GMG

Autonomous Mining Skills Migration Case Study

CASE STUDY: RIO TINTO'S EXPERIENCE WITH AUTOMATION IMPROVING SAFETY FOR EMPLOYEES AND CREATING VALUE

RioTinto

EXECUTIVE SUMMARY

Automation has been part of the Rio Tinto business for more than a decade, and it helps us run safer, more efficient, and low-cost operations. We are removing driver error and improving safety by increasing the automation of trucks, drills, and trains.

This case study covers:
1. How virtual reality has helped prevent dangerous situations
2. Context on some of the autonomous operations at Rio Tinto
3. Key learnings around communications and change management during the automation and technology journey
4. Partnerships with education and training institutions to enable the workforce of the future
5. How migrating some skills over to robots keeps people safe and productive

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1. Virtual Reality Training

Imagine learning how to drive an 85-tonne truck or heading underground for the first time surrounded by a lot of noise and huge machinery. By using simulators, we can create safe, real-life ways to train our truck, drill, and train operators. Rio Tinto also uses simulators to train more experienced operators for emergencies they may not have encountered before. They can learn first-hand what steps to take during a fire, without having to inhale any smoke.

At Oyu Tolgoi in Mongolia, we are using virtual reality as part of site inductions. New employees practice important tasks, like finding the correct safety gear for a job and locating underground refuge chambers in an emergency. We are also educating employees about critical risks and the steps we can take to prevent dangerous situations.

We have found using virtual reality for training helps people to better remember what they learn – which makes our sites safer and more productive.

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2. Context on Autonomous Operations at Rio Tinto

Our Iron Ore business operates the world's first fully autonomous, heavy-haul long-distance railway system—AutoHaul™—which has so far travelled more than 7 million kilometres.

AutoHaul™ is Rio Tinto's 1700-kilometre-long autonomous rail network in the Pilbara and is the world's first heavy-haul, long-distance autonomous rail operation, which transports iron ore to Rio Tinto's port facilities in the Pilbara region of Western Australia. The network includes about 200 locomotives.

AutoHaul™ improves safety by reducing risk at level crossings and through its automated responses to speed restrictions and alarms. It also eliminates the need to transport drivers to and from trains mid-journey, saving almost 1.5 million kilometres of road travel each year—a safety risk. And it delivers productivity and environmental benefits by using information about the train and rail network topography to calculate and deliver a safe, consistent driving strategy.

Rio Tinto is also a leader in autonomous haul trucks, with half of the Pilbara truck fleet being autonomous. One operator sitting in Perth can control up to eight autonomous drills, at any one time.

Rio Tinto runs more than 220 autonomous trucks as part of our Autonomous Haulage System, across our Iron Ore operations. The trucks are operated by a supervisory system and a central controller, rather than a driver. The system uses pre-defined GPS courses to automatically navigate haul roads and intersections, and knows actual locations, speeds, and directions of all vehicles at all times.

In 2018, each truck was estimated to have operated on average 700 hours more than conventional haul trucks, with 15% lower costs, delivering clear productivity benefits. They also take truck operators out of harm's way, reducing the risks associated with working around heavy machinery.

We operate the largest autonomous drilling fleet in the world. We use 26 autonomous drills to drill blastholes safely and accurately from a remote location. An operator, located at our operations centre, can plan activities for each drill for an entire shift remotely, rather than doing the work manually on-site. We have also introduced smart charge trucks, which automate the process of pumping explosives into drill holes. The trucks use computer systems and data analytics to determine the right amount of explosives to use for each drill hole, helping to reduce wastage and improve the effectiveness of the blast.

Automation improves the safety of our employees and creates value for our shareholders and the broader community.

3. Communication and Change Management

What Rio Tinto has learned from the conversations with our employees and the broader community, is that transparency is key.

As part of our automation and technology journey, we are committed to having open conversations with each potentially impacted employee. In 2019 alone we held more than 2,000 career conversations. It is about putting people at the centre of change. Really listening to them. Giving them key information. Engaging with them about what is going to happen and, more importantly, how they can prepare.

Not everyone will stay in the job they have today. Many will find tasks within their role change. There is no one-size-fits-all approach when it comes to reskilling, upskilling and career pathways. Every individual has different abilities, fears, and aspirations. It is up to us to help them effectively prepare to realise their pathway.

We need to create opportunities for people to understand and learn the skills needed to thrive in the workplaces of the future to give people confidence that there is a job for them and that they will be ready for it.

4. Developing the Skills of the Future

In 2019, Rio Tinto partnered with the Western Australian government, South Metropolitan TAFE and our industry colleagues to deliver the first nationally recognized qualifications in automation. The courses included a pilot program offering high school students the opportunity to study a Certificate II in Autonomous Workplace Operations.

This collaboration is creating transferable skills. Skills that are recognised across the country, not just at Rio Tinto, or another mining company. This means people can follow opportunity wherever they find it, in whatever industry they choose.

As pioneers in innovation, Rio Tinto is proud to be working with the Western Australian Government and South Metropolitan TAFE on this important skilling and education initiative.

As a proud employer of choice in Western Australia, we recognise that our vision to strengthen educational pathways represents an investment in training and education options for all Western Australians. The demand for people educated in the areas of science, technology, engineering, and mathematics will continue to grow.

As a member of the Minerals Council of Australia (MCA), Rio Tinto is working via this collaborative industry partnership, with the Federal Government under a Skills Organisations Pilot (MSOP). This will help enhance, expand and advance the skills of our resources workers.

