Rio Tinto opened a remote operations centre in Perth for its Pilbara iron-ore operations in June 2010

Remote possibilities

Ailbhe Goodbody investigates the benefits of using remote and integrated operations centres to run mining operations

The terms 'remote operations' and 'integrated operations' are both commonly used in the mining industry, but they mean different things. Remote operations simply run a mine site/s from a different place; the benefits of this include improved safety by removing people from more hazardous work environments, which reduces the frequency of human interaction with heavy machinery on site and significantly reduces the possibility of injury.

There is also a reduced impact of remote residential life or fly-in, fly-out (FIFO) on the workforce's health and family, resulting in a more stable and productive workforce. In addition, in the 'war for talent', it may be an incentive to offer a work location that is not isolated or in a harsh environment.

Reducing the footprint of the mine sites' infrastructure and the size of the workforce employed on site also brings environmental benefits. For example, in Western Australia mine sites are often located in remote desert environments; reducing the workforce on site leads to reduced energy use and carbon emissions from operating a smaller camp, flying fewer people thousands of kilometres to the site, and reduces the need to transport food and supplies by road away from major distribution centres. It also reduces the need for clearing larger areas to build communities or mine camps.

Integrated operations centralise decision making, planning, and end-to-end analytics functions for optimisation and process improvement at multiple mines or more complex operations. These hubs may be located remotely, or on site as a centralised control facility; this article will look at operations that are both remote and integrated.

Integration of operations has the benefit of improved planning capabilities. It provides the platform to perform mid-term and tactical planning/scheduling and resource levelling from within one location, where the relevant disciplines are co-located. Having access to the same data/information, the team tasked with optimising the short-term plans can thus avoid or minimise decision-making about resource allocation on the day or morning of the shift. Improved asset utilisation, reduced re-work and more effective task assignment and execution and hence workforce utilisation are the result.

From a mining engineering perspective, centralising some of the engineering functions can be valuable for knowledge-sharing. Mining engineers controlling different sites can now operate from a single location as opposed to being located hundreds of ►

"Integration of operations has the benefit of improved planning capabilities"

BHP Billiton's integrated remote operations centre in Perth, Western Australia, came into use in July 2013

kilometres apart; this centralisation supports opportunities for sharing knowledge, transferring skills and covering vacant positions.

In addition, they can result in improved efficiency and productivity. The productivity of the entire business can be optimised through full integration of the key components – the final outcome is superior to the sum of the individual parts. Increased information availability can lead to better problem solving – for example, collecting operating data from multiple sites can improve maintenance practices and uptime at individual operations, and facilitates collective reporting and co-ordination.

Neil Freeman, principal consultant – mining, minerals and metals, at automation specialist Honeywell Process Solutions, says: "The traditional approach to the supply chain, where the mine, plant, transport and port operate independently, creates silos of information, which is a barrier to communications. This makes it more difficult to make decisions that provide the best outcome for the entire value chain." Centralisation of operations can help reduce these barriers because all parts of the value chain are co-located.

The most well-known examples of such centres are in Western Australia, where Rio Tinto opened a remote operations centre in Perth for its Pilbara iron-ore operations in June 2010; while BHP Billiton opened its integrated remote operations centre in Perth in July 2013. Roy Hill Holdings also completed construction of its remote operations centre there in November 2013. However, there are other examples worldwide, such as some of Codelco's operations in Chile.

"Remotely operated equipment requires a new safety protocol to be adopted as well as acceptance by local maintenance and operations staff"

CENTRE DEVELOPMENT

The time needed to develop an integrated or remote operations centre depends significantly on the scale of requirements and the organisation's technical and operational readiness. The majority of infrastructure is related to communications and computing, rather than the centre facility itself.

The centre should be in a location where 24-hour access is easy; for this reason, centres are sometimes located near airports. Infrastructure requirements include fibre-optic broadband and a stable power supply with back-up power.

