

SAIMM Base Metals Conference, Namibia, July 2007

THE MINERALS INDUSTRY AND SYNDICATED RESEARCH

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Abstract

The minerals Industry carries out over US\$ 2 billion of R&D annually. The R&D is performed at three levels – in house research facilities; on a one-on-one basis with a research provider; as syndicated (collaborative) research.

The key to a successful R&D programme is project selection. It is suggested that at this time of “bounty” for the minerals industry the research portfolio should contain some “blue sky” but potentially long term significantly beneficial projects. This said, the projects should align the technical concepts with the business imperatives. AMIRA has found the “Road Map” concept has assisted in defining areas for R&D. Examples of this methodology using a Copper Road Map developed by AMIRA for the copper producers operating in South America is presented.

The benefits derived from syndicated research are also discussed.

Minerals Industry Research

In a study commissioned by AMIRA in 2000 it was determined that US\$ 1.48 billion was spent on Minerals Industry R&D. With the present improved metal prices, this figure has no doubt increased beyond US\$ 2 billion annually. The precise figure is not easy to determine because of national differences in the way it is reported.

This research is carried out in three ways.

Internal Research, carried out at a company’s own research facilities, is the biggest category, accounting for around 75 per cent of all company expenditure. The Intellectual Property (IP) is owned by the company and the research is aimed to give a critical advantage over its competitors.

External Research accounts for the other 25 per cent. This is performed in two ways. One-on-one, where a company deals directly with a research provider, be it a university or government research laboratory. The company may not own the IP, but will control it. Such work might also be done with a supplier, who retains or shares the IP. The bulk of external research – estimated to be around 85 per cent -- is conducted in this way.

Collaborative or Syndicated Research, represents the remaining 15 per cent of external research, where the IP is held by the researchers and the sponsoring companies have perpetual royalty-free rights to project outcomes. In this model risks and costs are shared and it is this area that AMIRA International operates. The leverage on the money spent on such projects is substantial. For example, an independent study found that the successive versions of Project P266 on research into improving thickener technology had returned the sponsoring companies around US\$ 240 million in direct benefits over the 10 years to 2005 for an outlay of under US\$10 million and it is still delivering further benefits. The returns on the longest running project P9, which develops models and simulations for mineral processing operations, are greater but because of the number of companies involved – it has more than 30 sponsors - and the variety of uses to which the techniques have been put, accurate calculation is difficult. However, the enthusiasm of companies to support continued extensions of the research over more than four decades suggests it is significant.

Advances in the minerals Industry are mostly incremental, thus making it ideal for syndicated research. The main benefit depends on how the research developments are applied and on how quickly one company can capitalize on this over another.

Real Innovative Research/Portfolio Selection

Most of the research is the development part of R&D typically leading to incremental improvements and application of technologies. What of real innovative research? Professor RE Robinson in his Journal comment in the October 2006 issue of the Journal of the Southern African Institute of Mining and Metallurgy (SAIMM) ⁽¹⁾ suggested that the selection of a research portfolio is likened to a share portfolio in an investment company, where invariably it is recommended that one spreads the risk over a range of shares from high risk to low risk. This he admits is easier to do for shares with accepted criteria like dividend yields and earnings per share. Although uncertainties are greater in R&D projects, a similar analysis can be done using critical experiments, critical path analysis and probability based on cost/benefit analysis. Another important consideration is that the ‘Research and evaluation Team’ must comprise far more than a group of creative research ‘boffins’. It must include hard-headed pragmatists who can distinguish competence from wishful thinking and with experience in feasibility and cost evaluations. One also needs specialists in negotiating contracts with customers and with an understanding of markets and competitors. Professor Robinson is indeed correct. But it appears, at least in South Africa, that little formal assessment of research portfolios is undertaken.

In a paper ⁽²⁾ a Team from the Department of Engineering and Technology Management of the University of Pretoria investigated the current practice of project portfolio selection in R&D of the South African Minerals Industry and concluded that no formal methods were used to decide upon the R&D project portfolio. Companies surveyed explained that

they do not use any formal methods due to the complexity of their business and the high uncertainty involved.

The question still remains; how does one select a winner? If this were known we would all be at the Races! Even so, the selection of low risk projects to counter high risk is a sound principle. Surely now, while the industry is generating large profits, is the time to support higher risk projects that, if successful, will have tremendous benefits in years to come by enabling companies to handle low metal prices again and even to ensure survival.

Therefore, R&D portfolios should be re-assessed to determine how they align with business imperatives and, where appropriate, revised to include some innovative “blue sky” projects that might deliver huge benefits in the future.

Government leverage

Governments recognise the need for research in their countries to drive industrial development. South Africa is no exception, where the examples of Korea and Finland, who have developed high technological industries from a farming/mining back ground, are recognised. They have noted that syndicated research provides projects that can generate the most value for their supporters. This is demonstrated in a number of AMIRA projects where the Technology and Human Resources for Industry Programme (THRIP) in South Africa, the National Science Energy Research Council (NSERC) in Canada, and the Australian Research Council (ARC) Linkage Project and Cooperative Research Centres have supplied matching funds.