Rio Tinto is also an active member of the WA government's STEM Advisory Panel. In 2019 we were proud to host the release of the State STEM Strategy, a blueprint from government, industry, and educators to enhance the state's STEM capabilities.

The key for us is ensuring that our people are the focus of conversations about change and the future of work –not the technology. We need to combine the insights and understanding of companies, with the resources and reach of our educators and government, to provide opportunities to understand and learn the skills needed.

Being clear about the future of work is vital to ensuring it is welcomed with the excitement that comes with new opportunities. Because, the reality is, none of this innovation is possible without the ingenuity of our people.

5. Letting the Robots do the Dangerous and Boring Jobs

We harness new and emerging technologies to make our operations more efficient, safer, and more environmentally friendly. We do this all the way through the mining life cycle: as we explore, design, build, operate and close our assets.

Across many of our operations, we are using remotely operated land rovers and drones to do risky jobs and keep our people safe, like checking high walls in open pits, and parts inside big machinery.

Deep inside our Bingham Canyon copper mine in Utah, western United States, we use a remote operated vehicle team—including drones and other equipment—to help keep people safe and save the business money. The newest team member is a robot named Mark II, designed, and built by our chief drone pilot, Matt Key, using an over-the-counter rock crawler and a 3D printer. Matt's ingenuity meant Mark II cost a mere $10,000 to build, a fraction of the $100,000 it could have cost to buy a similar robot. Mark II squeezes into small spaces and manoeuvres over tough terrain to test oxygen levels and collect soil and water samples. He can travel more than a kilometre away from his team and last for hours on a single battery charge.

Mark II and his older brother Oscar (also a robot) are already making a huge difference inspecting Kennecott's network of old underground mining tunnels. The tunnels are not used for mining anymore, but Rio Tinto maps them to make sure we don't inadvertently put people or machinery on unstable ground. Mark II uses high-definition video and other high-tech equipment to inspect the tunnels, check oxygen levels and look for other possible hazards before we send people in.

He is also there to help in an emergency. If there was a gas release underground, we could send Mark II in to take samples or drop off medical supplies and equipment while the emergency response team is suiting up. He can help the mine operate more efficiently too.

Checking parts inside big machinery like a grinding mill would normally mean shutting it down for four hours, pulling it apart, and sending people inside to do an inspection. But using Mark II and his flying drone sidekick Wilson, the team can check machinery in under an hour and without pulling the mill open, saving time and money.

Our operations centres in Perth and Brisbane in Australia, and the Saguenay region in Canada enable all our mines, ports, and rail systems to be operated from a single location. The teams work in rooms filled with screens that show the entire operation in action in real time. Using tools like predictive maths, clever computer code and powerful software, our operations centres help us identify opportunities for improvements and efficiencies, from finding the best way to get ore from the ground to improving the way we make products.

We use drones and ROVs for real-time 3D mapping and equipment inspections, as well as checking slopes, crests, and walls for safety risks like cracks and signs of rock movement.

One of the biggest benefits of our drones is safety. There are some jobs that are better for drones to do rather than people, for example high wall mapping. By using drones, we are removing people from harm's way.

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We are also using drones fitted with thermal diagnostic capability to identify equipment problems from the air. We can identify high friction rates on equipment in real time and notify the maintenance teams so the issues can be addressed.

The team's job is to drill holes in a set pattern, fill them with explosives, and then set off the blast to break the ore so that it can be extracted. Blast clearance is an important check, and in the past the process involved the team physically going to the blasted site to carry out the inspection, where they may have been exposed to risks from unstable or loose rock, fumes, or from walking on uneven surfaces. During this inspection, which typically took 45 minutes, operations within 500 metres are shut down, meaning potential production was also lost.

This new use of drones helps keep our team safe and, for every blast, the drones are now saving them around 15 minutes. Bots come in all shapes and sizes and are commonplace in our everyday work. Bots are what we call our robotic process automations (RPA), and they are already assisting our Iron Ore and Aluminium product groups and other support functions.

Our Information Systems & Technology team are making our jobs easier by developing and implementing this technology behind the scenes. Bots complete repetitive tasks for us like opening emails and attachments, data entry, moving files, filling in forms and making calculations.
At our Hope Downs 1 mine in the Pilbara, Western Australia, we developed an RPA responsible for logging the site's maintenance order requests. The bot is now saving our maintainers significant time each shift and simplifying the shift handover process. There are bots doing scheduling, ordering, learning and development, maintenance, finance, marine, and core services in Iron Ore. More bots are in—or about to be in—development, helping to make our jobs easier and more efficient.

About the GMG Autonomous Mining Skills Migration Case Study Project

To achieve the desired operating efficiency and productivity benefits of an autonomous operation, companies require resources with a different skillset than those which are required from the typical mining equipment operator. This project aims to develop case studies from organizations that have successfully implemented autonomous systems to help companies create a workforce that will enable autonomous mining.

Do you have a case study you would like to share? Contact us.

About GMG

The Global Mining Guidelines Group (GMG) is a network of representatives from mining companies, original equipment manufacturers (OEMs), original technology manufacturers (OTMs), research organizations, academia, regulatory agencies, consultancies, and industry associations who collaborate to tackle the challenges facing our industry. GMG aims to accelerate the improvement of mining performance, safety, and sustainability by creating guidelines and white papers that address common industry challenges, facilitating collaboration and expanding the industry's knowledge base. GMG also hosts and supports events that bring mining stakeholders together along with external industries to address the industry's challenges, successes, and innovations. Learn more about GMG at https://gmggroup.org/