# 16th Annual General Meeting of the

# Society of Mining Professors

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## *Research Co-operation in Mining*

## *A Rio Tinto view of collaborative research*

## *in Europe and the World*

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## Abstract

Rio Tinto is a leading multi-mineral mining company based in the UK but with operations around the world. Through its Office of the Chief Technologist, Rio Tinto has had a long-standing collaborative research philosophy and is engaged in developing a global external research programme. The company priorities are the health and safety of its employees and neighbours, return of value to shareholders, sustainability and low environmental impact. Many processes in the mining industry tend to have relatively low efficiencies of separation and high energy and other costs and a reputation for generation of large amounts of waste and surface damage. The mine of the future will make more efficient use of ores, energy and of land, with minimal surface disturbance so that land can easily return to sustainable and beneficial use after mining. Far reaching innovation is required to meet the challenge, necessitating a collaborative approach to research.

## Introduction

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I am honoured to be invited to this meeting and delighted to address you on a topic that has taken me on a fascinating journey over the past decade or so – indeed my company has been travelling this way for over 40 years. My aim is to present a realistic approach to research with great potential for successful application in the mining industry. We have proved it works and I hope to encourage you to join in – the very fact that you belong to the Society of Mining Professors – I note that your constitution mentions co-operative research - and are present at this meeting shows a willingness to consider this.

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I have divided the presentation into three main sections:-

1. Qualifications – what right has Rio Tinto to lecture you?
2. The Challenge – a vision of the mine of the future
3. Collaboration – an approach which could deliver

## Qualifications

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Rio Tinto is a leading multi-mineral mining company based in the UK but with operations around the world with a turnover of US$11.76 billion in 2003.
Rio Tinto (www.riotinto.com) produces aluminium, coal, copper, diamonds, gold, industrial minerals, iron ore and uranium on significant scales from operations in Australasia, North and South America, South Africa and Europe.

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Mining operations are managed within six global product groups– aluminium, copper, diamonds, energy, industrial minerals and iron ore. There are two global service groups – Exploration and Technology. I must emphasise that our approach is global, using a number of local offices around the world.

Rio Tinto's strategy is to concentrate on large, high grade, low cost mines in order to return high value over the long term to its shareholders by supplying raw materials demanded by our global society. The company sets high standards for the health and safety of its employees and our neighbours. It has embraced the concepts of sustainability and wants to be welcome in the surrounding society. A very great deal of attention is paid to safe operation, minimising environmental impacts and working beneficially with the local society.

Rio Tinto and its pre-cursors can claim to have practiced a collaborative strategy for a long time, with AMIRA in Australia well over 40 years ago and then as a founder member of MIRO in the UK in 1974. Both are non profit making organisations set up and supervised by the industry to develop and manage pre-competitive R&D. CAMIRO is a similar organisation in Canada. Whilst Rio Tinto is a founder member and major player in AMIRA and MIRO activities, many of the other companies participate in this collaborative approach. The whole community comprises mining companies, suppliers, public and independent research centres and especially universities from Australia, Europe, North America and South Africa. Funding is provided by the members supplemented by government programmes such as the relevant Research Councils of Australia, Canada and the UK.

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I work within the Office of the Chief Technologist, a component part of the Rio Tinto Technology Group. The Technology Group serves Rio Tinto's technical needs, both corporate and collaboratively with individual operations – we even use the collaborative philosophy internally.

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The Office of the Chief Technologist developed and manages a global external research programme. The programme is now much wider than the AMIRA or MIRO approach, although these organisations provide valuable and significant parts of our repertoire.

## Challenges

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Our society demands increasing amounts of raw materials; minerals demand rises in step with world GDP.

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Curiously enough the real price of many minerals tends to decline at the same time.

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Meanwhile ore bodies are becoming harder to find, more difficult in nature and tend to be deeper and of lower grade. They are becoming less accessible, more difficult to process and thus more capital intensive. The technical and economic challenges are increasing.

