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16th Annual General Meeting of the  
Society of Mining Professors  
11-16 June 2005, Ankara, Turkey  
*Research Co-operation in Mining*

*A Rio Tinto view of collaborative research in Europe  
and the World*

*Chris Cross*

*Office of the Chief Technologist, Rio Tinto Technology*



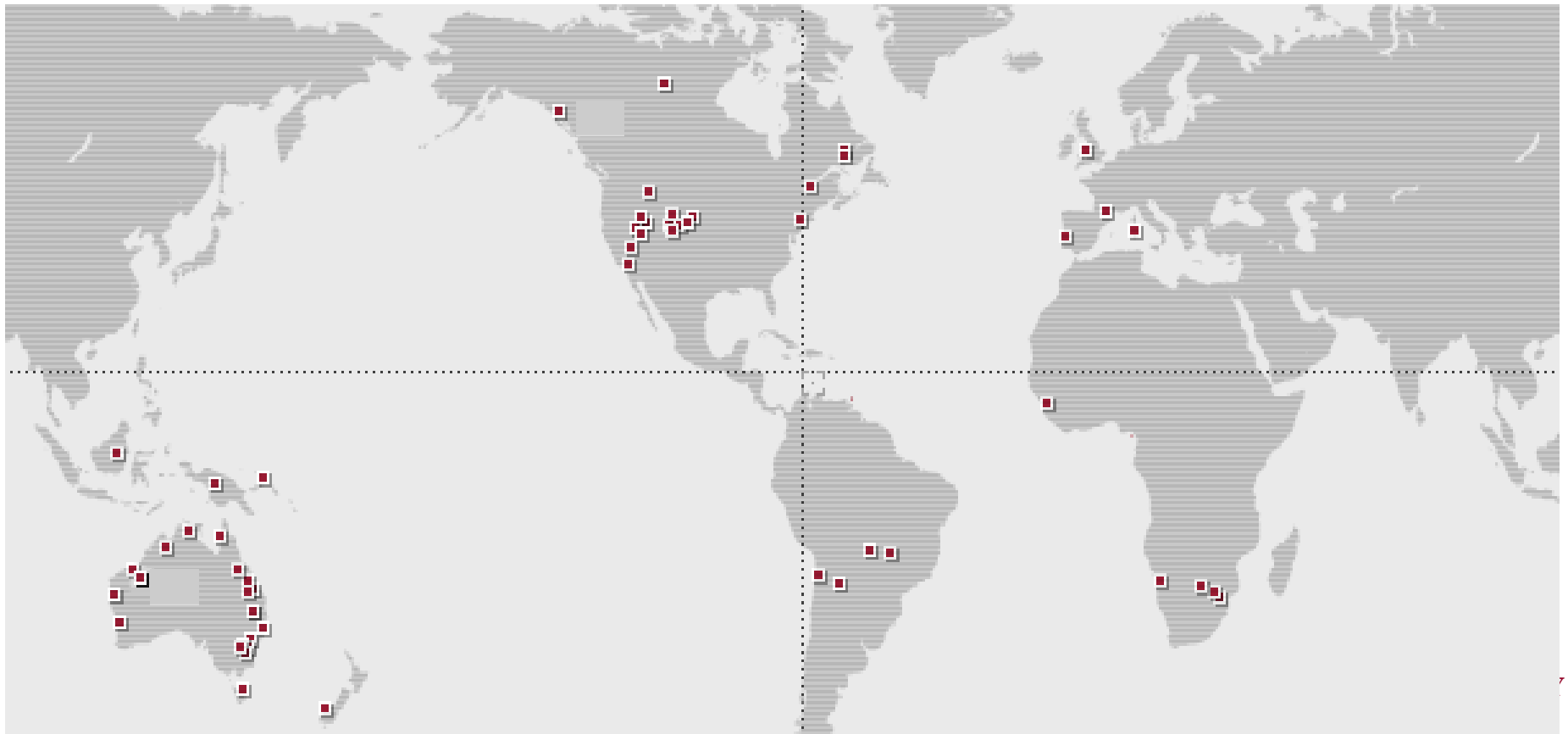
# *Research Co-operation in Mining*

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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