Philippe Lebleu, principal consultant at AMC Consultants, says: "The physical infrastructure is often less time-consuming than developing the human confidence in relinquishing control to the automated, semi-automated or remotely controlled systems and remote-operation methodology."

It is important to establish a long-term vision for integrated remote operations, and then start building it in pieces. A company could start with remote monitoring of haul trucks, then move to remote dispatch and maintenance planning, before progressing to automated or remote-controlled haul trucks. The design phases are critically important to successful implementation; poorly designed systems just do not work.

The main challenges of building an integrated remote operations centre are typically organisational change in terms of how the business operates. On a technical level, once this is understood, appropriate diligence can be undertaken to engineer the systems and centre to support the business. Chris Inie, mining industry specialist at Toric Technologies, a joint venture between True North Automation (Canada) and Calibre Global's Industrial Technology Division (Australia), notes: "There is no one-size-fits-all approach; there are common issues and requirements that need to be addressed where prior experience can be effective and efficient."

Change management is important, as workers may resist change, especially if it is not handled properly. The different expectations and organisational functions must be addressed to maximise the centre's value, and this must be carefully handled through a change management process.

Cam Harris, extractive metallurgy lead at management consulting company Accenture, says: "There are cultural and managerial issues to be addressed – remotely operated equipment requires a new safety protocol to be adopted as well as acceptance by local maintenance and operations staff. Managerially, the responsibility for production must be clearly defined as the operators are no longer on site and under the supervision of local management."

One of the key advantages of an integrated remote operations centre

Skills shortage

The mining industry has historically not been seen by the broader population as an attractive industry. This is partly due to its nature, but also because of the remoteness of some mine sites, which means the workforce must live in remote communities or work on fly-in, fly-out (FIFO) rotations.

In addition, the appetite of the younger generation to seek adventure by living in exotic and remote locations has dwindled in the last few decades, as younger people prefer the comforts of urban existence.

The ability for mine workforces to work in urban centres will mean the pool of potential employees could be expanded and more skilled workers could be attracted to an operation.

Peter Bryant, partner at strategy consulting firm Clareo, comments: "It is obvious in an era of impending skills shortages due to the retirement bulge that anything we can do to attract new and young talent to join mining instead of other competitive sectors such as oil and gas, aerospace, etc. must be grabbed and promoted."

There is also the opportunity to attract experienced mining staff who no longer want to work in regional mines.

Griebel of VCI says: "Recently I have noticed that mature professionals are simply bored by the work that occurs routinely in the mining companies, and integrated operations centres can provide the opportunity to attract individuals that cherish a variety of tasks."

For example, employees with young children are more likely to be attracted and retained to the mining industry if they are able to return home every day. This is a particular concern when workers have children that are reaching critical stages in education, or when considering spouses' careers; these issues often arise when people are entering a very valuable/experienced stage of their career.

Lebleu explains: "Moving most of the engineering and operations functions to city centres will make it more attractive to skilled workers, and transform the broader population mind-set, by showcasing the mining industry as a high-technology industry

should be to help optimise the whole mining cycle, from mining at the face to processing and transportation of the ore to its final destination. At mine sites, these departments are commonly working in isolation.

It is important that a remote operations centre is able to integrate all the functions benefiting from close collaboration. Making the whole mining process clearly visible makes it easier to understand and assess the impact of certain isolated decisions on the whole process, not just a specific function. It is therefore important that integrated remote operations centres are built to foster collaboration across multiple disciplines.

A key element in addressing this is tackling the organisational structures between the site and the centre with this design challenge in mind – not just building it and assuming that everything will work as it did before.

Another specific challenge is managing the disconnection between staff in the integrated remote operations centre and those on site, or between management's communication from the centre and the direct translation into action on site.

A primary driver to implement integrated remote operations is labour cost, so it should be noted that the benefit of making the expenditure is lessened in low-labour-cost regions. Justification for the investment must be made on the basis of improved operations performance, above and beyond what can be achieved locally.