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The mining industry also faces growing challenges from society over its license to operate. These challenges have coalesced into the comprehensive test of Sustainable Development. The industry has begun to respond, for example through GMI, the MMSD project and the formation of the ICMM. Rio Tinto recognised early on that it needed to adapt rapidly to secure its future, and has been developing an understanding of what the transition to Sustainable Development means for its business.

## Collaboration

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Recognising that the mining industry faces severe challenges to its survival we need a vision for the future, but what is it? The future will require the industry to mine smarter. During their operating life, mining operations will have to have a smaller footprint, and generate minimal impacts on the surrounding environment in terms of natural resource use (i.e. water and land) and with minimum emissions to the environment.

Air and water quality must meet the expectations of the local and increasingly the international community. We need mines that maximise the efficiency of extraction of the valuable mineral resources, whilst minimising the use of energy, water or land, and reducing the amount of waste generated. Upon depletion of the reserves, the system must be returned to an appropriate and sustainable use. These requirements will greatly affect what the “real” costs of the mine are and whether a particular orebody can provide a sound long-term investment that creates value for a company and wealth for the shareholders and community at large.

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In a very general way we can list the research areas needed in developing this vision of the mine of the future.

The magnitude of the vision has to be measured against the fact that the mining industry does not devote much of its turnover to research, only 0.2% of sales for Rio Tinto and the other majors.
In following the vision we make two fundamental assumptions.

Firstly we have to adopt a holistic approach, viewing the mine of the future as an entity. In this more holistic approach the mine can be thought of as a closed system in which capital, people and material enter and cash, air and water exit. The system has to be adjusted to ensure that the revenue stream is sufficient to attract the investor and the community. Within this we should integrate the technical issues e.g. not thinking of each unit operation on its own but as an interacting component of the whole system. The mine to mill concept is part of this approach.

Thus, a core task is to develop the technical and economic models that will allow us to assess the true value of an orebody in the future. We need to fully understand and assess closure costs, and develop the appropriate economic models that allow better assessment of the true value of our ore bodies. In the old view, whatever remains

after capital and operating costs is profit. In the new Sustainable Development paradigm, a mine may be a waste management project and whatever remains after paying for the treatment and safe storage of waste is a profit. Such a view will require a different approach to the way we evaluate the technical and economic feasibility of a mine.

The second assumption is that Rio Tinto cannot find all the answers with its internal resources. No mining company can be sufficient unto itself, employ all the right people and have all the good ideas. We must engage with a wide circle of external partners and advisors, seeking continually to improve our practices and performance.

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The mine of the future will be very different to the image given by the past. It is developing the following characteristics.

- For each new orebody economic evaluation, mine design and operation and mine closure or use of new purposes such as waste treatment/storage will be treated in a completely integrated manner, taking into account local community and ecology before, during and after mining.
- Underground mining and processing with limited use of land and minimal surface disturbance
- Mining will be on a very large scale at high rates using new techniques, such as block caving, with high levels of technology such as remote operation and automation to achieve high safety levels with a smaller but more highly educated work force.
- Efficient use of energy with high extraction efficiencies of minerals and metals
- Development of heap leaching above ground and In situ leaching underground with new barrier technologies
- Water use will be minimised – recycling, minimisation of losses, development of dry concentration, dry containment
- Operation will be safe for employees and neighbours There will be low to zero impact on other natural resources
- The mine site will be easy to return to sustainable and beneficial use

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The application of block caving is a perceived to be major component in the future for mining massive underground ore deposits. Historically it has been used for low strength and usually low grade orebodies producing fine fragmentation. The recent move to caving competent rock, such as the Rio Tinto copper mine at Palabora in South Africa, has resulted in decreased development requirements, drawpoints on a wider spacing, but greater unknowns and greater economic risk. This will be the focus of much research, as will employee safety. This is not only an intellectually interesting concept; this is the way forward for the mining industry.

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Rio Tinto's copper mining is projected to change from open pit to underground over the next few years.

More automation will lead to improved occupational health and safety, the priority of the Rio Tinto group, and we need to be flexible in being able to take advantage of emerging science and technology.

