

**Paper submitted to AJM for presentation at the
4th Annual Global Mineral Sands Exploration and Investment Conference**

Melbourne, March 2003

**VALUE ADDING – PARTNERING FOR PROFIT WITH THE
LATEST TECHNOLOGIES**

R.G. Richards¹ and G. Zille²

¹ Business Development Manager – International, Roche Mining (MT)

² General Manager, Roche Mining (MT)

Roche Mining (MT)

Evans Deakin Pty Ltd ABN 92 000 002 031
11 Elysium Road
Carrara Queensland 4211
PO Box 2569
Nerang Mail Centre QLD 4211
Australia
Tel: 61 7 5569 1300
Fax: 61 7 5525 3810
Email: sales@roche.com.au
Internet: www.mdmintec.com.au

INTRODUCTION

Background

The last decade of the 20th century saw increasing demands for better profit and returns from the investment community. Moving into 2003, the weakening economies and poor results from many corporate players has caused investors to be no less demanding as they struggle to protect the declining value of their portfolios.

Producers in the mineral sands industry continue to be faced with decreasing ore grades, increasing complexity of mineral suites, more difficult mining conditions, and weaker and more competitive markets. In this squeeze, the mining companies require greater productivity and efficiencies to improve profitability and returns.

Outsourcing of non-core elements of the business is a growing phenomenon and, if approached correctly, brings significant benefits; not only in financial terms. A key criterion for the success of an outsourcing programme is the development of sound partnering relationships, with common goals operating on a highly cooperative win/win basis.

Through partnering, a mining company has the opportunity to lever off experts in the industry to drive improvements through innovation and to achieve improved qualities of products and processes by accessing alternative ideas.

The key to managing a successful partnering relationship is the development of cross company teams with open communication and mutual trust. Effective partnering requires the supplier to fully understand the broader goals of the producer, all the limiting issues and the economic value of the alternatives being offered.

Roche Mining (MT)

Roche Mining (MT) has evolved over 60 years from a minor division of a mineral sands mining company (*Mineral Deposits Limited*) to a world leader in supply of technology and know-how to the mineral sands industry. This evolution has resulted from intimate partnering with *Roche Mining (MT)*'s clientele; a cultural phenomenon derived from the business's formation. In the early years the mutual survival of *Mineral Deposits Limited*'s two business areas (mining and technology) necessitated a close working and mutually accepting cooperative arrangement. Whilst this character is retained by *Roche Mining (MT)*, recent changes to the ownership has broadened the value-adding partnering potential now offered.

The wider capabilities of the *Roche Mining* group extends the traditional services to include contract mining, EPCM contracting, build, own and operate and BOOT arrangements for process plants. These options are all solidly backed by *Roche*'s corporate owner, *Downer EDI*, an ASX 150 company, whose focus for future growth lies in the provision of value-adding through services and asset management. This philosophy is being implemented in the resources sector through *Downer EDI*'s largest division, *Roche Mining*.

Business Environment

Historically, the mineral sands industry involved a few mining companies who grew their knowledge and expertise through their own personnel and in association with key technology suppliers. As a consequence, the mineral sands industry has been a "small world" where most of the players are known to one another and investment decisions have been based on internal evaluations and financing.

In more recent years, there have been a number of new entrants into the industry. Financing of projects has generally involved outside financiers in investment decisions. This, together with more rigorous technical and financial auditing brought about by demands of heightened scrutiny by the investor community, has forced mining groups to accommodate a more prescriptive role for financiers in their projects.

Risk-averse financiers, who often have no technical understanding, have created much work for consultants, and have effectively placed constraints on the implementation of technological advancements in the industry.

Furthermore, the movement towards EPC-type contracting, particularly by under-resourced minors, has had a negative impact on the implementation of technological advancements in new mineral sands projects. The contracting environment encourages supplier selection for services or product to be based on price without due consideration to performance, quality and after-sales service. Suppliers are barred from partnering with the producer, sterilising the golden opportunity to achieve partnering benefits.

