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The WOW factor in Mining

Author: Andrew Okely

The mining industry is in the midst of a sustained period of good commodity prices and high profits. Many companies are reporting record profits and have record or near record market capitalisations. Profit margins are also strong, with many companies reporting earnings in excess of 20% of revenue. Much has been written about how long this situation can last with some commentators talking about super cycles of up to 15 years driven by China, India, Indonesia and Brazil.

Many projects are currently economically viable and demand for construction and operational resources, particularly people are at critical levels. These are the challenges facing the industry right now and have been analysed extensively. This article will look at three other factors, which have the potential to dramatically influence the present commodity cycle, namely water, oil and war or the WOW factor.

Water

Water is, in many ways, like some of our mineral resources, a vast resource most of which is not in the form or place it is needed. In fact, most water is saline and/or in the ocean. Getting from the coast to a mining project or desalinating it for human consumption requires energy. Clearly there is a finite amount of fresh water available for human use, with the demands on this resource increasing rapidly as the second and third world modernise. In Australia the southern end of the country is in the midst of a long-term dry spell compared to historic averages, whilst our northern areas are also hoping for a "good" wet season.

Mining, or more precisely, mineral processing, consumes vast amounts of water. It is not uncommon to hear of projects whose development, expansion or even continual operation is dependant on finding water. One current example is the Gladstone Nickel project whose feasibility study is looking at pumping seawater to site, then to transport ore back to the coast as a slurry. An example from the past is the Ok Tedi operation in PNG who have reported past production restrictions due to insufficient water supply. There is no question that the use of water in mining is a significant issue and will eventually move onto the general population's radar as the true value of fresh water is acknowledged.

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Oil

One of the biggest questions facing the modern world is the availability of oil. In Australia we depend upon oil and, in particular, petroleum products to run our cars and trucks, whilst other parts of the world also depend upon it for heat. Whilst other resources such as coal or uranium could provide fuels for heat/electricity, the use of this technology in the motor industry is not yet widely available.

The importance of oil and its price to the structure of our economy is becoming increasingly apparent in everyday life. Sales of motor vehicles with large engines have collapsed, consumer confidence (a good indicator of short term consumer spending) has fallen significantly and reports that reduced weekend trips by car is impacting local tourism can be readily found in the media. The cost of transporting every product we consume is increasing rapidly. A scenario in which global growth is curtailed by a fall in demand for goods and services is not difficult to foresee.

In mining, oil prices are every bit as important. It is difficult to pick up an annual report without reading about the impact of oil prices on total operating costs. Some prospective projects have even cited this as one reason why they did not proceed. Remote projects that generate their electricity via diesel generators are feeling the greatest impact. Potentially, the mining industry could be squeezed on the cost side in the future, whilst falling economic growth reduces demand for commodities, and all this as a result of oil prices.

War

Many of the most resource-rich parts of the world are either embroiled in conflict or have just recently seen a cessation of hostilities. The mining of diamonds in particular has long been associated with some African conflicts, whilst oil production and the possible consequences of conflict are closely associated in the Middle East. The potential for mining operations to be embroiled in and even lost to local power struggles was never more obvious than the events that ultimately shut down the Boganville mine in PNG. Mining is a major contributor to the Gross Domestic Product (GDP) of many nations and also serves as the major source of hard currency. This makes mining an attractive pawn in any power struggle.

A different kind of war could also have an impact on the mining sector - that is a trade war. The rise and rise of China as a destination for manufacturing has lead to enormous demand for raw materials but also huge falls in the cost of consumer goods. Increases in the cost of raw materials, such as coal and iron ore, have seen China looking at ways of gaining control over mineral assets through investment in western countries. If control of the resources is gained, the mining industry could see a fall in the demand for minerals in the open market and thus a fall in commodity prices. China could effectively shift mining margins into manufacturing margins.

