At the time of writing this piece I Googled “collaboration and innovation” and received 880,000 results. Clearly there is significant chatter on the net that speaks to the link between these important processes.

The more credible postings suggest that the old models of innovation no longer work and that now, more than ever, collaboration, whether internal to a company or external, is the way to success. It’s difficult to see how internal collaboration in a company is going to work effectively when business units are largely independently run and communication and the flow of information are inhibited by various administrative obstacles.

I am sure that most people would agree that the sharing of solution to problems at different mining operations or indeed across different business units, should be encouraged. Any process or measure that encourages and facilitates collaboration across business unit boundaries should significantly improve the opportunities for identifying and capturing ideas for innovation. However, it’s not enough to look within the company for inspiration as there is now clear evidence that gazing across industries is a very productive way of looking for solutions. There are a number of methodologies and platforms to help facilitate this process.

We are seeing more evidence of external collaboration. For example BMW and Daimler are now working together designing car seats and on affordable electric vehicles, which will deliver multi-million euro cost savings whilst still competing in the market place.

External collaboration to support product innovation is apparently quite common in the U.S. biopharmaceutical industry. As the Dow Chemical Company notes on its website “to ensure a successful path to developing truly breakthrough solutions, we recognise that collaborative efforts are essential”. In the mining industry, Rio Tinto has partnered with Atlas Copco to develop autonomous drilling solutions for surface mining. More recently, Rio Tinto signed a MoU with Chinalco to advance the development of new mining technology, and to further develop their Mine of the Future® programme.

It’s not a huge leap however, to consider the concept of multi-competitor collaboration as in the case of BMW and Daimler. When would it make sense for mining companies to collaborate? Clearly when it comes to facing industry wide challenges like capacity building, addressing skills shortages, sharing best practice and in supporting pre-competitive research the outcomes of which will ultimately benefit everyone.

AMIRA International of course is very much into facilitating multi-competitor partnerships that focus on pre-competitive R&D. In fact, it has been the very basis of AMIRA for over 54 years. Competitors in other industries often collaborate by sharing a part of value-creating activities not just in R&D but also in product design and distribution. We are already seeing reports of collaboration between competitors in the mining industry when it comes to infrastructure for example. Obviously rising development costs make it difficult for any single company to undertake remote infrastructure development on its own, particularly when it comes to such things as ports and rail. Competitor collaboration obviously must not contravene any anti-trust laws.
What happens to collaboration and innovation during the business cycle, particularly in the mining sector, has intrigued me for some time now.

Once the business cycle turns and companies start to focus on increased efficiency, cost cutting, and generally trying to squeeze more value from assets, then one would expect that the imperative to collaborate should intensify, but why?

Firstly, and perhaps the most important reason is that along with the general reduction in capital expenditure, research budgets alongside other discretionary spending such as greenfield exploration for example are usually slashed. In the current downturn, global expenditure in the latter is expected to decrease to some 15%$, some 29% reduction. So companies that still have a mind to invest in research would be expected to ‘drive their research dollar’ further by leveraging their investment through collaboration.

Secondly, as a result of the restructuring that many companies undertake, a lot of experienced people are let go. There are fewer internal champions, and those that remain no doubt have other concerns in mind than championing research. Interestingly, one would expect that such companies would have a greater need for organisations like AMIRA to take the place of the dwindling internal expertise and indeed the diminishing ability to scan the technology and research space and keep them informed of opportunities. During tough times the imperative to innovate could be a matter of survival. This probably also applies to the joint-ventures, the partnership business models between explorers – it may be the only thing keeping some junior explorers alive at the moment.

It’s difficult to ascertain the degree of collaboration in the mining industry and it is also difficult to work out the extent of intra and inter-group collaboration between the various large and small producers, explorers and suppliers at the best of times.

Indeed I need to be careful not to generalise too much as even now not all companies are responding to the downturn in the same way or to the same degree as the majors.

The juniors have never been a significant source of research funding for AMIRA. There are obvious reasons for this but they have been indispensable in many research projects for providing access to the natural laboratories necessary to test or trial new technologies.

According to some commentators, productivity across labour and equipment in the mining industry has been on the decline for nearly a decade. So it’s difficult to see why companies cannot collaborate on key issues that will help to arrest this trend and improve long-term value without jeopardising their competitive position. There are indeed many areas that would be eminently suitable for collaboration that address productivity issues.

One such area is energy. Identifying areas and unit operations where energy consumption is higher than “the norm”, is the first step towards energy reduction. AMIRA project “P1126 Energy Efficiency Benchmarking” is designed to help companies understand where they stand relative to industry best practice. Another is maintenance. What can we learn from other industries, such as aviation, marine etc, which could help us significantly improve efficiencies and lower costs?