Mineral Sands Industry Peculiarities

The mineral sands industry is somewhat different to most other minerals industries in that each project requires specific process design to meet specific ore-body peculiarities. In contrast to coal preparation for example, where a complete washing plant can be designed from fundamental feed characterisation and product specification data only, the design of a mineral sand separation plant necessitates thorough laboratory and pilot-scale testwork. Only in this way can the process design be optimised to guarantee the generation of products consistently to specification. This process design invariably involves a complex multi-stage flowsheet.

Furthermore, process designs are becoming more challenging as ore-bodies become more complex, grades diminish, product specifications become more stringent and project viability less easy to achieve.

These demands can often only be effectively addressed through a close working relationship between the technology supplier and the prospect developer; the start of a partnering process. This relationship can lead to a joint R&D effort to create specific technical solutions peculiar to the ore body. In this way leading technology suppliers become “Process Solution Providers” rather than simply equipment suppliers. This “partnering” relationship allows the producer to tap into external expertise and the latest innovations in technology that is often not known to them.

With many investment decisions being controlled by the financial sector, and their requirement for certainty on process technology, there is growing demand on reputable technology suppliers, with substantial backing, to accept technical risk by way of process guarantees. Such risk can only realistically be accepted by “Process Solution Providers”. It is suggested that in the complex operational environment that exists in the mineral sands industry, guarantees from other than a reputable solution provider who has been intimately involved in the original testwork, process and engineering design would carry an unacceptable level of risk to financiers. The realistic approach to minimise technical risk is for supplier and producer to work in partnership to ensure the most cost effective and technically competent solution. This will ensure that financier-sponsored technical auditing will be expedited and that all parties can look forward to a successful outcome.

TECHNOLOGICAL DEVELOPMENTS

Historical Developments

The technological developments that have been part of the evolution of the mineral sands industry have generally resulted from survival needs.

The age-old adage “Necessity is the Mother of Invention” could well be considered appropriate to the changes that have occurred as a result of needs associated with changing ore characteristics and production cost pressures. The early significant technological developments in the mineral sands industry resulted from the need to economically mine and process ores of progressively decreasing grades. These pressures entrenched the use of low cost dredge mining and high throughput floating concentrator plants. With mining and primary processing costs of typically <\$2 per tonne of ore mined for a large (3,000t/h) operation, the mineral sands industry is considered to have one of the lowest extraction costs in the mining sector.

Recent Advances

The suite of processing machines utilised in almost every operation in mineral sands plants consists of various combinations of screening and classification systems, wet gravity concentrators (spiral separators), magnetic separators (wet and dry, low and high intensity, permanent and electro magnetic systems), and electrostatic separators.

Recent significant technological development programmes have focused on the need to process more difficult-to-treat ores with characteristics such as high slimes levels, finely-sized valuable minerals, and more complex heavy mineral suites. Solutions have come from improvements in operational systems, efficiency gains in specific separation capabilities, or a combination of the two.

Some recent examples of the cooperative development and implementation of technological advances in which *Roche Mining(MT)* has partnered with clients in the minerals sands industry are detailed below.

MG5F Spiral Separator

The MG5F model spiral separator was developed in cooperation with a major international mineral sands producer. Development work identified an ingenious method of removing a rejectable tailings fraction part way down the spiral trough, thereby significantly improving the overall recovery of valuable heavy minerals. Use of this new model spiral is estimated to have increased mineral recoveries by 2% – 3%, generating additional revenue in excess of \$4.0 million per annum; a significant return for a total net investment of less than \$350,000.

MG7S Spiral

The MG7S spiral separator was developed in cooperation with a major Australian mineral sands miner. The challenge was to provide equivalent metallurgical performance to the MG4 spiral (the benchmark for rougher duties) whilst splitting the tailings fraction into two streams to simplify the operational requirements for tailings disposal. The two tailings streams required were:

- a high sand / low water stream; and
- a high water / low sand stream.

The development work involved close cooperative evaluation of several prototype machines developed by *Roche Mining (MT)* and optimisation of the design. This culminated in the supply of 1,728 spiral troughs which replaced the existing model spiral separators. The consequential savings in energy and reduction in water management costs associated with tailings disposal were significant. The energy savings alone amounted to \$0.5m over the life of the project. The marginal investment in hardware and R&D to produce these benefits was approximately \$300,000.