In South Africa, the new 150% tax rebate for research has provided yet another driver for R&D.

Over the last 10 years there has been a change in the targets for research funds by both the South African Government and the minerals industry. The “super creative professor”, recognised as the A-grade researcher through the National Research Foundation (NRF) as an individual, is replaced by the “collaborative team” led by the A-grade researcher. This team will have to have links to other local and overseas researchers and, in South Africa, the team needs to include previously disadvantaged individuals, whose talents can be developed.

Development time

In the minerals industry, research and the practical development of the outcomes is a long term commitment. Ten to Fifteen years seems to be the normal time to get from the laboratory to implementation. A good question is why does this take so long? Companies in the high-tech (pharmaceuticals, IT) business would be out of business very quickly if they followed this conservative approach. Two ready answers are the large risk involved in failure and the conservative nature of the Industry, no doubt driven by the former.

There have been some failures. But why reflect on those when there have been great successes. SX/EW for copper recovery, blast hole stoping, Ausmelt, Isamill and HPGRs.

Syndicated Research

The list of potential areas of research is huge and no company – not even the giants like Anglo American, BHPBilliton and Rio Tinto, nor their international rivals – could ever develop what is required. Thus real collaborative efforts are needed.

The greatest example of syndicated research in the minerals industry must be the development of the Uranium Industry in South Africa that led to new technology and the building 17 plants in the country between 1946 and 1952. This work involved the Government Metallurgical Laboratories (the forerunner of Mintek) as well as a number of overseas organizations including the Massachusetts Institute of Technology, Battelle Memorial Institute, the Argonne National laboratory, the National Chemical laboratory in the UK, the Department of mines in Ottawa, and the Atomic Research Authorities of the USA and the UK. The first full scale plant was started within 3 years of the project commencement. The project was supported through the Chamber of Mines and all the Mining houses seconded engineers and scientist from all disciplines to work on the project. The project was a national effort supported and encouraged by Government⁽³⁾. What could the minerals industry achieve, if even a small part of such resources was applied to the current challenges of energy reduction and water consumption or even deep level mining?

The AMIRA flagship P9 project “Optimisation of Mineral Processing through Modelling and Simulation” celebrates its 45th year in June 2007. This project is researched in South Africa (UCT), Australia (JKMRC) and Canada (McGill). The new extension project (P9O) is looking at further researchers in Turkey and Australia and possibly Latin America, depending on Sponsors. The project is supported by 33 companies around the world. It is interesting to reflect on how the same pieces of equipment, for example cyclones, were modelled in the early years of the project (Lynch & Rao) and still form part of the current and proposed research. The new tools of CFD, DEM and tomography have opened up insights and models that would make Lynch and Rao green with envy.

The human talent bank that flows from syndicated research should not be underestimated. In the period 1990 to 2004, some 430 students and 65 post-doctoral researchers were involved in AMIRA-led university-based research projects. Of the students, 261 were pursuing a PhD⁽⁴⁾.

How to generate new ideas?

One of the challenges that face researchers and industry is how to develop new ideas. There are many traditional areas of interest and known challenges. They keep being brought up in reviews of research needs, including such topics as energy reduction and water usage, to name the two that currently make the top of the list. But what are the

research topics and programmes that will bring about meaningful improvement and change? How can novel ideas be generated and brought into well structured research programmes?

Road Maps

One possible way of developing ideas in a structured manner is the Technology Road Map. These have been used over the years in a number of Industries. A Technology Roadmap is a strategic plan that contains a focused, goal-based R&D agenda that can be pursued by both individual companies and collaborative partnerships within an industry. An Industry, as defined here may be sectors of the minerals industry for example; copper, zinc, hydrometallurgy or pyrometallurgy.

Some key elements of Roadmaps are:

- Industry developed strategic vision for its future
- Well defined scope to achieve technology goals contributing to this vision
- An Industry endorsed path to achieve these goals, built on a consensus of key priorities
- Research and development plans to achieve goals
- Focus on pre-competitive collaborative partnerships and an emphasis on attracting funding for this type of R&D
- A framework around which companies can develop their internal competitive technologies and R&D programs, and
- A strongly proactive plan to implement the recommendations

A well developed Roadmap will, in addition:

- Provide a consensus on future technologies needs
- Identify major barriers/constraints to technology development
- Guide future collaborative and in-house R&D investment
- Reduce the financial and technical risk through collaboration
- Generate opportunities by virtue of the increased financial resources and collaboration that can be brought to bear

Road Map Structure

A Steering Committee is formed to develop goals for the sector/topic over the next 10 to 15 years. The trends, drivers and challenges are determined, with the economic, social and political forces shaping the sector/topic in the future and the challenges and opportunities they create. The R&D needed to respond to the trends and challenges and achieve the goals, are recognised and organised into a number of focus areas. Urgent needs are deemed priorities, representing prime opportunities for collaborative research. The activities that the sector/topic representatives will have to conduct to implement the priorities of the roadmap are determined.