It is gratifying to see that quite a few of our larger members are now coming to AMIRA with research concepts that they are potentially willing to collaborate with their peers.

I encourage all our members, whether large or small, miners, explorers or suppliers to talk to us about their needs. AMIRA is well placed to help facilitate inter-group and intra-group collaboration between members.

We recognise for example that the needs of the majors may not align with the needs of the smaller companies or suppliers for that matter.

One final point, I read the following comment on one internet posting, regrettably I lost the reference, so my apologies to the author: “Collaboration sometimes thrives, but often fails--especially in difficult financial times or without grant funding”. I contend that despite the need for collaboration mounting during tough times, it nevertheless needs to be nurtured because if nothing else that is when jobs are at stake.

Innovation can be achieved through collaboration, in all its forms, and the new products and processes and indeed business models could help to reduce the jobs losses during downturns. Governments need to step up at these times to provide more support to ensure that collaboration is encouraged – it’s at these times that market failure is likely to be more common. Supporting high value collaborative research through organisations like AMIRA is one way of helping to achieve this. The mining industry is critical to Australia’s future prosperity as it is in many other countries that we operate in. We need to ensure that governments are not blinded by the so called super profits that companies were reporting at the height of the boom and recognise that they also have a role to play to encourage innovation through collaboration during the downtimes.

Joe Cucuzza

AMIRA receives CEEC Sponsor Seal of Distinction

AMIRA is pleased to launch its CEEC sponsor logo presented by CEEC in recognition of AMIRA’s ongoing support.

Sarah Boucaut, Executive Officer CEEC International Ltd said “AMIRA is leading change in the mining industry through support of CEEC. Accelerating the awareness of the benefits of alternative comminution processes provides companies with strategies to deliver shareholder value despite industry challenges.

Recognition of CEEC’s sponsors is well deserved, as with their company’s vision and support, progress is evident in the level of awareness of the benefits of comminution efficiency. The CEEC Seal of Distinction is granted only to CEEC sponsors and differentiates AMIRA International as forward thinking, acting for the broader industry good and a member of a select cohort of global mining leaders.”
AMIRA Low Grade Copper Program

The AMIRA International Low Grade Copper Program comprises a number of related projects aimed at significantly changing the economic viability of the large inventory of ore resources that are just below the economic cut-off grade for conventional processing. The projects within this program range from those with immediate operational application, to those with longer term industry-changing potential. Although each project has its own specific objective, there is considerable synergy between the various projects, and sponsors may benefit from supporting multiple projects within the program. While the program has an initial copper focus, the projects have significant application potential to other commodities including nickel, uranium and gold. Each project is briefly described.

Help Leach Scale-up for Liquid and Gas Dispersion

The aim of the project is to develop a robust heap leaching scale-up methodology, where laboratory-determinable parameters reliably translate into full-scale heap performance. The scale-up methodology will focus specifically on liquid and gas distribution, as these factors are most critical to improved heap leaching performance.

In many instances heap leaching is not an appropriate or viable treatment option for low grade ore, even when optimized for hydraulic and gas dispersion properties. Heap leaching is not effective for applications with inherent unfavourable hydraulic properties, where copper occurs mainly as chalcopyrite, or where extended heap leach times lead to high acid consumption. An important reason for low rates and recoveries in heap leaching is because solution access to most of the target mineral surfaces is via capillary diffusion rather than bulk solution flow. This results in solution chemistry gradient effects that preclude effective chalcopyrite leaching. Diffusion-related limitations can be overcome by using a saturated continuous leaching reactor in which coarse particles are minimally and intermittently mobilized (not agitated) to alter the pore space arrangement. This strategy eliminates the occurrence of stagnant pore spaces (and thus diffusion-controlled solution gradient effects) and facilitates high solution throughputs, improving control of the leach solution chemistry and increased metal recovery. The aim of the project is to develop a viable alternative option for low grade ore, based on high rate leaching kinetics (~two orders of magnitude greater than for heap leaching) in continuous coarse particle (3-6 mm) saturated leach reactors (new generation, vat-style reactors). Reactor development for this project will draw upon technology advances in dredging, slurry conveying and stirring, as well as thickener technologies.

In-Situ Fracture Stimulation and Leaching

Heap leaching and coarse particle continuous vat leaching, circumvent the high energy cost associated with milling, thereby reducing operating costs. However, neither of these methods circumvents mining costs, which along with milling are typically the main operating costs. For this reason, heap leaching and saturated coarse particle leaching, is most applicable to Brownfield low grade scenarios where the ore has already been mined (and mining costs have been expensed) as part of a higher grade mining operation.