This success has since been progressed further with an innovation resulting in further improvements to tailings dewatering, by introducing recently developed hydrocyclone systems. Results from this initiative by *Roche Mining (MT)* and successful partnering with the client have seen a synergistic outcome.

Carrara High Tension Electrostatic Separator

Electrostatic separation systems remained largely unchanged for over thirty years from the late 1960's. The development and introduction of the *Carrara* high-tension electrostatic separator has resulted in significant separation efficiency improvements and major economies in dry mineral separation plant circuits.

A study completed for a prospective new operation has shown that benefits can be achieved in capital costs, circuit simplification and operating expenses. More than 10% of the capital cost of a 65t/h mineral separation plant can be saved by using the *Carrara* HTR machine in place of conventional high tension roll units.

The number of processing stages is reduced from 23 to 17, and there is a 55% reduction in the total number of installed machines. The new technology also impacts on the building size with a reduction of 36% expected.

A significant spin-off for existing HTR owners is the development of a retrofit kit which will provide similar benefits without having to replace the complete unit.

Process Change

Studies completed for an ilmenite producer have demonstrated that major operational performance benefits would be gained through an innovative change in the process design. By replacing the existing gravity circuit of cone concentrators and obsolete model spiral separators with a combination of recent model spiral separators and wet high intensity magnetic separators, recoveries can be improved by >5%, with attendant reductions in operating costs. The capital payback period for the plant upgrade incorporating the proposed process design change is estimated to be 6-9 months.

The recommended modifications and benefits to be gained only became evident through extensive testwork and evaluation of a number of process options.

Process Audits

At the request of an Australian mineral sands producer, an audit was undertaken of their wet processing plant. This identified an area in the process where spiral separator performance was less than optimum. Subsequent on-site testwork established that changing the existing cleaner stage wash water spirals to recently developed MG6.3 model spirals would significantly improve plant performance. Apart from increasing overall rutile recovery by ~1%, other potential operational benefits included reduced plant water use, better metallurgical control and simplified circuitry.

The investment programme to replace the spirals in the plant that followed proceeded on the basis of the incremental revenue associated with improved rutile recovery with a payback period of approximately 6 months.

New Concepts in Wet Gravity Plant Design

Studies on a conceptual basis undertaken by *Roche Mining (MT)* incorporate new plant arrangements using new model spiral separators. These studies have established that significant Capex savings can be achieved by layouts which achieve a smaller footprint of the processing plant and reduced operational complexity. This outcome results from a solution sought by thinking “outside the square”, as innovations require a departure from the way traditional equipment is configured.

These innovative concepts indicate that the potential for smaller, better configured wet gravity processing plants may offer savings greater than 15% on Capex costs, with significant reductions in Opex expenses.

The Future

Plant design will move towards a greater degree of automation in the future. This will include remote control systems and in-stream analysis and feedback control. In this regard, a remote controlled spiral splitter actuation system developed by *Roche Mining (MT)* is currently under field trials.

Other significant technological advances from *Roche Mining (MT)* that have the potential for significant impact on the mineral sands industry include the HC and EP model spirals (both of which will be launched in 2003) and the improved high capacity model J1800 Kelsey jig, which is unparalleled in its capabilities to efficiently separate alumino-silicate minerals from zircon.

Competing Technologies

The mineral sands industry is a “small world”, with a limited number of global technology suppliers. These typically provide items of equipment, process design or engineering design. Worldwide there are three significant suppliers of spiral separators and several suppliers of electrostatic separators and magnetic separators. Few suppliers lead with innovative developments. Even fewer have the capability to take a broad operational view of the impact of technological developments and thence be effective in working with mining companies to jointly achieve improvements to equipment, processes and systems that return real value to all stake-holders.

Roche Mining (MT) supplies most items of process equipment necessary for a successful solution for mineral sands processing. The supply of equipment is complemented by metallurgical testwork, process and engineering design, training and commissioning services. *Roche Mining (MT)* undertakes significant R&D work, spending 3% of its profits on technology development annually.