Innovation, breakthrough and step change is needed in a number of areas to deliver future mines that meet sustainable development targets. Rio Tinto perceives gaps in

the supply of innovative technology to the mining industry, ones that no amount of internal investment in researchers or facilities by one company will ever cover. It is essential to get access to innovative technology arising from original ideas in the external research world and ensure successful application. However the end-user has a role in guiding and validating significant technology along the route from idea through demonstration, supply to implementation. This is collaborative research.

The Office of the Chief Technologist has been directed to access good ideas and enable their successful application. Therefore, a global programme has been developed to find the innovative ideas, evaluate their value to Rio Tinto and assist the flow from idea to application. In many instances it is concluded that it is to Rio Tinto's advantage for implementation to be made as quickly as possible by wide participation. In that case collaboration and involvement of the best centres of research excellence as well as input from a wide range of industrial experience and know-how is indicated.

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If it is done well, this collaborative approach has a number of advantages.

- There is no limit to capturing good ideas, wherever they occur
- We have access to best possible researchers and facilities
- Supervision by industry brings a wide range of experience
- Costs and risks are shared
- Government or EC financial support is possible
- Implementation is at company site
- High leverage of costs, typically 10;1

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To exploit this approach for the benefit of Rio Tinto, the Office of the Chief Technologist has developed an overall program with the following features.

- increasing use of external research
- a structured global program
- highly leveraged projects
- technology transfer through Rio Tinto Technology into operations
- value to Rio Tinto from:
  - direct project deliverables
  - research networks for proposal development
  - an infrastructure for other work including
  - contacts/networks for internal technology activities.

Many of the projects use highly leveraged funding, firstly from other partners but significantly from many governmental bodies and programmes. Research Councils and many other public bodies in Australia, Canada and the UK as well as the European Commission Framework Programmes are important sources of financial support, often providing matching funding to the industrial partners financial and in-kind contributions. Engagement with these bodies and meeting their requirements is complex and the use of experts is advisable, for example Rio Tinto often uses MIRO for UK and European funding applications.

Projects tend to be arranged into the following groupings.

- Specific resource/ product development will be a Rio Tinto led development

- Equipment / mining method development will be collaborative with manufacturers
- Environmental projects tend to be broad collaborations

As well as specific project groupings, Rio Tinto has joined a number of external research organisations, notably AMIRA in Australia whose projects form the largest fraction of the project portfolio. Similar research brokers such as MIRO in Europe and CAMIRO in Canada also feature. Rio Tinto has taken part in several European Framework projects and networks, currently participating in NESMI, LIFETIME, TAILSAFE and BIOMINE.

Collaborative research means bringing different university departments, different universities and research organisations together, each supplying its strengths to enhance the success of projects. It also involves rolling together programmes of related projects to achieve cumulative benefits in a whole process.

We believe that the collaborative research approach needs active participation by industry to help manage and finance the administration of the external research world, subscribing to and working on many councils, committees, steering boards and advisory panels in the collaborative research organisations. It means playing support and advisory roles in research networks and research bodies such as the Australian Co-operative Research Centres, universities in Australia and the UK and in UK networks such as Faraday Partnerships and other co-operative networks. These activities encourage minerals industry research and help maintain researchers and facilities.

Under Europe's proposed Framework 7 R&D programme a major feature is to be the operation of European Technology Platforms, potentially powerful mechanisms for the development of collaborative research. An ETP is being developed by the minerals industry – watch that space.

Other important projects and developments are collaborative in the industry e.g. the INAP (International Network for Acid Prevention) project. This is an excellent model of global industry collaboration working on issues of significant environmental impact that are common to most. Acid Rock Drainage is a major issue facing the industry and to pool our collective expertise can only be beneficial. Rio Tinto has been one of the prime movers in INAP, and we will continue to be involved in driving the future direction.

## Conclusion

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The mining industry faces many technical and economic challenges from current legislation and the expectations of society. These pressures can only increase and the industry should set high technical targets in order to be ahead instead of behind. However, significantly improved technologies are needed to achieve these targets, with step changes required in performance. This requires innovative ideas, the participation of leading researchers from many areas, good facilities, good understanding of industry needs and significant funding. Almost uniquely, collaborative research can bring these elements together whilst minimising risk and cost to individual partners.