# Rio Tinto operations worldwide

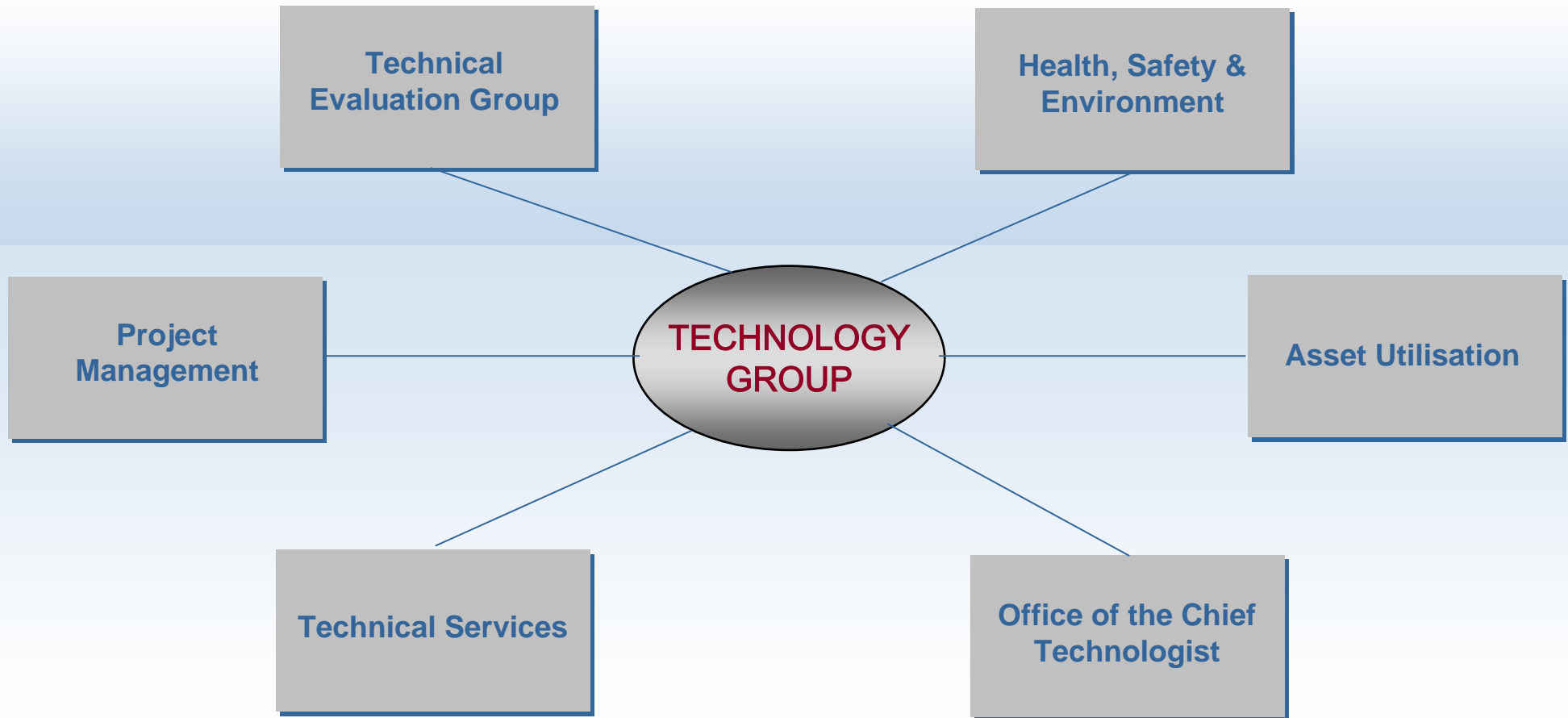
- Rio Tinto is a world leader in finding, mining and processing the worlds mineral resources
- 36,000 employees worldwide, Annual turnover ~US\$11billion
- Health, safety and environment are key considerations in all that Rio Tinto does.



