes are performed multiple times using different data and parameters. Keeping track of how processes were performed is difficult and the use of multiple systems and inconsistent standards precludes any automated processes to track what, when and how things are done.
- *Staff training and support*—Mining operations are often in remote locations and keeping a stable workforce is often an issue. Fly-in operations exacerbate the problem, so there are frequently poorly trained and inexperienced staff tasked with critical activities that they are not familiar with.

The net result of these problems is often cumulative and results in significant loss of productivity, effectiveness and decision-making capability throughout a mining operation.

A conceptual solution using a modern IT approach

In order to derive an appropriate conceptual solution to the problem, it is necessary to step back from the detailed technology requirements of each department in a mining operation and look at the overall way the mining activities fit together and how information flow between activities affects the total operation. Analysing the holistic view enables a conceptual solution to be created using modern information technology methodology. This approach identifies that the key asset of any mining company is its orebody (the 'resource') and that the planning and management of the extraction and depletion of the resource is key to the profitability of the mine as a whole. It is also necessary to understand where information is important and what issues dictate how well a mining company plans and manages its operations.

Strategic mine planning

The modern approach to mine planning is to take a 'strategic' approach. This implies a much greater role for planning than is normally assumed in a mining operation, and takes into consideration the high degree of risk that is endemic to all mining operations. Some of the key elements of a strategic mine planning process are:

- Management of business and technical risk through improved marketability of the mineral resource
- Increased technical certainty
- Comprehensive planning steps that take into account the mine's business plan as well as the more traditional life-of-mine and operations plan.

The planning process needs to consider significantly more than just the delineation and then the scheduling of the extraction of the ore. It needs to consider a huge amount of unpredictability and uncertainty—ranging from product prices, to orebody geometry, to grade, to rock mass conditions, to production rates and even overall mine behaviour. This all has to be communicated to a wide variety of stakeholders who are involved in every aspect of the mining operation—from the equipment operators, through planners and managers, all the way up to the Board of Directors. Effective dissemination and availability of this critical information (rather than just data) to all these stakeholders is key to high performing operations.

The mineral balance sheet

One of the primary deliverables of the strategic planning process is a mineral balance sheet. The balance sheet is a familiar tool to accountants as it provides a clear statement of the financial health and history of a company. Applying the same approach to a mineral resource allows a mining company to present a similar picture of the health of the mineral resource. Managing the mineral resource can be compared to managing the mining company's financial resources and auditability is one of the essential features required.

Preparation of a mineral balance sheet is a complex task, which takes input from a diverse range of activities. It must record a complete history of changes to the mineral resource over time as the resource is defined, refined and then depleted. The mineral balance sheet is a multi-purpose tool. As well as providing an accurate statement of the current resource, the historical data in the balance sheet can also be used to predict the effect of new resource estimation techniques or to monitor and simulate alternate depletion strategies. It also provides the ability to manage multiple versions of a mineral resource statement and eases the task of what-if analysis and of making actual vs. planned vs. estimated comparisons. In addition, many countries have government regulations controlling the management of the mineral resource and mandate that various reports and statistics be produced on a regular basis. Again, ready access to information and to data is essential to the preparation and maintenance of the mineral balance sheet. Without a holistic approach to the information needed it would be impossible to effectively create and manage such a tool.

The mining value chain

The 'value chain' concept was first introduced by Michael E. Porter of the Harvard Business School as a way of looking at how different parts of a company fit together from an information technology standpoint. Porter's definition relates to the ways in which information technology changes the way companies operate and the way it affects the product creation process. In summary, the value chain represents a company's main technological and economical activities (Porter calls these 'value activities') it performs to conduct business. The term 'chain' implies that these activities are inter-dependent or linked such that performance in one activity affects the cost or effectiveness of other activities.

