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CONSULTANTS

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DIGGING DEEPER

SELECTING UNDERGROUND MINING EQUIPMENT

Peter McCarthy

While underground equipment should be selected to suit the mine, it is equally true that the mine should be designed to suit the equipment. It is impossible to begin mine planning and scheduling without a good idea of the type and size of equipment available and how it might be applied. Design of the stopes or panels, mine accesses, development cross-sections, ramp gradients, electric power reticulation, ventilation circuit and so on must be based on an assumed type and fleet of equipment.

In practice, equipment selection for a new hard rock mine starts with the stoping operation. Stopping equipment should be appropriately sized for the characteristics of the orebody and the stope dimensions. Stope development openings should be sized to suit the stope dimensions and the stoping equipment capabilities and requirements.

Development equipment should then be sized to mine the required size of stope development. Separate development fleets for access and stope development may be required. If this logic is not applied, big "efficient" development equipment may be acquired for the access development, and then used in the stoping areas, with the result that the stope development is sized to fit in the jumbo drill, rockbolter booms or even the haul trucks and must be far larger than the optimum, causing inefficiencies in stope design, poor geotechnical conditions or excessive overbreak and dilution.

Of course, it is often necessary to select new equipment for an existing mine, where the constraints including access dimensions, ventilation etc have to be identified and managed. In a shaft mine, for example, the machine size may be limited by the dimensions of shaft compartments and the component sizes in which the machine can be broken down for transport.

Proposed or possible changes to the mine plan, such as a move from a 5-day working week to continuous working or a change in the decline gradient, will affect the duty and must be considered. Sometimes the new machine may allow a new way of working. For example,



replacement of rear-wheel drive trucks with 4-wheel drive trucks would allow ramps to be steepened. This could reduce overall costs, and it is this larger context which must be analysed.

Machines should be compared in terms of capital cost, operating cost, specifications, performance, availability, service and parts backup and service life.

Equipment matching

The individual items of equipment together form a development system or a production system and thus they must be physically compatible. Jumbo drills must be capable of reaching the limits of the largest excavation required, usually determined for the production drills and the trucks. LHDs must be able to reach and fully load the tubs of the trucks in three to five passes.

Sometimes a workaround will enable incompatible units to be used. For example, a "step" in the floor may enable small LHDs to load large trucks.

The electric machines should all operate from the same electric supply voltage. A decision must be made about whether compressed air will be reticulated and if not each machine must be self-sufficient for compressed air.

When items are obtained from a single manufacturer then the manufacturer will be able to say how well-matched they are. If they come from different manufacturers then some research may be needed, including detailed study of the specifications and calls to other mines using the units together.

Choice of manufacturer or supplier

The manufacturers of underground equipment range from large, international firms with worldwide representation to small manufacturers, generally serving a local market or a specialised niche. In general, the international firms offer robust, reliable and well-proven equipment at the upper end of the price range. Equipment is usually priced in Euros or US dollars, which may appear prohibitive when converted to a local currency.

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MINING INDABA CONFERENCE

Paul Harper

The Mining Indaba Conference held in Cape Town early February 2010 was attended by more than 4,000 delegates and hosted more than 250 exhibitors. The sentiment throughout the conference was one of optimism with the global mining industry, China and India being the main focal point for this global resurgence with the increase of prices and production levels in iron ore, copper, platinum, gold, and rare metals.

There were fewer mining companies exhibiting their projects than previous years, however there were more service providers that filled the gap, AMC Consultants being one of these providers. It was also noted that there was a strong contingency from Africa, Australia and the United Kingdom.

The message was very clear that Africa has a huge potential for investors with the growth of the overall gross domestic product remaining positive in 2009 and expected to increase in the

coming years. China in particular is making a strong presence in Africa to secure sources of key commodities.

This optimistic outlook we can confirm is occurring globally as the level of enquiries and projects that have materialised have certainly increased over the last few months for our international consultancy business.

Amongst this bullish outlook there were undertones of some key challenges in Africa mainly in the supply of reliable energy resources and water; and poor infrastructure such as transport. These issues will certainly need to be addressed to give investors more confidence to enter the African market. There was very little mention of the political uncertainty and labour challenges including tackling the aids situation which is prevalent in Africa. This no doubt will be an on-going challenge for mining companies and investors. There were however companies spruiking their mining developments in Western Africa and the Democratic Republic of Congo.