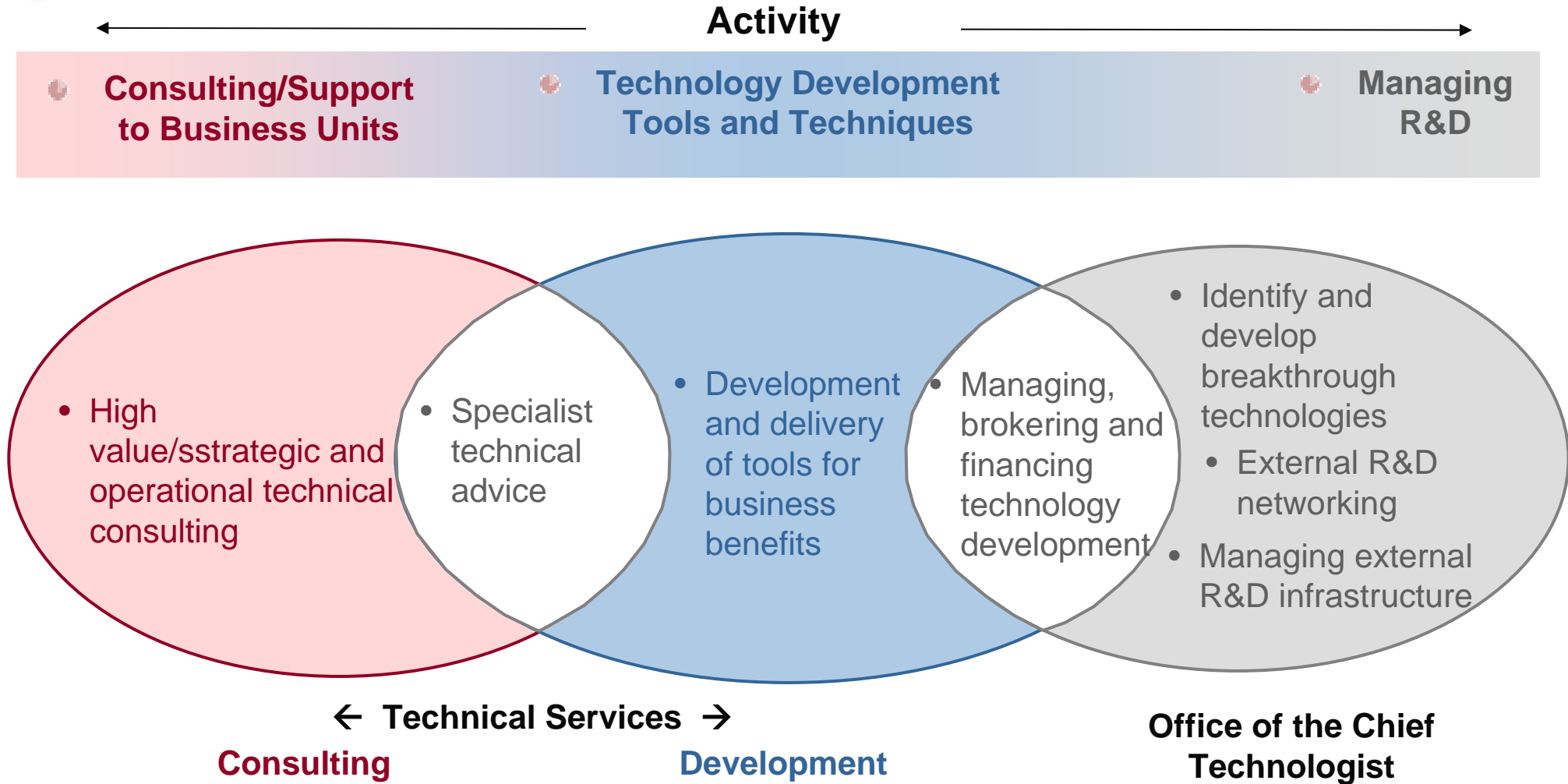
# Rio Tinto business units



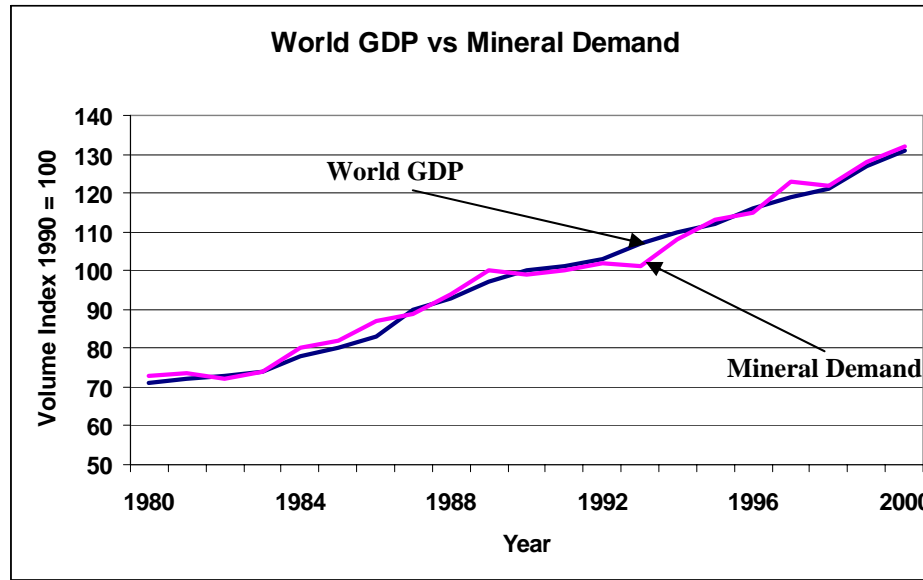
# TG Harnesses technical strength to support creation of value and transfer of best practice



