

Technology & Innovation
Changing the face of mining





We work to develop and implement new processes, technologies and tools to improve future mining processes.

Technology and innovation in Rio Tinto

Rio Tinto is a leading international business involved in each stage of metal and mineral production. The Group combines Rio Tinto plc, which is listed on the London Stock Exchange, and Rio Tinto Limited, which is listed on the Australian Securities Exchange.

*Cover image
Aeroplane wing and
engine – illustrating
the use of metals in
transport.*

*Left
Bucket wheel at the Blair
Athol Mine, Rio Tinto
Coal, Australia.*

*Below
Drills illustrating end
use of molybdenum and
steel. Made from chrome
molybdenum steel.*

We aim to have the best mining and processing technology available, and to innovate new ways of operating that will benefit our business, employees, customers and shareholders. We are devising new technologies that minimise our impact on the environment, as well as improve the health, safety and working conditions of our people.

The Technology & Innovation (T&I) group provides world class technology services to Rio Tinto's product groups and businesses. It also advises Rio Tinto's executive management. T&I is made up of a number of functions that identify, share and implement leading practice across Rio Tinto. The functions each have responsibility for different areas of mine technology, which include surface and underground mining, asset management, strategic production planning, processing, project development and implementation, and technical risk evaluation of investment opportunities.

The various elements of T&I collaborate in capturing knowledge and spreading it across Rio Tinto. T&I identifies and promotes leading practice in operational technology. It also pursues step change innovations that will provide Rio Tinto with further competitive advantages as it develops the orebodies of the future.

We have the experience, know how and capability to be a key innovator in the mining industry, and the vision to be a world leader in technological development. We work to develop and implement new processes, technologies and tools to improve future mining processes.

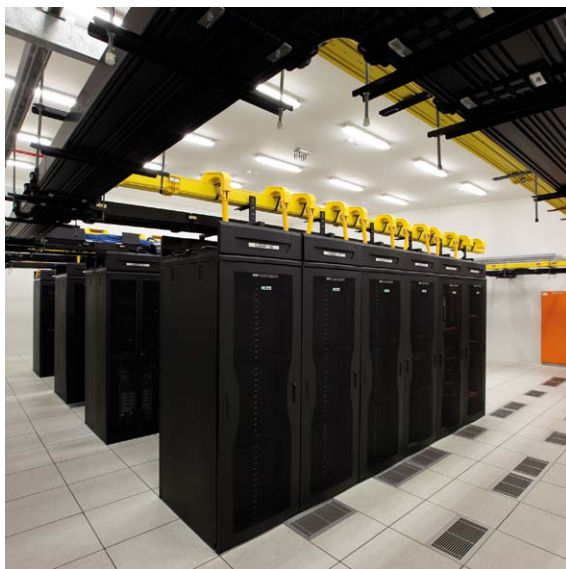


Technology trends

Right
Rio Tinto works in partnership with leading academic institutions like Imperial College London and the University of Sydney.

Below
The Pilbara Operational Control Centre, based in Perth, Australia.

Technology is an increasingly important success factor in the metal and mineral industry. Improvements in technology can change the way that we look at mineral deposits. Orebodies that at one time would have been uneconomic to exploit – due to their grade, mineralogy or location – may become economic prospects with the help of new technologies.



Technical challenges for the mining industry are likely to become more complex, as companies pursue opportunities in new mining territories, while managing costs and responding to environmental imperatives in a carbon constrained world.

The large scale surface operations of the past will need to give way to greater use of underground techniques, such as block caving, which uses less energy and creates less disturbance at ground level.

New processing techniques may make it possible to extract minerals from the ore in situ, without bringing huge amounts of rock to the surface, again saving energy and reducing the footprint of the mine on the land.

Mining increasingly takes place in remote parts of the world, where it's hard to recruit the necessary staff expertise. So tomorrow's mines are likely to rely on remote monitoring and control, with employees running the mines from cities thousands of kilometres away.

We're already making these visions a reality with our Operations Centre in metropolitan Perth. From here, we remotely manage the automated operation of our iron ore mines in Australia's Pilbara region, some 1,500 kilometres away.

Our own technology professionals are working with some of the best academic minds to achieve our goals, through partnerships with leading institutions such as the University of Sydney and Imperial College London.