It was a busy event which provided an excellent platform for networking. There was a lot of interest in the AMC Consultants stand with companies seeking advice on developing new projects across Africa, mainly in conceptual, prefeasibility and feasibility studies. Some of these enquiries have already materialised into projects which certainly confirms the level of activity in the African mining industry.

The other important benefit was that the event provided a concentration of previous colleagues and clients and allowed an opportunity to catch up and hear their news and remind them of AMC.

A very successful mining event which AMC Consultants intends to participate again in February 2011.



Paul Harper
CEO
pharper@amcconsultants.com.au

SELECTING UNDERGROUND MINING EQUIPMENT

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Small, regional manufacturers can offer attractive pricing and may offer a viable alternative to the "name" brands. Because their level of research and development is limited and because they are building to a price, machines from such manufacturers generally have lower availability and may have reduced performance. These factors should be assessed carefully in deciding whether the lower capital cost outweighs the higher operating costs, including the impact of servicing and breakdown delays on the mining system as a whole.

Other manufacturers offer specialist equipment that is not available from the major suppliers. Examples of the products of international niche manufacturers include narrow-vein mining equipment from France and Canada, rockbolting platforms from Canada, backfill slinger trucks from Germany, raise climbers from Sweden and so on.

Equipment of similar specification from the major manufacturers will generally give similar performance. This is often compared with the choice of buying a car from Ford or from General Motors – both will do the job. It is worth enquiring at mine sites using the equipment because specific models sometimes have problems that are not really resolved during the model run, while competing machines are free of that problem.

The most important factor in choosing between otherwise similar machines is the level of backup support provided in your region by the manufacturer. Appropriate questions include:

- What training will the manufacturer offer to your operators and maintenance personnel?

- Does the manufacturer have service facilities with trained personnel within an hour or two by road of your mine? If not, is it willing to establish such facilities on the basis of your order?
- Will the manufacturer stock a comprehensive range of spare parts in-country for the specific model that you are buying? What is the likely delivery time?
- Will the manufacturer provide spare parts in your mine store on a consignment basis, so that you pay only when they are used?
- Which major components are not stocked in-country? How long would it take to obtain them if needed and what would be the cost of urgent air freight?
- Will the manufacturer offer maintenance and consumables on a fixed cost per hour or per metre basis, establishing its own maintenance workforce on site?
- What is the reputation of the manufacturer for service and spares backup in your region?

Once these questions have been addressed, it may be advantageous to source the key fleet items, such as trucks, LHDs and jumbo drills, from a common supplier. It is also attractive to minimise the number of different models of equipment on the mine site, even if from the same manufacturer; to minimise duplication of stores inventories.

Appropriate technology

Any new machine should incorporate a level of technology that can be understood and



supported by the operators and maintenance team. While it may be appealing to engineers to acquire the latest technology, the potential performance will not be delivered if the machine spends much of its time waiting for repairs. At the crudest level, there are mines which operate compressed-air rockdrills and do not have the workshop facilities or the skills to maintain hydraulic rockdrills. Similarly many mines do not have the electronics capability to maintain the latest fully computerised jumbo drills and prefer to buy the versions with manual controls.

In general, the longer the supply lines to the mine and the less educated the workforce, the more robust and less innovative should be the technology. It is also difficult to mix different technologies within the one operation.

MESSAGE FROM THE CHAIRMAN

Most of us, in the mining industry, visit and report on mines from time to time. The reasons for visiting can range from self-education while on holiday to preparing a formal Due Diligence report. I have found often that the key points to a mine's prospects and performance are not found in the management's Powerpoint presentation, but in a quiet chat with the mine foreman in his office or the contract superintendent in the wet mess.

It was ever thus. JH Curle, author of "The Gold Mines of the World" (1902) wrote "...there is a certain freemasonry among mining men, whereby one can learn, if he only meets the right people, the inward and true position and value of every mine in the world." It is disturbing then, when commissioned to formally report on a mine, to have strict limits placed on who can be spoken to, and then only in the presence of the General Manager. Alarm bells ring immediately – what is there to hide on this site?