Many low grade deposits, however, do not have a high-grade component. Such deposits can only be made economically viable if both the mining and milling costs are circumvented. In-situ leaching provides a potential option to achieve this objective.

The aim of this project is therefore, to enable viable in-situ fracture stimulation and leaching (ISFS&L) technology for suitable hard rock sulfides mineral deposits. In addition to circumventing mining and milling costs, the in-situ leaching also offers the potential to overcome the capital costs of pre-stripping and significantly reduce above-ground processing plant costs.

In recent years there have been significant technology developments in non-mineral industries that may be deployed, with suitable adaptation, for in-situ fracturing and leaching. Hydraulic fracture stimulation techniques have been developed to a high level of sophistication and maturity in the oil and gas industries. Similar fracture stimulation techniques are also used for hard rock fracturing in the mining industry as pre-treatment for block caving. The maturity of these methods provides the basis for adapting the technology for mineral in-situ leaching processes.
AMIRA Low Grade Copper Program

The project is designed to overcome the main hurdles to effective deployment of in-situ fracturing and leaching, which include:

- Solution containment and hydraulic management to prevent groundwater contamination.
- Ore permeability and the extent to which existing or induced fractures can effectively access and intercept target minerals - particularly relevant in the context of hard rock mineralization.
- The ability to leach target minerals for economically effective metal recovery.

The process, to be developed in the project, is referred to as In-Situ Fracture Stimulation and Leaching (ISFS&L) to emphasise the importance of fracture stimulation to access hard rock sulfides, as opposed to In-Situ Leaching (ISL) of existing porous/fractured material. Low grade copper sulfide deposits at <500 m depths are suggested for initial development of the technology. The target application would be geological formations in which sulfide minerals are present as late stage veins or in stratabound ore.

**Micro-Capsule Leaching**

Economically viable hydrometallurgical metal recovery from low grade ore is dependent upon two criteria: (1) effective recovery and (2) affordability. An important constraint for low grade ore processing is that high potency (effective) leaching reagents are often consumed by gangue mineral interaction, thereby precluding their use. This, in turn, results in the use of low potency leaching reagents and reactor methods, with poor metal extraction outcomes, particularly from low grade chalcopyrite ores.

In this project, micro-capsule technology is proposed as a means to overcome this constraint by facilitating selective interaction of lixiviants with valuable target minerals. Micro-capsule technology can be used to create optimal leaching conditions locally by encapsulating and presenting leaching agents selectively and directly to target minerals, with minimal gangue mineral interaction.

Conventional mineral processing already makes use of selective chemical interaction with sulfide minerals over gangue minerals, in the form of collectors. The most widely used example is the use of xanthate chemicals that selectively interact with sulfide minerals to render them hydrophobic, enabling effective mineral flotation. The proposed concept is that similar selectivity can be achieved through functionalising the outside of the micro-capsule wall with collector-like functional groups so that they selectively bind to valuable sulfide minerals.

Once delivered to the target sulfide mineral surface, the capsule discharges its lixiviant cargo in close proximity to the target mineral site. The cargo in the capsule can be tailored to initiate a leaching reaction, prevent passivation or disrupt already-formed passivation layers, deliver oxidants or provide local pH modification at target mineral surfaces.

The micro-capsule cargos can be designed either to improve conventional leaching methods (such as heap leaching) and chemistry or to facilitate leaching using unconventional solution chemistry conditions (e.g. in non-acidic bulk solutions). Micro-capsules may also be used to enhance coarse particle saturated leaching kinetics, or for effective metal recovery from in-situ leaching scenarios.

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**AMIRA 2012 - 2103 Annual Report**

AMIRA’s 2012 - 2013 Annual Report is now available on the AMIRA Website  

Sharing the Benefits
P1126 Energy Efficiency Benchmarking

The AMIRA “P1126 Energy Efficiency Benchmarking” project is designed to assist members in assessing the energy intensity of production across all mining projects and unit operations to identify opportunities for energy cost savings. The project aims to develop a new approach to energy benchmarking through the development of a relevant, normalised system that covers the whole mining activities.

The program has been developed with the assistance of The Coalition for Eco-Efficient Comminution (CEEC) following their roadmap workshop last year. The project will be conducted by AMIRA in collaboration with Energetics Pty Ltd who have significant experience and expertise in this area.

The program is planned to commence in the second half of 2013 and will be undertaken in 2 stages, the first is focussed on:

- the evaluation of available normalisation procedures,
- development of the model based on the normalisation methods and
- application of the model to two case studies.