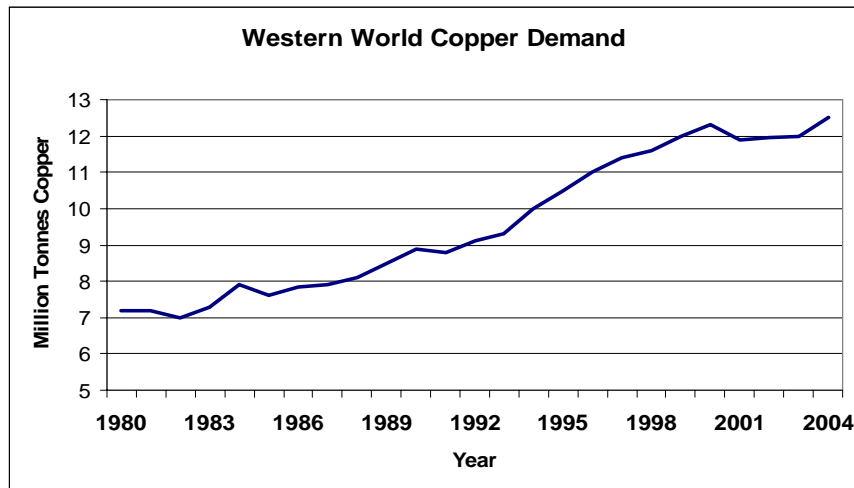
# Technology Group – Seeking opportunities for continuous improvement



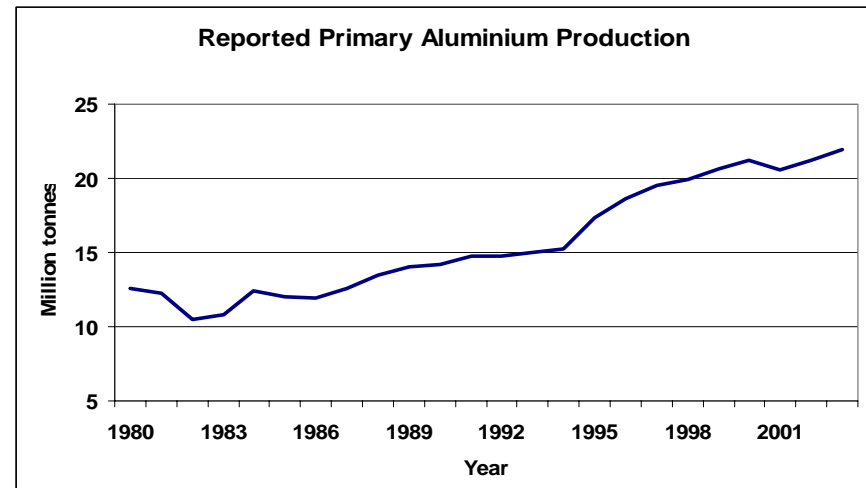
# Mineral output continues to rise to match the demands of society