The members of a technical Due Diligence team should be free to ask whatever they choose, and should expect an honest answer without the intimidating presence of the senior site executive. They should be able to query everything from the sampling and assay technique (with check

sampling if doubts arise, though this rarely happens in practice) through to the ore reserve estimation technique, details of costs and the performance of the management team. Strangely, the companies most alarmed by this are large companies with well run operations. At the small end of town, access is still generally unconstrained as it should be.

Why do the big companies try to limit and compromise due diligence? Mostly, because they think they can. Most site executives in the large companies don't have a transactional background and have spent their careers carefully limiting outside access to corporate secrets. By contrast, managers in junior companies spend much of their time dealing with investors, shareholders and analysts and understand very well their responsibilities under a continuous disclosure regime. At their mines, everything is material to share price and is (one hopes) disclosed promptly. At a big company mine, a variance of tens of millions of dollars or a serious ore reserve error may be immaterial to the parent's share price and is not subject to disclosure.

Information becomes knowledge and can be a very valuable thing. To quote JH Curle again: Once, at a board meeting in Johannesburg, some



very bad news about their mine was announced to the directors. A few moments later, one of the directors was taken with terrible internal pains. Muttering hoarsely the word "brandy" he rose, and staggered to the door. But the chairman rose up like a flash and reached the door first. He locked it, and put the key in his pocket. "No you don't my friend," he said to the suddenly recovered and astonished man; and then, in a firm voice, tapping the damaging report which he held in his hand, "we will all reach the Stock Exchange together."

Peter McCarthy
Chairman
pmccarthy@amcconsultants.com.au

Innovative models

Innovative new models of machines, even from the most reputable manufacturers, may present operational problems. It often takes two or three years of operation to resolve design problems in trucks, loaders and jumbo drills, with trucks giving the greatest problems. Usually the machine gets a bad name in the industry and a revised model with a new code name is released once the problems are resolved. The problems are not predictable and could be as simple as shearing of wheel studs on a high-powered truck.

The promised performance of a new model may be appealing, and some mine has to be the first to try it. If you are considering such a machine it is usually possible to negotiate a performance guarantee with the supplier. This should take the form of an operating availability guarantee, possibly with a minimum performance expressed as tonne-kilometres per hour, metres drilled per hour, or similar. Financial compensation applies if the machine does not deliver the guaranteed performance.

It is usual for the manufacturer and supply agent to be very interested in the success of a new product and they may provide high standards of operator training and assume responsibility for maintenance for an extended period.



Peter McCarthy
Chairman
pmccarthy@amcconsultants.com.au

PRINCIPLES BASED RISK MANAGEMENT

Craig Purcell

Risk Management is a term often used to define and justify many differing processes and procedures within an organisation. It is generally held that the function of risk management procedures is to remove the potential for defects or errors. This is most appropriate in an environment where the same product is required to be produced without fault day after day. Is this appropriate for a professional services environment where the product is by necessity different due to the differing client requirements? Does risk become an accepted (as opposed to acceptable) aspect of the professional service process? Where does quality assurance stop and risk management begin?

In an article authored by Hall and Johnson (Harvard Business Review, March 2009), it is suggested that work outputs could be categorised as either "Art" or "Science". Work that is considered "Art" is judgement-based work or professional work. It empowers staff to use their own judgement, based on a set of agreed principles, when making decisions. It is also used when clients value a distinctive or unique output, when the same outcome every time is not required or desirable. It is the business of professional service providers

to be flexible and creative enough to adapt expertise to the varied needs of their clients' projects. (See diagram on page 4)

Quality assurance has two aims. Firstly to maintain the quality of the service offered, and secondly to limit the associated project risks overflowing from the bowl. The stem of the glass represents the principles that support the connection between risk management and quality assurance. The base of the glass is where professional services firms establish and maintain risk management and these intentionally work in the background of the revenue generating arm of the business. When defects or errors occur the base is strong enough to maintain the integrity of the glass.