In the 2nd Stage it is planned to develop and apply the tool:

- as a Web-based model for application by individual sites
- undertake the evaluation of all involved sites based upon
- a database of normalised energy efficiency data.

The output will be a confidential review of each site’s normalised efficiencies and a report outlining energy reduction opportunities.

This is a low cost project with the potential to benefit the majority of operating members.

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AMIRA: East meets West

On 11 September 2013, Joe Cucuzza and several AMIRA Program Managers, met with a government delegation from Yunnan province, led by Madam Wang, Director of Land Resources Bureau of LinCang City.

Yunnan is located in the southwest corner of China, and borders with Myanmar, Laos and Vietnam. This province is rich in natural resources, with its reserves of Aluminium, Lead, Zinc and Tin being the largest in China. There are also major reserves of Copper and Nickel. The 13 member delegation was comprised of government staff and engineers from various districts. Their purpose was to investigate the legal, environmental, and management systems of Australia, and the best practices within the mining industry outside of China.

Joe Cucuzza introduced the AMIRA business model to the Chinese delegation. This included the role of AMIRA, the value propositions of related parties, how AMIRA International creates value to the global mining industry as a not-for-profit organisation, and some brand flagship projects were briefly explained. He particularly emphasised the importance of collaboration across industry to address global challenges such as: declining ore grade, increasing production costs, and increasing pressure to reduce the industry’s environmental footprint and enhance its license to operate. He welcomed the possibility of Chinese companies participating in collaborative projects facilitated through AMIRA International, projects that offer great leverage, shared risk and costs, and benefits from research outcomes together with peers from around the globe. AMIRA Program Managers and the Chinese delegation discussed the requirements of local industries, how AMIRA manages IP issues and how we work.

The delegation was very interested in the AMIRA business model which does not exist in China at present, and expressed a desire to engage AMIRA for the effective bridging of mining companies and research excellencies.
West African Exploration Initiative ("WAXI")
L'Initiative d'Exploration Ouest Africaine

WAXI is an ambitious research and training program based on cooperation between most of the major stakeholders in the West African Minerals Sector. It is focused on the mineral potential of the West African Craton. WAXI’s overarching aims include:

- to enhance the exploration potential of the African Craton through an integrated program of research and data gathering into its "anatomy"
- to augment the capacity of local institutions to undertake this form of work.
- to help local Geological Surveys and Universities in the region in their role of providing pre-competitive data and information

The first two stages of WAXI have built up a dedicated team of researchers who combined to provide major syntheses of newly acquired and archival structural, geophysical and geochemical datasets to unravel the complex relationships between mineralisation, tectonics and surface processes in West Africa. They have also undertaken a major Capacity Building effort involving over 30 graduate students and 300 short course participants.

Stage 2 of WAXI, which ran from March 1st 2010 to May 2013, has just completed.

Achievements to date (WAXI 1 & 2):
- The founding of a collaborative international research and training network in the Stage 1 WAXI dedicated to better understanding the West African Craton
- An improved knowledge of the tectonic history and metallogeny of the craton
- 3D models of mineralised terranes and of the entire West African Craton
- New harmonised 1:500 000 integrated geophysical and geological maps of key zones
- New models for regolith and landform evolution
- 500 km Magnetotelluric Survey down to 300 km
- New geochronological data has been acquired
- The assembly of a 250Gb craton-wide GIS product bringing combining over 200 distinct themes, 50 of which are unique to the WAXI project
- An Atlas of West African Ore Deposits
- Delivering 15 training courses covering Geophysics, Geochemistry, Field and Mine Mapping, Exploration Targeting and Research Management.

Stage 3 will build further upon this unique public-private collaboration by extending the geographic, tectonic and geochronological scope to cover the entire West African Craton.

A four year program is planned for WAXI Stage 3, expecting to commence in the first quarter of 2014. In consultation with existing and potential new sponsors a program for Stage 3 has been designed:

- Theme 1: Regional Field-Based Studies
- Theme 2: Mineralising Systems: a multi-commodity focus
- Theme 3: Craton-Scale Geophysics
- Theme 4: Surface Processes
- Theme 5: Capacity Building

Sponsors for Stage 3 (WAXI 3, P934B) are currently being sought.

For further information please contact:

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and visit

AMIRA International supports the AusIMM’s initiative for professional development through its events as listed.

AusIMM Events

For more information on conferences please contact the events department on +61 3 9658 6120 or email conference@ausimm.com.au

Sharing the Benefits
Data Metallogenica Website

AMIRA has just released the new Data Metallogenica website to the 53 sponsors of the P1040 project.