Figure 1 shows an outcome of the Copper Technology Roadmap supported by the Copper Industry, primarily in South America.

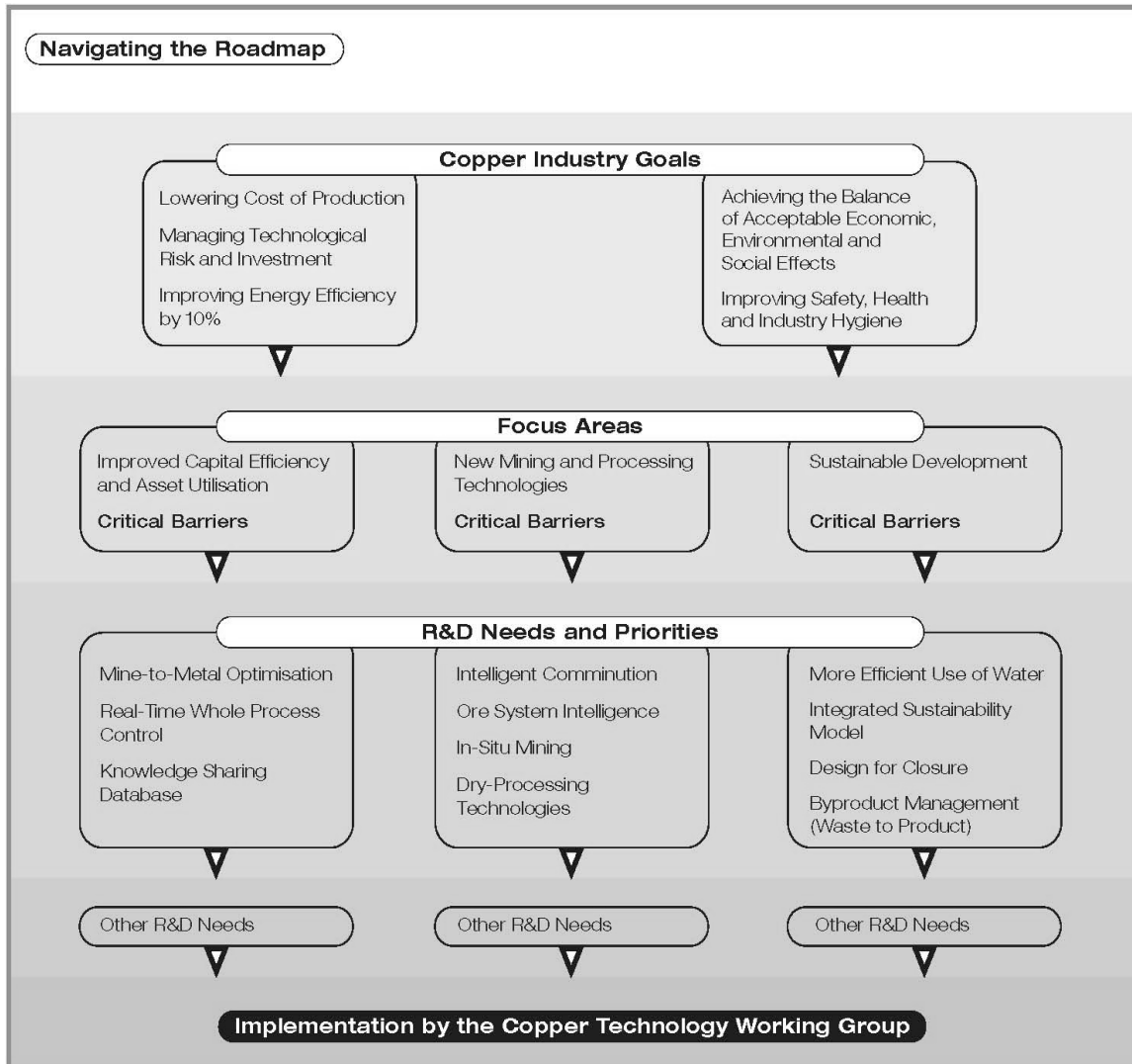


Figure 1 Copper Technology Roadmap⁽⁵⁾

Conclusions

At this time of “bounty” for the minerals industry the research portfolio of companies should contain some “blue sky” but potentially long term significantly beneficial projects.

Research portfolios need to be balanced so that high risk projects are countered by lower risk project and aligned with technical needs and business imperatives.

The benefits of collaborative/syndicated research have been demonstrated to be very large indeed, with the leverage of funds from industry and governments. You do not have to own the technology, but you need to have access to it – and to have been sufficiently involved in its development to be sure that when it comes to the critical point of implementation, your in-house people are up to speed.

Novel ways to generate new ideas are required to move away from “motherhood” statements of research needs to create real advancements on topics that are currently challenging the Industry.

The roadmap strategy is suggested as one possibility.

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