Source – DRI-WEFA and Rio Tinto

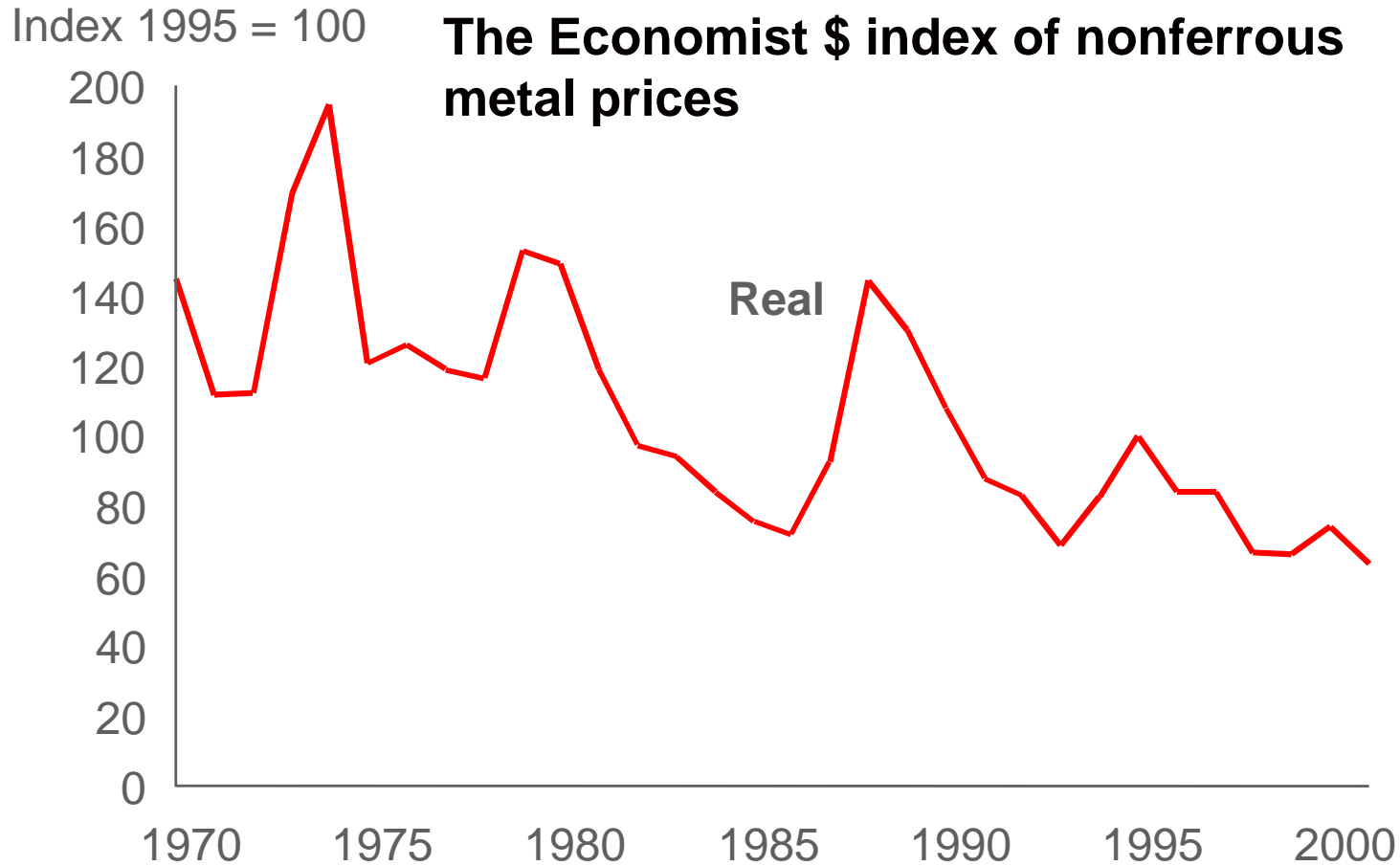


Source – Global Mining Research



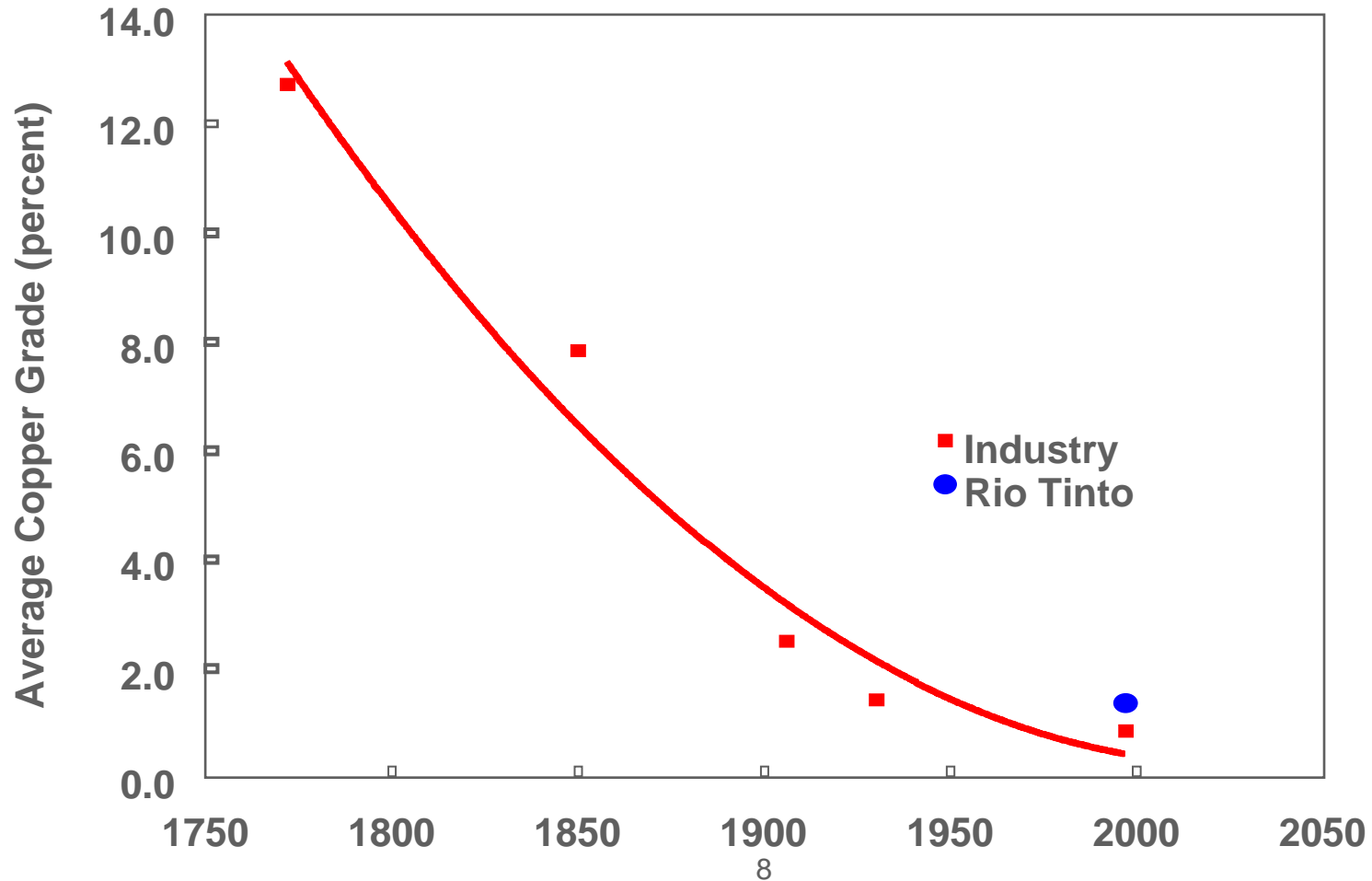
Source – International Aluminium Institute

# The real price of metals



# Head grades are in decline

Copper Industry Ore Grade





# Challenges

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- Economic – declining grades, increasing difficulty means higher energy and other costs
- Technical – difficult to separate
- Sustainable development – whole range of issues and challenges including
  - Acceptable impacts
  - Use of the site after closure of mining operations



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# The Mine of the Future – Sustainable & Economic

- Limited use of land and surface disturbance during mining
- Easy return of land to sustainable and beneficial use
- Safer conditions for employees and neighbours
- Lower risks of incidents and emergencies
- Lower or zero impact on quality and available quantity of other natural resources
- Activities consistent with development plans and targets



# Precompetitive sustainability research

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## Mine of the future

- Closure and legacy issues
- Bonding and after-care (of local people)
- Eco-efficiency
- Product stewardship and the safe use of metals
- Risk assessment and management
- Recycling
- Sustainable production and use of metals
- Roles and responsibilities of players
- Biodiversity and protected areas
- Large volume waste
- Parts-per-million waste
- Watershed management, water demand and choices
- Energy management – reduced intensity and impact of use
- Community relations