Rio Tinto pursues step change innovations in mining and technology, such as our remotely operated, autonomous haul trucks.



We know that the time to start innovating for tomorrow's mines is today.

Our activities

*Below
A laser scanner is used
to measure the volume
of the coal stock pile
at the Kestrel Mine,
Australia.*

T&I creates value for Rio Tinto businesses in several ways, we:

- support them as they implement leading practice in their operations
- support them as they develop high value projects
- develop and implement innovative technologies that they can use
- evaluate the technical risk of their projects and help them mitigate those risks
- devise measures that they can use to analyse their effectiveness in the areas we cover
- help develop employees' capabilities.

Our core team of technology professionals develop leading practice and drive sustainable improvement in seven areas, described here.

The functions are:

- Innovation
- Underground Technology
- Asset Management
- Mining Technology
- Project Development and Implementation
- Technical Evaluation Group
- Mineral Technology Services

Innovation

Our Innovation team works to create the Mine of the Future™ programme, which looks at:

- How we will explore better
- How we will exploit the resource better
- How we will go underground – deeper and faster – better
- How we will recover more from increasingly difficult deposits
- And how we will do all of the above more safely.





*Above
The Technology & Innovation group supports Rio Tinto's businesses in implementing leading practice.*

*Below
Electrical circuit board – an illustration of the end use of copper in electrical appliances and its effect on modern day life.*

The Mine of the Future™ programme is not a single mine site. It is how we describe the approach that we are taking across Rio Tinto to find advanced ways to extract minerals deep within the earth while reducing environmental impacts and further improving safety.

These advances are about achieving step changes in mining that come from leadership in technology, starting with academic origin and resulting in a commercial outcome.

Within the Mine of the Future™ programme there are a lot of exciting projects, including:

- Demonstrating better ways of mining through automation and remote operation. We are the first mining company to attempt automating the production value chain and to manage it remotely. We've started an Operations Centre in Perth to oversee operations some 1,500 kilometres from our mines. This Centre will direct remote controlled haul trucks and drills to extract our ore, and driverless trains to carry it to port.

- Developing block cave mining and rapid tunnel development technologies, which allows us to extract ore from large orebodies without having to dig an open pit at the surface.
- Recovering more ore from our mineral deposits using techniques such as mineral sorting and pulverising, and enhancing metal extraction in heap leach process.

The Mine of the Future™ is creating new, different, more highly specialised jobs, which will also bring more flexible working conditions for our staff.

Rio Tinto recognises the value of intellectual property and actively promotes its development and protection for the wider benefit of the Group. Responsibility for management of Rio Tinto's intellectual property sits within T&I's Innovation function. Management of the Group intellectual property portfolio is conducted centrally.

These steps and others will help us reduce our footprint and operating costs, and allow us to be more efficient.



Raw molybdenum

Molybdenum has the ability to withstand extreme temperatures without significantly expanding or softening, which makes it useful in end products that involve intense heat, including the manufacture of armour, aircraft parts, electrical contacts, industrial motors and filaments.



Underground Technology

Rio Tinto is continually searching for ways to extend the operating lives of its mines to maximise potential value from its orebodies. It is, after all, almost always preferable to keep an existing mine operating rather than planning and constructing a new one.

The objective of T&I's Underground Technology function is to create and develop a world class team in technical aspects of underground mining that will provide Rio Tinto with a competitive advantage by combining veteran expertise with youthful potential. The focus is on partnering with T&I, the Copper group and the Diamonds & Minerals group on the technical aspects of design, construction and operation, including the delivery of fit for purpose technology.

This will be achieved by concentrating on the recruitment and retention of suitably qualified underground professionals coupled with a leading practice programme of skills development, education and on the job learning. The Underground Technology group will also provide technical review, guidance, direction and assistance to both projects and operations as well as facilitating a culture of continuous technological improvement in underground mining through innovation, development, adaption and deployment of fit for purpose technology.

Asset Management

Asset Management's role is to establish and implement global asset management strategies and programmes aimed at improving the performance and reliability of the Group's physical assets. These assets include both fixed equipment in processing plants and heavy mobile equipment, such as trucks and shovels. Asset Management works in partnership with business units to implement these strategies and improvement programmes.