Within each activity are software applications that assist in automating processes and tasks. Critical information is constantly moving from one activity to another. How that information is used and the way it moves from activity to activity is the key to better decision making, improved efficiencies, increased productivity and reduced costs. Detailed analysis of the value chain as it relates to specific mining operations enables management to identify the information that is critical to the efficient working of their mine. These pieces of information are termed Key Performance Indicators (KPIs), and must be readily

available from any IT solution that is implemented.

An example of such a value chain is shown below.

Enterprise mining systems

What is required is an approach that has been proven to be successful in other industries—the enterprise approach, whereby all the applications are integrated into a single product that spans the complete mining enterprise.

Enterprise systems, commonly called Enterprise Resource Planning (ERP) systems, are now commonplace in manufacturing industries. Typically ERP systems cover the more traditional back office business applications such as finance, accounting, human resources, inventory management and so on, as well as front office applications such as sales and customer relationship management. Increasingly though, industry specific ERP systems are being developed that incorporate the specialized technologies that the target industry relies on. Software industry giants (such as SAP, Oracle, and JD Edwards) and industry niche players develop these systems.

The mining industry is starting to implement ERP systems at the larger mining operations, and interest is rising in the application of the enterprise concept to the technical aspects of mining. Gemcom is playing a leadership role in this, advocating the enterprise approach to key customers and the industry in general. Gemcom is calling the concept an 'Integrated Resource Asset Management Solution' (IRAMS for short).

The overall Integrated Resource Asset Management system approach calls for the integration of four main areas of Information Technology:

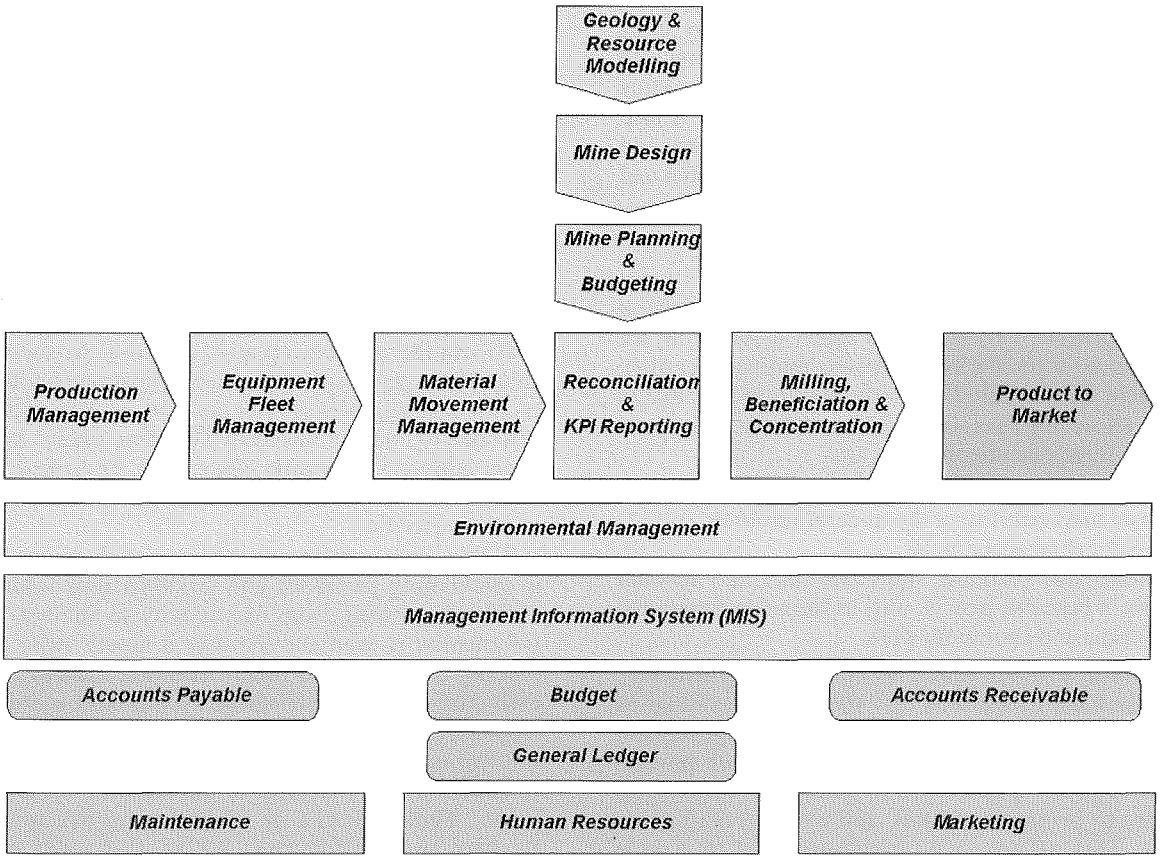
- Strategic and tactical mine planning and production systems
- Milling, beneficiation and process control systems
- Commercial and financial systems
- Management Information Systems.