Geothermal generator at Lihir

Addressing the WOW factor

Fortunately, the mining industry is both resilient and creative. Harnessing both of these qualities, it is already finding ways to address the impact of the WOW factor. For example, projects such as those at North Parkes and Cadia/Ridgeway in NSW use the output of the Parkes and Orange effluent treatment plants. The Lihir project is successfully using geothermal energy in the form of a 50mW generator to provide much of its power requirement and thus retiring their diesel generators. Many mines are using more efficient and larger mining equipment to minimise fuel costs.

Outokumpu Technology – paste thickener

In the concentrator where recovery is the key focus, reclaiming water through the use of high rate and paste thickening is increasingly taking a centre stage role. The mining industry has seen increased focus on issues such as water recovery and optimisation of the thickening process, particularly in the high density and paste sphere, is increasingly important.

Some technology suppliers have responded to this market demand and introduced thickening design improvements to recover the maximum amount of water possible. Outokumpu Technology, for example, has increasingly designed more and more thickeners with higher tank wall heights and slope floor angles and also introduced more innovative torque mechanisms.

Paste and high rate thickening is such a significant area of technology that it now has its own global conference every year. Recovery of the valuable minerals is also a key measure, having invested all of the energy and water to progress the minerals into the separation phase, (be it via flotation or a physical separation process), it is imperative that the maximum amount of mineral possible is recovered. In this field, advances such as a more effective flotation process for ultra fine particles and new higher efficiency spirals are extending the boundaries of what was previously possible.

Many mining projects have done wonderfully well in integrating local communities into the benefits of the minerals industry in recent times. Developing programmes to improve health, housing and education through direct employment at both the mine and via local service providers has become the norm. This type of relationship-building can help to ensure that any party which obtains power in the countries where we operate has a vested interest in sustaining the existing mining industry.

In all of these areas the mining industry must and will innovate. The ability to reduce the use of energy and water will determine where one can operate over the next 50 years. It is incumbent on the industry as a whole to demonstrate that development in the third world is about sharing the wealth generated fairly and permanently. Without these developments mining may well become something considered as a necessary evil rather than positive contributor to modern society.

Andrew Okely is currently Manager – Minerals Processing Technologies for Outokumpu in Australasia. He has a bachelors degree in Metallurgical Engineering from RMIT, a post graduate certificate in marketing and a masters degree in business finance, both from UNSW. He has over 10 years experience in the design and selection of minerals processing technology, having worked on projects such as Cadia/Ridgeway, Century Zinc, Mt Keith and Telfer. Prior to joining Outokumpu Technology, Andrew was a research metallurgist with Pasminco for three years.

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Finite Element Analysis – smoke and mirrors or genuine engineering tool?

Author: Hamish Mackie

Finite Element Analysis (FEA) is an engineering term that is freely used nowadays but is not completely understood except by those in academia and the engineers who use it regularly. Put very simply, FEA is a mathematical model where an object or system is simulated by a series of linked and simplified representations of discrete regions (i.e. finite elements). This model is then used for predicting the behaviour of the object or system when an external action is applied.

Pioneering roots

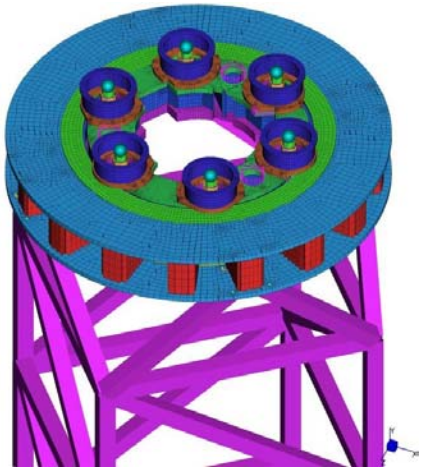
FEA is not a new technology as it was first developed for vibration systems in 1943 and further expanded into stiffness and deflection systems in 1956 by the pioneers of the aerospace industry. In the early days, FEA was confined to the expensive mainframes of the aeronautical, automotive, defence and nuclear industries. With the advent of more powerful microcomputers, it has become readily available to the general engineering community.

It was less than 10 years ago that commercially available FEA software needed specialist programmers to operate it and gross simplifications of the object being modelled had to be made. The introduction of the Graphical User Interface (GUI) and software development such as automatic meshing of imported objects has allowed engineers to create more detailed models in much less time.

