

“What we can imagine, we can achieve”



Grant Thorne, new Group executive, Technology and Innovation, takes Julian Cribb on a guided tour of Rio Tinto's mine of the future.

Driverless trucks ferry their loads around the mine with the synchronized perfection of a ballet, reporting to the workshop as maintenance falls due or faults are predicted. The processor makes constant fine adjustments to itself to win more metal for less energy, water and time from the ever varying stream of ore. Even the excavators and draglines do much of their operational thinking for themselves.

The absence of people is perhaps the biggest revolution since humankind first laid pick to rock-face. But far from being excluded from the equation, the operators are ensconced in an urban mission centre a couple of thousand kilometres away, running the mine “hands off”, scrutinizing its functions in minute detail from an avalanche of data, and tweaking them ever closer to the technical limits to win the edge in the fiercely competitive world of resources in the 2020s.

Others remain on site, servicing and replacing parts whose sensors have predicted a failure, ground-truthing what the models foretell about the character and shape of the orebody, monitoring operations and systems constantly. The whole business now functions more like a giant power station or refinery than a mine as we know it today.

Automation is but one of the trends which Grant Thorne considers inevitable in the resources industry's quest for superior performance, reduced use of energy and water, a smaller environmental footprint, and alignment with the lifestyle aspirations of its people. “Within five years some of Rio Tinto's operations in the Pilbara will be reliant on driverless trucks,” he predicts. “It means safer min-

ing, far less wear and tear on people and machinery, less energy, smoother synchronization of operations and lower cost. It isn't science fiction at all.”

After more than 30 years at the sharp end as metallurgist, operations specialist and manager in the company's mines, Grant has a keen insight not only into the technological possibilities, but also the human qualities needed to run them at peak performance. The man charged with overseeing the technology and innovation that will shape the next quarter century for Rio Tinto has no doubts about the profundity of the changes ahead.

Remote operation, enabled by the explosion in computer speed, capacity and bandwidth, is within our grasp because of the reliable, real time feedback it can now provide, he says. A tiny sensor, watching over a minor bearing in a giant machine can report in an instant to a mission centre if it detects an incipient fault, unleashing a cascade of action all down the line to forestall or compensate for it. The sensor is one among millions of such “nerve endings”, monitoring all aspects of the mining and mineral extraction activity and reporting to the “brain”. The twenty first century mine is evolving into an intelligent organism.

“Automation or robotics isn't science fiction. It's here now. We are already making the first strides in railway locomotives and drill rigs. Our first goal is to show the value of controlling a Western Australian operation from a control centre in Perth,” Grant says. “I've no doubt that in five years we will be operating much of a bigger iron ore business in the

Stills from a new Rio Tinto Iron Ore DVD “Imagine the future” show an unmanned survey drone controlled from a single operation centre thousands of kilometres away in a city centre tower block. This centre controls all aspects of mine operations, including, in these stills, guidance of a maintenance crew on site working in an environmentally controlled dome. The crew is diagnosing an equipment fault spotted from the operation centre.

Pilbara routinely with driverless haul trucks.”

There may be just a hint of nostalgia in the voice of this former “boy from the bush” as he talks of mining based in cities. Born on a family dairy farm at Maleny, Queensland – where he still raises beef cattle – Grant Thorne chose to study metallurgy because he was enthralled by the minerals industry, its science and technology – but also from a deep love of the Outback and the remote places like it, where most mining happens.

In a career that has led him from the floor of the lead/zinc concentrator in Broken Hill – source of many an important R&D advance – to living mainly out of a suitcase as he patrols the technological frontiers of Rio Tinto’s far flung world, Grant has managed to fulfil both cravings. “For me, it’s been the perfect career,” he reflects. “I’ve had fantastic opportunities, mentored by wonderful people, in diverse commodities, role types and cultural settings.”

It began with a doctoral thesis at the University of Queensland’s respected Julius Kruttschnitt Mineral Research Centre on the modelling and control of lead/zinc flotation processes. The two thick, black volumes still sit proudly, but slightly fly specked, on the shelf of his spartan office overlooking the Brisbane River. He handles them with some incredulity for the industriousness of the

The processing plants are remotely controlled and operated with reduced noise and dust, plus minimal water and energy consumption.

young Grant who churned all that data to deliver his findings three years to the day after he started.

Far from an academic work, it had immediate real world application, helping to lift the quality of concentrate and reduce waste in flotation. It also achieved a “seamless transition” for the young man, from academe to the processing heartbeat of Broken Hill: the ZC and NBHC concentrators.

The move brought with it both satisfaction at being able to turn theory into practice and contribute to real improvement of a well characterized process – and a rude shock at the rigidity, complexity and archaic practices of the industrial milieu at Broken Hill in the mid 1970s.