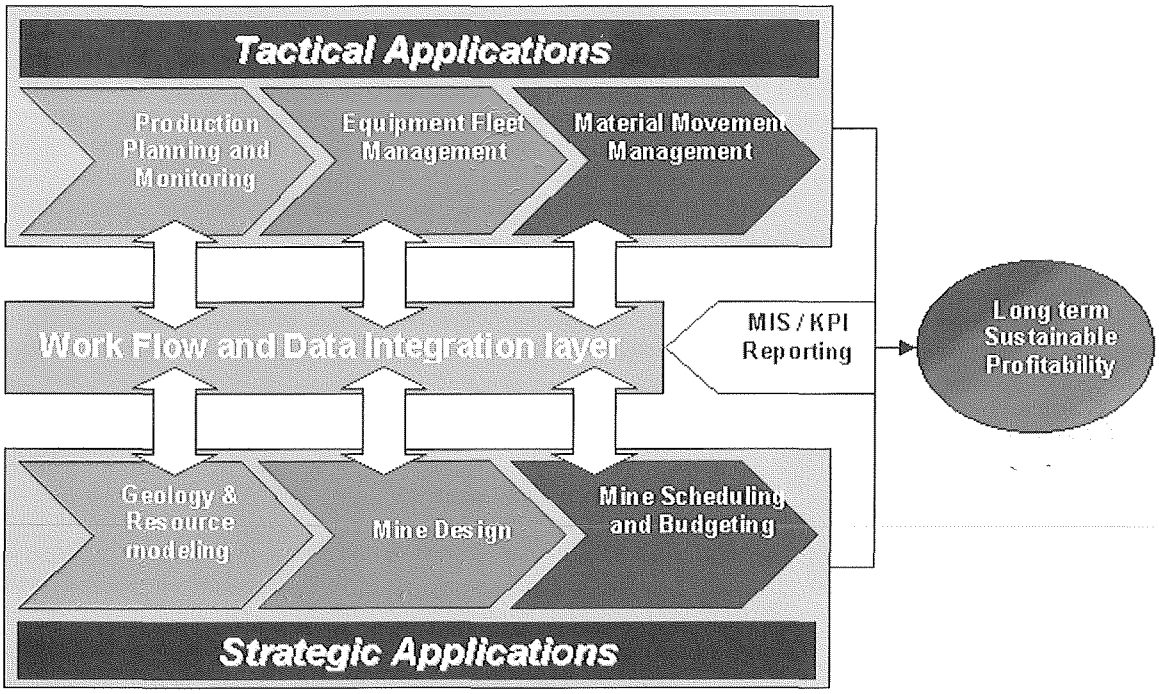
Strategic and tactical mine planning and production systems

These are the essential components of an enterprise mining system and are the type of applications that are generally considered to be the norm on today's modern mine.

- Geological modelling, mine design and mine planning systems for the strategic and tactical planning of mining operations
- Mobile equipment fleet management for open pits. This type of technology is wireless, GPS and software-based technology that is used to track and automatically dispatch heavy earth-moving equipment within an open pit.
- Information Technology closely related to Mobile Equipment Fleet Management. This covers a variety of different types of system, such as high precision drill and shovel positioning systems, tyre management, maintenance planning, crew scheduling, etc.
- Mine production control systems, that include applications for production schedule optimization and blending, drilling and blasting design, mineral inventory management, material movement tracking and stockpile management, and production record keeping, statistics and reporting.