Also the phenomenal increase in computing power has now made it possible for very complex models to be created and solved at the desk of the design engineer. This has allowed many companies to bring new products to market far quicker than previously possible.

Benefits of FEA

Nowadays the field of FEA has developed to such a point that an enormous number of different "behaviours" can be predicted from an equally large number of "external actions". FEA also is very useful for tailoring designs to individual project requirements and optimising current designs in order to improve performance. Most people think of FEA as being only for mechanical and structural applications but it is also routinely used in the analysis of many other types of problems, including those in heat transfer, Computational Fluid Dynamics (CFD) and electromagnetism.



FEA-designed column & bridge mounted thickener

Some technology suppliers use FEA and CFD software to design, optimize and individually tailor aspects of their projects. Outokumpu Technology, for example, has used FEA for over a decade. It is an invaluable tool for producing reliable and cost efficient results in a much shorter timeframe. Also, any design modifications to a project or testing of various scenarios can easily and quickly be viewed using FEA.

With FEA, the company has designed the complete new high torque range of column and bridge mounted thickener drives (refer figure 1).

It has also enabled experimentation in different types of tank designs in order to come up with the most efficient design possible. This means the customer has a range of fully-designed scenarios within a far shorter timeframe and at lower costs.

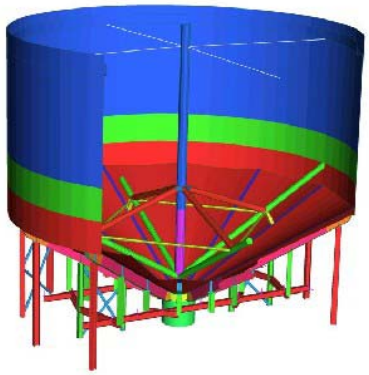


Fig 2: FEA model of thickener transport study

Genuine tool

The benefit and power of the technology was dramatically confirmed during one particular project when a client required the projected footing loads after the expected subsidence of the concrete supports. After consultation with the software developers it was found that the required displacements could easily be added to the model and the new loads were then dispatched to the client in a matter of days. Also when a transport study was requested for the complete tank and mechanism, the models of each were combined to give the loads that would need to be taken by the heavy lift trailers (figure 2). Had FEA not been used, it would have taken at least twice the time to produce.

Validating the model

It is obviously important to check that the results from FEA models are based on correct assumptions. One way of checking the accuracy of a model is by carrying out validation tests on the final product to confirm the results predicted by the model. These checks are carried out using strain gauges, positioned in areas predicted by the FEA model to be the most highly stressed. It is also worth placing gauges on other areas not predicted by the model to ensure it is accurate. Outokumpu has carried out a number of these validation tests on thickener tanks and flotation cells in the past and each time the results have concurred with the predictions from the models.

Rubbish in = rubbish out

FEA is an excellent engineering tool allowing companies to come up with bigger and better products faster and more economically than before, but as with all computer systems and programmes, the basic rule of "rubbish in = rubbish out" still applies. In other words, if the model is not an accurate representation of the actual object or system, then the results it gives will not be accurate either. Therefore it must be ensured that designs are modeled by trained and competent engineers and are verified by a qualified third party in order to minimise the chance of errors.

More than smoke and mirrors…

In conclusion, the power of FEA has dramatically increased due to the advances in mathematical theory, software engineering and computer hardware. It has become an integral part of every modern engineering design. With proper care and diligence, it can prove to be a very reliable tool in the engineering field and there is no reason to think that it will not become even more powerful in the future as people find more and more ways to utilise it.

Hamish Mackie is currently Engineering Manager for Outokumpu Technology in Australasia. Hamish is also responsible for the company's global engineering design for its thickening technologies.. He has a Batchelors degree in Mechanical Engineering and has been with the company for 12 years. His previous roles included draftsman, project engineer, IT manager and design engineer. Over the years, Hamish has been involved in the development of all of Outokumpu's large float cells from the OK-100, all the way through to the OK-300 as well as the FEA modeling of the company's range of high torque thickener drive units.