Data Metallogenica is the global encyclopaedia of ore deposits being built for the minerals industry by AMIRA International. The initial part of DM was based around a major physical collection of ores, alteration, host rocks and regolith from thousands of deposits of all kinds from around the world. This was initially collated by Peter and Sarka Laznicka, and acquired by AMIRA in 1999 when the entire collection was expanded to over 60,000 samples and photographed at high quality and placed on the web (via the P554 and P554A projects). While the early support focus has been on geoscience and exploration technical documents, there are increasing amounts of mining, mineral processing and environmental information being added to the website. The current coverage is increasing all the time through P1040.

The new website is valuable because, apart from a large amount of often unique data on about 4000 global deposits, there are now better and more powerful facilities for search capacity and map plotting. In addition, there is a translation option for the whole website as well as most information files (to any language including all European and Scandinavian languages, Russian, Chinese, Arabic, Farsi, Hindi, Swahili etc) for training, education and reference. DM is also a permanent repository for much transient or fragile information on ore deposits, and will later include a wiki-option so all can then contribute their own information to this community database.

The new website will soon be made available to all other DM subscribers. All users are encouraged to regularly browse the site for new additions of information, and indeed even non-subscribers can investigate the site via a Free Search option. New sponsors to the P1040 project are welcome, and will allow even more work to be done on DM in the immediate future.

For further information please contact:

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New Staff

AMIRA recently welcomed Yen Woo on a part time basis as the Assistant Accountant.

Yen graduated from Victoria University with a Business Degree majoring in Accounting.

She has many years of experience across a variety of industries.

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AMIRA P260 Silver Jubilee
25 Years of Benefits to Minerals Flotation

ABSTRACT

The AMIRA International P260 series of flotation projects was initiated in 1988 at the University of South Australia, and was sponsored by 17 companies. The major focus of P260 has been all aspects of base metal sulphide flotation, expanding to gold, and more recently to phosphate and other value ores.

A key feature of the research has been a deep understanding of pulp and surface chemistry under processing conditions, as well as the mechanisms underpinning the sub-processes of bubble-particle collision, attachment and detachment in flotation. Research comprises a combination of physical chemistry and engineering, aiming at optimum value recovery and selectivity. Copper flotation in a variety of ore types and deposits (Cu/Pb/Zn, Cu/Au, Cu/Mo, etc.) has been a constant theme in the project, encompassing research for operations on four continents.

Now in its 25th year, AMIRA P260 was recently evaluated by an independent consultant, RMDSTEM, as having returned over $1 billion to industry over the project life. This represents a 22:1 return on investment to the sector.

Please refer to the link for a paper written by M Zanin, W Skinner, The Wark and S Grano, IMER whereby they present some case studies of Cu flotation research in the P260 project, together with highlights of research tools and knowledge development contributed to industry.

AMIRA P260 Silver Jubilee

Workshop Announcement
Managing R & D and Innovation in the Process Industries

Managing R&D and Innovation in the Process Industries
Date: 11 December 2013
Time: 2.00 pm to 6.00 pm
Venue: Melbourne Convention and Exhibition Centre.

This workshop is being held as part of the 6th ISPIM Innovation Symposium to be held in Melbourne from 8-11 December, 2013 (http://symposium.ispim.org).

This workshop will be a facilitated dialogue between R&D Managers, policy-makers and researchers focussing on the challenges facing the process industries with respect to R&D and Innovation Management. The workshop is organised jointly by the Department of Management, Monash University (Australia) and the Centre for Innovation, Technology and Entrepreneurship, Grenoble Ecole de Management (France).

Process Industries (spanning over several industrial sectors including minerals & metals, pulp & paper, food & beverages, chemicals & petrochemicals and pharmaceuticals) constitute a substantial part of all manufacturing industry worldwide. There are indeed some key differences between the management of R&D and innovation in the Process Industries and in other manufacturing sectors.

Moreover, there are also fundamental similarities in the management of product and process innovation among companies in different sectors of the Process Industries. Companies in the Process Industries may focus on being efficient commodity producers or on developing and marketing products and services with more advanced functionality and performance specifications. In both cases, the management of R&D and innovation is critical to sustainable corporate performance.

We invite participation from R&D Managers, government officials, industry associations and researchers to take part to identify and discuss relevant issues and help set future direction for both research and practice in the management of R&D and innovation in the process industries.

If you would like to participate, please contact Professor Amrik Sohal, Monash University (see details below).

Chairman and Co-Chairman of the workshop are:
Professor Amrik Sohal, Department of Management, Monash University, Australia.
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