What is different in an enterprise mining system environment is that these applications are built to share a common repository and are tightly integrated together so that common data models are used throughout. The 'integrated' approach is a significantly different approach to an 'interfacing' approach, which is where different and disparate systems export data to some common data





warehouse, which then forms the basis for MIS systems to operate from.

Milling, beneficiation and process control systems

Historical and real-time information for the above processes is obtained from plant automation systems, namely PLC/SCADA systems. Standard SCADA applications have their tag databases available in ODBC compliant formats for industry standard databases to receive historical and real-time information feeds into industry databases such as SQL Server, Oracle, Sybase, etc. This information can be used to identify plant performance criteria and allow the value of information to be integrated from the 3 main information inputs, namely Commercial Applications, Technical mining Applications and Process Control systems.

Commercial and financial systems

It is important to note that in reality, all systems probably relate to one another. Systems integration and data flow from mining technical systems to commercial and financial systems must be achieved to present management with an integrated set of value-added information in order to take pro-active decisions.

Management Information Systems (MIS)

An enterprise mining system will be capturing significant amounts of data and information relating to the resource, the strategic mine plan, the tactical mine plan, production information to the shift level, operating costs, revenues and finances.

To unlock the true value of this information, insight must be sifted from these vast amounts of information. The insight must be timely, and relevant, and must be available to all of the stakeholders in the operation in relevant forms.

Delivering this insight requires powerful and comprehensive Management Information Systems (MIS) that have the capability to manage the most complex analysis of the very large data stores that will be created. The MIS solution must also provide transactional capabilities that allow the users to act on the information and also to define the communication channel that best suits their needs (such as direct access to the information, web access, or wireless access through WAP or SMS).

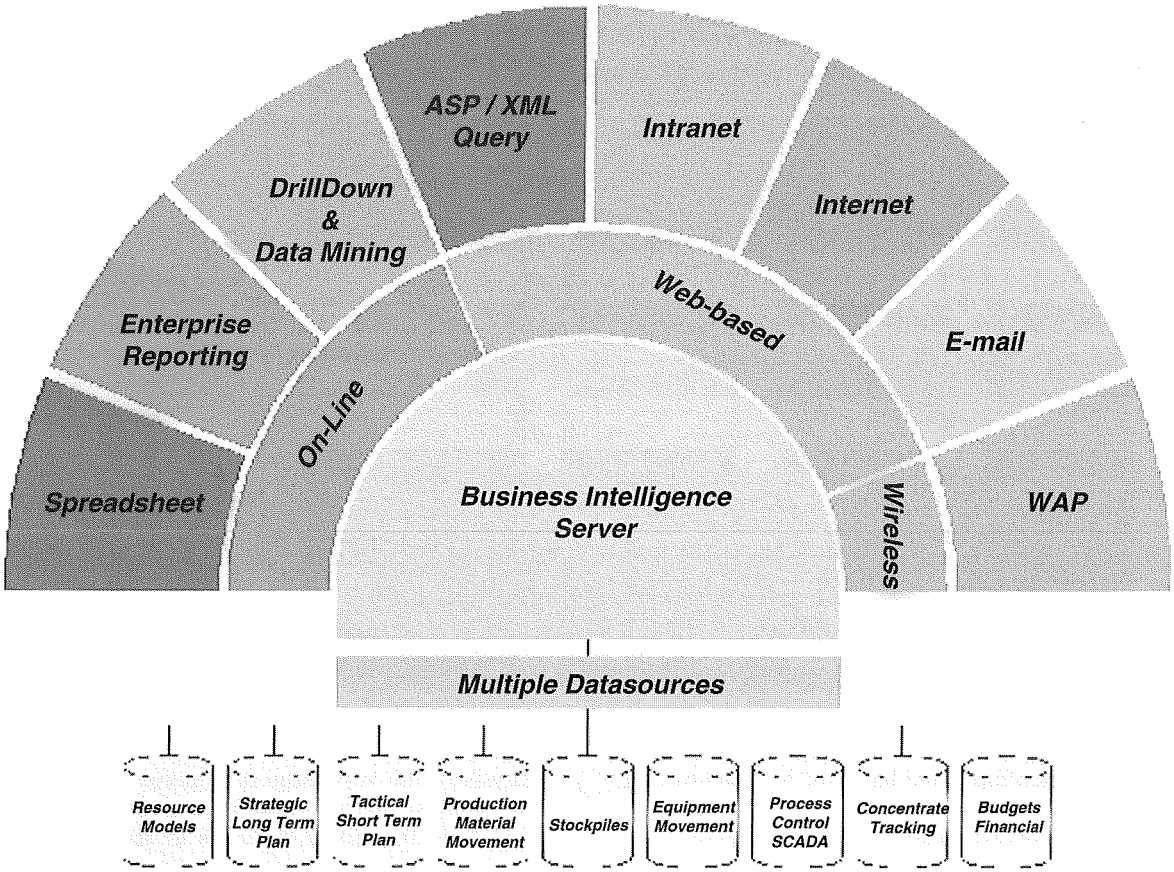
The Figure overleaf illustrates how a business intelligence server can form the core of an MIS solution, acting on the various data stores, and publishing information through various media.