PARTNERING

Ingredients for Successful Partnering

The key to achieve real value from technological development is to bring together the best skills and ideas to address specific technical challenges. This usually means partnering of a producer and technology supplier. To be effective there needs to be a mutual recognition of the value of contributions from each party and the adoption of common goals. Furthermore, there is a need for mutual trust and transparency in revealing confidential data on developmental costs and projected returns. Moreover, the most equitable liaisons will share the gains from the combined effort.

A partnering arrangement with a well-chosen entity, if properly structured, should provide producers with significant benefits. It will:

- Enable growth through the introduction of innovative ideas
- Provide versatility to the resource needs
- Share the risks and rewards
- Improve the quality of technology and the service being provided
- Leverage off experts in the industry
- Allow a focus on core competencies

The best solutions arise when a holistic view is taken of activities. For example, there is little value in developing a process improvement when the resultant proposed change would increase plant water demand, without considering the availability and cost of the additional water supply and/or the consequences for the downstream processes and the overall water management system.

It follows from the above that parties in any partnering arrangement should concentrate their resources on what each party does best. The strength of any partnering arrangement will be further enhanced as each party ensures a growing level of expertise in its organisation by attracting and retaining appropriately skilled and experienced personnel in developing its own core competencies.

Partnering between mine operators and technology suppliers to develop and implement technological advances provide the greatest potential of value adding for mineral sands producers. The added value can be by way of reduced capital and / or operating costs, increased productivity or improved product qualities.

Barriers / Traps to Effective Partnering

Barriers to effective partnering and traps that may befall parties attempting to reach a partnering agreement include the following:

Price-Based Decisions – A common fault in investment decisions is often a lack of understanding or a reluctance to accept and quantify, the value of quality associated with performance, longevity and backup service. Such short-term thinking with false economics is often the case when a third party takes procurement decisions.

Value Identification – A supplier, whose philosophy is to ensure quality and fit-for-purpose supply, may have its standards compromised through price-based procurement practices. A relaxation of standards forced on suppliers will result in an erosion of value in the marketplace over time.

Unwilling Openness – Clear objectives, realistic openness on costs and the subsequent benefits of the implementation of technological developments are critical to successful partnering. The potential gains for the end-user and the willingness to share these gains with the supplier/s will not only ensure a successful outcome, but incentivise the supplier to maximise the return.

Third Parties Without Buy-In – Third parties who have nothing more to gain than to elevate their own position should be excluded from a partnering relationship. Consultants in advisory roles can be dysfunctional and non-productive, with comments often ill-conceived or based on a shallowness of understanding of the development and implementation process. There can be no stronger team than that which has worked together to produce a technical solution for common benefit.

Cultural Pride – Discounting the value of contributions from one party by another party may be a result of cultural pride, through a reluctance to accept that there is a lack of expertise in an organisation or that another organisation may have more to offer in a particular field of expertise. Such cultural pride is counter-productive to effective partnering.

Control Loss Fear – Over-concern about the lack of control or loss of proprietary knowledge can lead to less open communication between parties, and will inevitably weaken a partnering arrangement.

IP Ownership – The ownership and control of intellectual property derived from or pertaining to technological advancements is an important issue that should be dealt with in the early stages of any partnering arrangement.

Confidentiality – The need to ensure confidentiality on critical and sensitive shared information, and the willingness to trust the partner is an essential element of any partnering agreement.

FUTURE CHALLENGES

Ongoing R&D effort to improve mineral processing hardware and process systems for the mineral sands industry must continue. Only this will ensure that solutions will be found to future process challenges presented by more difficult-to-treat ores. The key to promoting this effort is the willingness of mining companies to adequately reward suppliers for the added value derived from improved separation performance resulting from continuing R&D.

It is clear that astute partnering for the development and implementation of technological advances provides the greatest potential to add value for mineral sand producers. The most effective R&D happens in response to users' needs. Sharing these needs with solution providers will generate the best results in answering any technical challenge.

The increasing involvement of financiers in the decision-making process for new mineral sands projects means that technical risk (generally outside a financier's realm) is becoming more significant for such projects. The innate conservatism of risk-averse financiers (and their technical advisers) is a major constraint to the introduction of new technology. It follows that perhaps the greatest challenge is to convince the financiers that innovations achieved through partnering carry relatively low risk.