Risk Management is a supporting function that manages risk as it occurs, it does not seek to remove risk from the provision of professional services. In contrast, quality assurance is the methodology used by the professional service arm of the business to maintain the quality of service and project deliverables. Quality assurance practices are a vital component in mitigating a wide variety of project issues. Reliance on these risk management procedures

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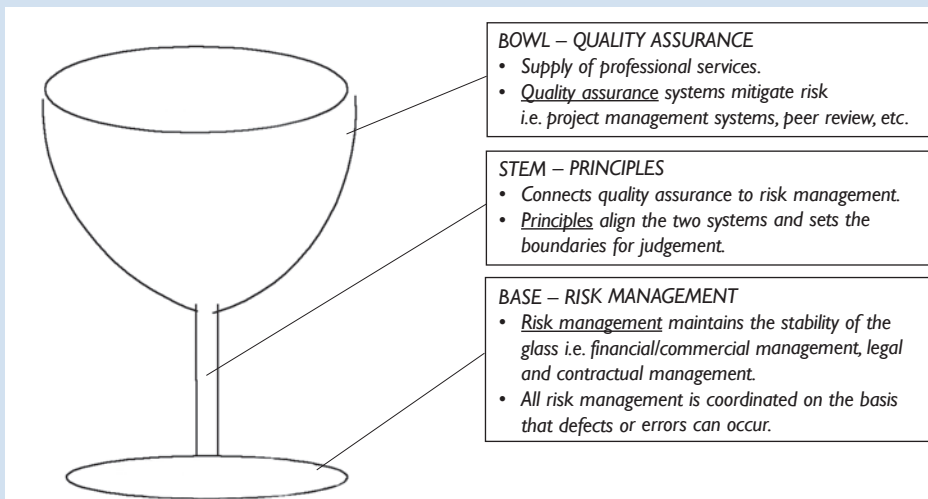
PRINCIPLES BASED RISK MANAGEMENT

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as a risk management solution may limit the creative flexibility of professional services provided to the client.

Principles based risk management gives staff the opportunity to use their own judgement, based on a set of agreed broad principles. David Maister, an expert on business management practise and the management of professional service firms, believes that individuals and organisations cannot excel in their performance unless they are prepared to act in accordance with an agreed set of principles, values and ideologies. He calls this "Values in Action" – the willingness to be accountable for progress towards goals, and to accept consequences for non-compliance.

Setting the risk management principles that align quality assurance and risk management will depend on the organisation. A principle such as "Do not sign agreements unless you have the appropriate authority" assumes that the level of authority has been clearly stated and is known to all employees. The principle supports risk management structures, such as insurances, by setting the boundaries of authority for signing agreements. This should then link into the quality assurance process when judgement is used by an employee to escalate the agreement to an appropriate authority. The use of principles supports the judgement of employees and empowers individuals to act responsibly at each activity level. Risk management procedures often remove judgement as the individual places



I have used a wine glass example to illustrate where risk management principles connect quality assurance and risk management in the production of "Art".

faith solely in a methodology to alleviate risk. "If I tick this box then the problem cannot occur" or as dangerously "if I tick this box my responsibility for risk has been discharged", can only lead to an increase in risk events.

In summary, risk management procedures are established to control steps in a process to produce a consistent outcome. They attempt to remove the necessity for judgement. Risk management principles do not attempt to control outcomes but link risk management with quality assurance. These principles recognise that problems will occur and seek to establish the boundaries where judgement can be employed. A key element of quality assurance is the peer review process. The risk management system simply requires that peer review be undertaken

and that the peer reviewer is appropriately qualified – it does not interfere with the application of sound judgement. By controlling the boundaries, risk systems can be maintained to lessen the impact of risk events. In professional services delivery, a commitment to quality assurance underpins the judgment of the service provider within the boundaries offered by the risk management principles. This allows for a greater flexibility to the benefit of the client, and most effectively manages risk on behalf of the organisation.



Craig Purcell
Commercial Manager
cpurcell@amconsultants.com.au

NEW EMPLOYEE



Julia Martin

AMC is pleased to announce that Julia Martin has joined the company as Principal Mining Engineer based in Perth. Julia's expertise is in mine planning, feasibility studies and project management. She has experience in both underground and open pit mining as well as corporate activities across sites in Canada, Australia and Africa.

UPCOMING EVENTS

AMC will be attending the following functions over the next few months.

7 – 10 March	PDAC 2010	Toronto, Canada
19 – 22 April	AGC Caving 2010	Perth, Australia

AUSTRALIA

amc@amconsultants.com.au

UNITED KINGDOM

amcuk@amc-consultants.co.uk

CANADA

amccanada@amconsultants.ca

www.amcconsultants.com.au

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