Conclusions

The cornerstone of any learning organization is systems thinking. This is the ability to see the bigger picture, to look at the inter-relationships of a system as opposed to simple cause-effect chains allowing continuous processes to be studied rather than single snapshots. Systems thinking shows us that the essential properties of a system are not determined by the sum of its parts but by the process of interactions between those parts.

This is the reason systems thinking is fundamental to any learning organization; Integration is the discipline used to implement the disciplines. Without systems thinking each of the disciplines would be isolated and therefore not achieve their objective. This discipline integrates them to form the whole system, a system whose properties exceed the sum of its parts. However, the converse is also true—systems thinking cannot be achieved without the other core disciplines: personal mastery, team learning, mental models and shared vision. All of these disciplines are needed to successfully implement systems thinking. Systems should be viewed as inter-relationships rather than isolated parts.

Integrated systems for the mining industry are in effect building the foundation upon which mining companies can begin to build the infrastructure for the learning organization. However, without the strategic initiative being driven by management and the concept being embraced by all concerned, the need for integrated systems will never be supported as much as it needs to be right now.



Generic Business Intelligence Architecture

The future of the mMining IT industry and the value that it can add to its clients thus is dependent on the ability of the industry to recognize the values and principles of the learning organization and the acceptance of the benefits knowledge management can deliver through integrated systems. Globally it is estimated that the entire mining industry spends some 50–100 million US$ per annum on technical IT systems. During the same period, individual mining operations were reported to have spent 50 million US$ on commercial ERP systems.

The mining IT industry is fiercely contested with numerous niche and specialized players fighting for a small piece of the pie. It often seems that every player (technology provider) has developed the same technology as his competitor, spreading the development dollars mining companies pay for such technology over a broad and non-value-adding front. Most of the owners of the companies providing such technology to the industry are private individuals and the business objectives of such individuals appear to be less inclined to embark on high risk re-engineering of the current systems to be able to deliver true enterprise solutions the industry requires.

Integration enables organizations to leverage the experience and knowledge of all employees by connecting technical applications and synthesizing processes across departments. This holistic approach to working is quite different from the way in which today's operations function. However, it is the key to better performance, increased operational efficiencies, staff retention and competitive advantage. Within the mining industry, integration of systems and processes is just beginning and will provide dramatic productivity improvements for mining companies over the next decade. Integration provides all employees with relevant information to make prompt, informed decisions. It enables unsurpassed strategic capability in the planning of the extraction of a mineral resource and simultaneously affords unparalleled insight by all stakeholders into the tactical progress to plan.