“I’d come from farming stock, where you’re self sufficient. If you need something done you get on with it, even though you may not be an expert.” Grant smiled wryly. “And that was before I used Take 5.* Broken Hill was a closed shop. You couldn’t even pick up a screwdriver. I found it really confronting to see simple jobs

**An integral part of Rio Tinto’s language on safety.*

It refers to the five minutes taken at the start of every job to be sure that all risks have been identified.

that should take one person ten minutes, occupy several men for hours.”

Within the labyrinthine rules and demarcations Grant’s discerning eye saw something else too – the hard won skill of the foremen on the plant, who’d been operating it much of their working lives and knew intuitively how to get the best from it. That respect for the wisdom of the deeply experienced mining operative has never left him and is an important component in how he sees the industry’s future.

“It’s scary to visit concentrators around the world today and see that some of the insights and good practices of the 1970s have been lost along the way,” he says. Grant attributes the loss in part to the harsh era before the present minerals and energy surge, when metals prices were low and cost containment was the watchword.

“In those days technical staff tended to be viewed as a cost rather than an asset. As we took out the cost, we also shed knowledge and corporate memory. A key function of my present role is to ensure we retain our base of technological knowledge and experience, as well as building on it.”

Grant also aims to consolidate another kind of mining operation – harvesting the insights of the company’s leading technical specialists

before or even, if need be, after they retire. “The technical know how of individuals is very important to the performance of any company, and is easily lost. In a few individuals, it can be priceless.”

The rubric that people are Rio Tinto’s most valuable commodity is far from mere rhetoric in Grant’s eyes. Recognizing the profound impact of technology on the resources sector in the years to come, a current goal is to put technological muscle back on the organizational bone.

After a decade in Broken Hill, including a helicopter’s eye view of the company’s mining and smelting operations in corporate reviews, Grant found himself headed for the tropical island of Bougainville, as general manager of the leading edge concentrator division at its huge new copper mine at Panguna.

Grant was next manager of Comalco’s bauxite and kaolin mine at Weipa, at a time when the relationship with Australia’s aboriginal people was at the forefront of public concern and Rio Tinto was – amidst some acrimony from other miners – leading a paradigm shift in attitudes towards indigenous peoples in the mining sector.

Weipa was also at the sharp end of a paradigm shift in the equally sensitive area of work practices. “The cultural shift in

On site accommodation works in harmony with the landscape and underground living reduces surface footprint and energy consumption. State of the art facilities create a “home away from home”.

workplace relations achieved during my tenure at Weipa, the opening of the Weipa township to community governance and the consolidation of good relations with Aboriginal people, made those four years the highlight of my operational experience. And there was only one nuisance call, despite a publicly listed number,” he recalls.

Grant briefly served as Comalco’s vice president, Research and Technology, before moving to London. As a mining executive with overview of operations in Europe, Africa, and South America, and then in the Copper Group, it was an opportunity to see the Rio Tinto world. “I learnt an awful little about an awful lot – and in a hurry,” he reflects.

His term as manager of the Kaltim Prima coal mine in East Kalimantan, Indonesia, from 1999 to 2001 coincided with tensions between Indonesia and the international community, particularly Australia, over newly independent East Timor. Expatriate Australians in their midst were a focal point for the expression of anger by young nationalistic Indonesians, especially students at the University Samarinda.

“We’d put a lot of effort into understanding and working with traditional community

leaders and local government. We communicated regularly, treated people with respect, always attended local events and made the effort to speak the language. It served us well – as East Timor, the devolution of power from Jakarta, and then militant unionism broke over us in successive crises,” Grant says.

“Although I decided to remove the expats briefly during the East Timor, it was because of strong local support and not lack of it. Local leaders had resolved to confront, violently if necessary, militant students who were travelling to the mine to harass Australians. Things cooled down quickly, but it was not the last time in Indonesia that I would marvel at the power of sincerity, truthfulness and respect to build relationships that transcended race and creed.”

In 2002 there was a homecoming for Grant when he returned to Brisbane to manage Rio Tinto’s coal assets in Queensland. The Tarong mine had been one of the first to establish a community trust in a developed country. Similar models quickly followed for the communities surrounding Blair Athol, Kestrel and Hail Creek.

When Grant was appointed to manage all of Rio Tinto’s coal operations in Australia his watch incorporated a remarkable host of community projects, especially in the Hunter

Valley – from river restoration, education and training, and school science challenges to helping local industries (such as tourism, wine and horse breeding), young achievers, the disadvantaged of the community, and aboriginal employment.

But one *coup* was undoubtedly Rio Tinto's decision – at Grant's urging – to offer a financial lifeline to the distressed rugby league football team, the Newcastle Knights, adored with almost religious fervour in the Hunter region.

"You could hardly count the benefits that this one decision brought us," says former rugby league referee Grant. "It would have been a cynical gesture if we were not already engaged on meeting less glamorous community needs. But I've never experienced anything like it before – it unleashed a wave of goodwill that is hard to value. Even our critics would say: 'They saved the Knights. They can't be such a bad bunch'. I doubt our corporate name is regarded more warmly anywhere than it is on the jersey of the Knights."