Asset Management implements metrics and standards throughout Rio Tinto that are designed to monitor and improve performance, and increase the reliability and life of the Group's equipment. It supports the development of Rio Tinto employees through a number of professional training programmes and sponsors a number of collaborative forums to promote the sharing of leading practice.

Asset Management also determines the standard technical systems to be used across the Group as part of Rio Tinto's Global Operating Model. These include real time online equipment monitoring systems which have led to improvement in heavy mobile equipment availability and economic extension of engine and component life.



*Right
Rio Tinto has the
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and capability to be
a key innovator in the
mining industry.*

Mining Technology

The focus of Mining Technology is to establish leading practice and develop Group wide solutions in the core mining production processes of surface mining, underground mining, strategic resource development, resource and reserves estimation, orebody knowledge and mine planning, and make sure that these are shared and implemented around the Group. We help develop the skills of Rio Tinto employees who are involved in these processes.

Mining Technology also includes a Strategic Production Planning (SPP) team that works with business units to develop comprehensive plans and valuations of strategic development options. While this work is strongly driven by the nature of reserves and resources in the ground, the production and economic models must include all elements of the value chain, from mining and processing to sales and marketing, over the potential life of the business. Results from SPP provide a logical resource development framework for more detailed studies and investment decision making.

*Below
Copper's open pit
Bingham Canyon
copper mine,
Kennecott, US.*

Project Development & Implementation

Project Development & Implementation (PDI) is the centralised group responsible for partnering with Rio Tinto's product groups and business units to successfully develop and deliver capital projects.

PDI consists of a Project Management Office (PMO) and a number of Project Delivery Hubs. The PMO is responsible for developing, delivering, promoting and governing the processes, systems and tools for all capital projects to achieve repeatable success. The Project Delivery Hubs are responsible for managing and delivering major projects, as well as supporting businesses to develop potential projects.

PDI aims to align key project requirements to assist Rio Tinto to achieve capital efficiency and effectiveness. To enable this, the Capital Projects Framework (CPF) provides a consistent approach by aligning four key elements:

- (i) Project portfolio planning and reporting, including resources planning, quarterly reporting to Rio Tinto Exco, and performance benchmarking.
- (ii) Project governance, including governance structures and authorities, project assurance planning and execution, and health check reviews.
- (iii) Practices, including project management processes, guidance and tools. The guidance documents and templates are made available via the Projects Warehouse.
- (iv) People, including capability development, talent management and communities of practice.

Technical Evaluation Group

The success of Rio Tinto's worldwide operations is largely based on sound investment decisions. Such decisions are not made lightly, with all investment proposals subjected to a thorough process of technical review and evaluation before an investment decision is made. The Technical Evaluation Group (TEG) is a team of internal professionals responsible for rigorously reviewing all major project proposals to ensure Rio Tinto's Investment Committee (IC) is provided with independent technical assessments to support its decision making.

TEG reviews are a well-established part of Rio Tinto's project development process, having been in place for nearly 15 years. They are generally recognised within Rio Tinto as the "acid test" for the technical aspects of a project. Apart from providing a corporate governance function, TEG review findings can help strengthen investment proposals by providing feedback on the quality of study work.

The TEG team provides the Rio Tinto IC with the following support for project proposals:

- Independent and objective review of the key technical elements of major project proposals (covering technology selection, sustainable development, costs, value and project implementation)
- Independent review of the technical aspects of strategic planning
- Recommendation to the IC on investment proposals, including greenfield and brownfield projects, make acquisitions and divestments and major contract proposals
- Review and commentary on the results of many project post-investment reviews.





Above
Rio Tinto is developing an underground block cave mine under the open pit at Argyle Diamond Mine, Australia.

Below
An illustration of the end use of metals in car engines.

Mineral Technology Services

Mineral Technology Services (MTS) is a team of technology professionals based in seven offices in North America, Australia, South Africa and the UK, who partners with Rio Tinto's business units in the delivery of large, measurable increases in earnings and value. MTS provides technical service in the areas of geology, mining, mineral processing, geotechnics, hydrometallurgy, process control and the environment. MTS also works to increase the technological excellence and capability within the Group.

MTS is also focused on establishing leading practice in the areas of processing methodologies and metallurgical technologies, which include methods to identify, understand and reduce product losses that occur during mineral processing.



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