# Mine of the Future

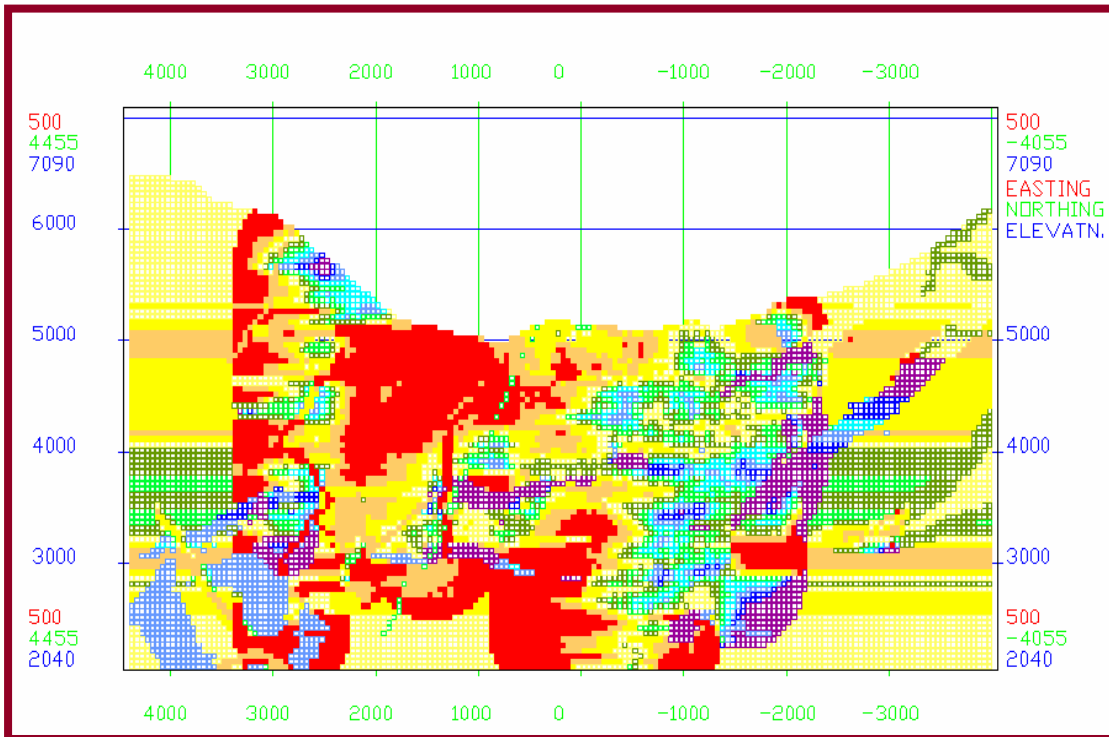
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- Economic evaluation, mine design and operation and mine closure or use of new purposes will be treated in a completely integrated manner, taking into account local community and ecology before, during and after mining.
- Underground mining and processing 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
- Efficient use of energy with high extraction efficiencies of minerals
- 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

# Technologies for block cave - a key focus

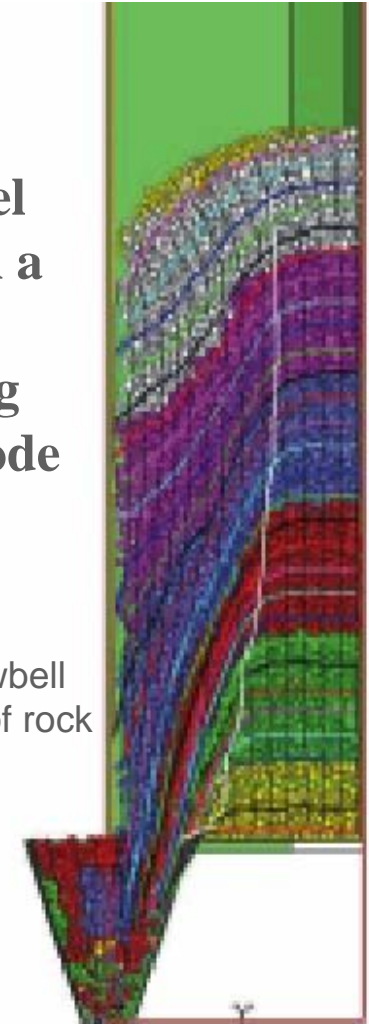
## Geostatistical analysis of geotechnical data:

Section through Bingham Canyon showing rock quality

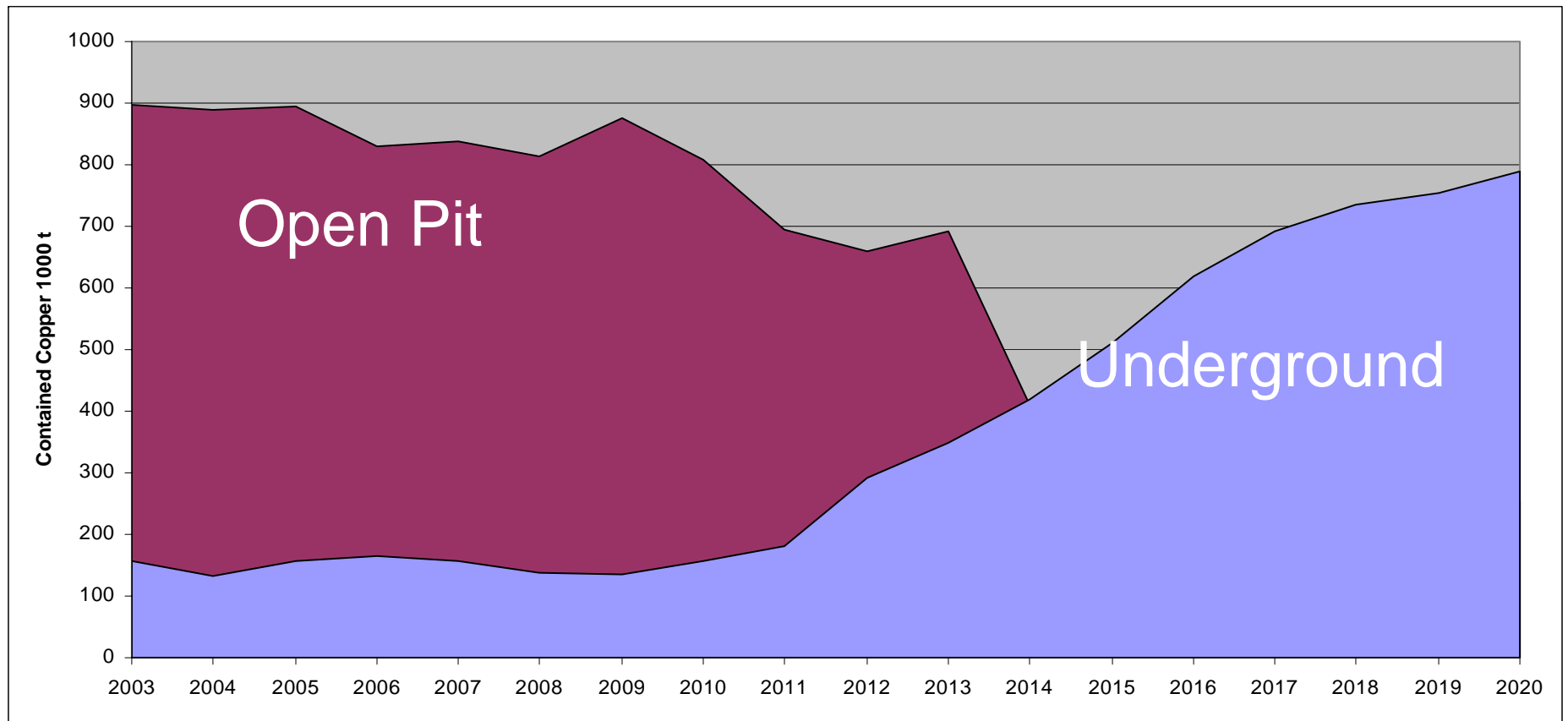


Ability to model material flow in a block cave operation using Particle Flow Code (PFC)

Section through drawbell showing flow paths of rock entering the drawbell



# Predicted copper output from Open Pits and Underground (Rio Tinto Production Share)





# Advantages of a collaborative project

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- There is no limit to capturing good ideas, wherever they occur
- 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 is possible, typically 10:1



# Collaborative research programme

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- 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

Projects tend to be arranged into the following groupings.

- Specific resource/ product development will be led by Rio Tinto
- Equipment / mining method development will be collaborative with manufacturers
- Environmental projects tend to be broad collaborations



# Conclusions

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- The Mine of the Future will support the transition to Sustainable Development
- Technology Innovation is essential to meet society's needs **and** expectations. Step change innovation is a key part of our business and essential for the industry
- Broad ranging international alliances will be necessary to innovate successfully – collaboration is the key



# Rio Tinto Technology Group

**Dr Chris Cross**  
**Office of the Chief Technologist**

*Chris.Cross@riotinto.com*