While community relations and industrial goodwill may seem remote from the challenges of identifying the technologies that will shape the future of resources, Grant's view is that these will always involve people – and even a robot mine sits in the midst of a highly skilled workforce and a

Unmanned trains, remotely controlled with locomotives powered by natural gas, transporting product direct to the port of embarkation.

community, on whose approval it depends.

Often, too, this will be an indigenous group with quite different goals and dreams, that nonetheless must be listened to with sensitivity. Leadership and innovation in mining carries with it a responsibility to lead and innovate in human relations also. In part, he attributes his strong feelings on this score to his rural upbringing and awareness of the sense of identity and mateship that binds so many rural communities.

In the twenty-first century, resource companies face unprecedented challenges on all fronts – technological, social, environmental and economic. "The biggest is the way the face of our industry will continue to change in profound ways," he says.

In what seems a reversal of the trend of the past 50 years, the giant pits will start to disappear and mining will head back underground, Grant foresees. Community standards as well as cost efficiency are demanding mines reduce their ecological footprint. "The acceptability of massive machinery moving vast quantities of material in order to extract relatively small amounts of metal is declining. The challenge is to position

our organization for competitive advantage with the orebodies available to us in 20 years' time."

These ores will lie deeper. They will often be more complex, of lower grade, harder to access, more difficult to process. "We had our origins in the deep underground mines, like those of Broken Hill – and there is no shortage of history and experience in this field. In the last 20 years the number of underground operations has declined. But they will come again," he explains.

Block caving for resources such as copper is clearly a prospect: "It certainly represents the future for us – but we have to lift profoundly our understanding of behaviour of rock in these large caving operations. We have to understand how to be more selective about what material we actually move, be more discriminating in the mine, remove much less waste, then engage in a more precise extraction process at the surface."

And maybe not even the surface. "Can we imagine the day when our understanding of geomechanics, hydrology and chemistry enables us confidently to carry out hydrometallurgical extraction of ore in the ground? What can we do to reduce substantially the amount of energy consumed per unit of metal? What can we do to reduce the requirement for water? What can we do to

reduce the environmental footprint of the entire operation? These questions all tend to take you to less opencast mining. To discriminate early, to reject the ores which will consume too much energy.”

On biomining – using microbes instead of machines to extract metals – Grant is more cautious. “There’s no doubt it has some attractive features. It was more topical 20 years ago than today, but it may well come again as we become more preoccupied with the importance of energy conservation. Chalcopyrite is a case in point. It’s been a bit of a holy grail to come up with a hydrometallurgical process. The most economical pathway will

R & D investment

In July Rio Tinto committed A\$21m over five years to a new Centre for Mining Automation at The University of Sydney, based at the university’s Centre for Field Robotics. At its head will be Professor Hugh Durrant-Whyte. Said Grant Thorne: “By partnering with world class research and development groups such as the ACFR we will be able to create a significant advantage for our company by developing leading new technologies that will enable us to be more competitive in the minerals arena.”

The port is enclosed in a dome with power generated by its own solar energy panels. A subsea tunnel connects to an offshore loading dock unaffected by tides. Satellite communication and translation software provide real time direct links with customers.

probably be something that involves bioprocessing. But actual mining with bugs may be at least 20 years off.”

Another highway to the future has been signposted by the recent Rio Tinto-BP joint venture Hydrogen Energy (see pages 24-27), in which the partners plan to turn coal first to liquid fuel and ultimately to hydrogen fuel via the complete removal of all the carbon. “This is very exciting, with tremendous opportunities for the future,” he says.

“In the nearer term, I don’t think there is any alternative but to confront head on the whole carbon capture and storage issue. There are too many coal fired power stations around the globe that if we just rely on new technologies we won’t be addressing most of the problems. I think we are closer than many might imagine to a broader coalition on how we deal with CO₂, and carbon capture and sequestration has to be a part of that solution.

“The expense of proving these technologies is clearly greater than any single company can bear, but Rio Tinto – quite properly – has recognized that, as a global player, we have the ability to influence the selection of technology

and the policies of governments. We’ve also shown we’re prepared to put our hand in our pocket, not just stand at the pulpit. We will only make progress in this area in partnership with other industry players and governments. By being early movers in this area, we’re achieving an influence likely not available to us otherwise.

“If we can use our insight as to the likely winning technologies for the clean combustion of coal, arguably we can secure deposits which are more amenable to these technologies – and do so before their potential is recognized by others.”

Ultimately mining success relies on doing a relatively small number of things extremely well, says Grant Thorne. Some of these are unsophisticated, but with rising emphasis on conserving energy, water and land, are rapidly becoming more complex.

“Our challenge at Rio Tinto is to get there before others and to hold the advantage as long as we can sustain it. And while the scientists pursue the step change breakthroughs, we will still be reliant upon the engine room of our organization to do those relatively few things extraordinarily well.”

Australian science writer Julian Cribb is adjunct professor of Science Communication at the University of Technology, Sydney, and was previously science editor of “The Australian”.