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Getting the most out of training

Author: Frankie Taylor

Managing all or part of a concentrator can be a daunting task. Even just from the perspective of minerals processing, there are a myriad of issues which need particular attention: grade, recovery, safety, etc… In addition to these responsibilities, human resources also need to be managed effectively. Increasingly, organisations are linking learning to performance and the bottom line. They understand the relationship between creating a trained, motivated workforce and achieving success. However, with issues such as shortages in skilled labour and personnel moving from site to site, it is difficult to maintain a consistent skill level throughout the plant. As a result, training is taking more of a 'centre stage' role not only in human resources but also in overall optimisation and management of a plant.

The first step – setting the standard

There is no doubt that training is extremely effective in raising the standard of performance among employees, whether they are operators, metallurgists or maintenance personnel. But what is the required level of performance? Other questions to pose would be issues such as - who is at or above this level and who is below? What criteria should be used to determine who needs training and who doesn't? What content and style of training is required to bring them up to the desired level of performance?

So, the first step in evaluating training would be agreeing upon and setting required performance levels for specific roles on-site.

Once this initial step has been completed, it is time to assess the various training providers in the marketplace and decide who is the best 'fit'. The following are eight useful pointers when undertaking this process:

Some tips on evaluating training providers

- Ensure the training can be tailored to your specific needs - not all training providers offer the option to customise training. Sometimes you are just offered standard 'off the shelf' training which is not necessarily best aligned to your specific business goals.
- Accreditation – does the required training fall under the VET scheme? What qualifications are desired on site? What qualifications are desired by the training participant?
- Training provider credentials – how much experience does the provider have in mining and minerals processing? How much experience in training itself?
- Trainer credentials – Find out who will actually be training your staff. This is critical. You may have a highly experienced professional who has 'sold' his company's services, but who will actually be carrying out the training? How much experience does the trainer have? - in your required on-site technologies? In training itself?
- Customer service and support – If the training provider is the original equipment manufacturer (OEM), can they also offer follow up or consultancy support?
- Does the training material incorporate elements of safety or safe operation of equipment?
- Training venue – one of the biggest costs of training can be travel and accommodation. Choosing a course which is either on-site or local to your plant saves both money and people's time away from site.

- What type of course material is offered? What documentation is supplied to participants? For example, checklists during emergencies or abnormal conditions can prove invaluable.

Typical training course content

In the context of minerals processing, basic equipment training should cover essentials such as components and their function, principles of operation, safe operation of technology/equipment. Further training may involve such material as troubleshooting, process optimisation, calibration, some theoretical material, regular maintenance routines and maintenance of critical spare parts

Tailoring your training course

Whatever the case, the greatest benefit can be gained if the training programme is tailored to suit the trainees. Once the desired skill level is determined, it is important to question the trainees about their past experience and knowledge to determine their current skill level. This exercise helps to tailor the training material to focus on the areas that need improvement (including briefly refreshing their existing knowledge) and introduce new content to raise them to the next skill level. An example of this would be the increased responsibility on operators for maintaining technology such as thickeners and flotation cells. Introducing regular maintenance and troubleshooting into operator training may also give them a better understand of how these machines perform.

The training content may cover a lot of information that participants find interesting, and the practical exercises may be challenging and even fun. But can trainees immediately put their newly acquired knowledge into practice? Can they really relate the training to their day-to-day work? A good training session leaves the trainee interested, motivated and ready to tackle their normal work. But most importantly, a good training session is evident in the improvement in job performance: increased efficiency and productivity, reduced hazards and incidents, and an improved plant process. And, at the end of the day, what we are all looking for in training is value for money.

Frankie Taylor is currently Customer Training Manager for Outokumpu in Australia. With an Electrical Engineering degree from UNSW, she acquired her experience and qualifications in product marketing and training at Schneider Electric. At Outokumpu Technology, Frankie works closely with a team of experienced engineers and maintenance personnel to develop training courses for Outokumpu's minerals processing technologies.

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