Remote operations are facilitated by communications technology such as the Honeywell Experion Collaboration Station

employing highly skilled people rather than a 'dirty, dark and dangerous' industry."

Another advantage of an integrated operations centre is the ability for people to service and support multiple operations.

Freeman explains: "This means that specific skill sets can be shared among operations – whereas, if site-based, this particular skill might only be utilised for a percentage of the time. In effect, this means that a skilled resource can be fully utilised, and not diluted doing other tasks as might be the case if dedicated to one site.

"This in turn can lead to increased job satisfaction, which, with a city-based lifestyle, could lead to reduced turnover."

Fully utilising such skills should also have the effect that companies will keep employees through the mining cycles.

There can be an issue, however, of some very valuable people not wanting a position in such a centre, given the lack of proximity/connection with mining operations.

DATA

Integrated and remote operation necessitates the collection and manipulation of large amounts of data, which in turn opens opportunities to optimise the whole mining process.

Increasingly, operations personnel are inundated with a plethora of information from different sources; this is exacerbated within an integrated remote operations centre. The challenge is to make sense of the data and effectively co-ordinate and collaborate with this information.

Freeman says: "The Abnormal Situation Management (ASM) consortium is dedicated to making sense of this information to avoid incidents. This includes analysis of operator effectiveness, alarm management and operations visualisation. The research has resulted in a number of guidelines, which are being used by the major oil and gas companies, and increasingly by mining and metals companies."

Data capture, storage/accessibility and the capability to analyse the vast quantities of data are key to any integrated operations centre. Ernst Griebel, associate consultant at Virtual Consulting International (VCI), observes: "I don't think that any of the existing integrated operations facilities are capturing this benefit – mainly because they have not managed to find the people that specialise in this – and turn the data into knowledge. Predictive analytics for everything in the value chain will improve efficiencies by an order of magnitude."

Mining companies can use the collection of large production and telemetry data sets and the associated analytics of 'big data' to make better decisions, improve prediction of certain occurrences and streamline the business process. While these are not specific to integrated operations centres, they provide an organisation with a more natural focal point for the use of such systems to assist decision making and execution.

Studying the data provided by operations can uncover indicators that would otherwise go unnoticed. The availability of this data eases such tasks as reporting, and makes key performance indicators (KPIs) available in near-real time. The ease of distribution and general availability of these KPIs will allow management to respond more quickly to changes, and to speed fine tuning to optimise operations.

Through understanding the leading indicators, a company's maintenance can move to being predictive (rather than preventative or reactive), which improves equipment availability and reduces costs. There is often a huge amount of data collected that is not fully used for predictive and preventative maintenance.

"There is often a huge amount of data collected that is not fully used for predictive and preventative maintenance"

However, often the challenge is to interpret the data and effectively focus on what is important. For instance, a haul truck collects hundreds of measurements daily which, if monitored remotely, can be used to reduce maintenance costs and also assist in training of personnel.

Predictive maintenance can dramatically improve equipment reliability. Centralising information ►

Photo: Schneider Electric

gathering and analysis allows the team to develop algorithms that predict what leads to equipment failure – they can then fix the problem before it fully manifests, reducing the probability of a failure and increasing asset utilisation.

Tracking and monitoring factors that in the past have led to equipment failures will deliver an understanding of when machinery will probably fail – therefore allowing for planning and action, such as anticipating maintenance and reducing the level of 'back-up' machinery and staff required to manage the variability.

Greg Johnson, senior manager, operations optimization at Schneider Electric's mining & metals center of excellence, explains: "There are pattern-recognition technologies that can recognise the lead-up signs to an asset failure, enabling more time to plan, schedule and carry out repairs in a predictive, proactive mode. This is potentially many times more cost-effective than reactive maintenance, and even many preventive practices."

Jeff Loehr, strategy practice leader at global strategy and innovation consultancy CNARIO Consulting, says: "One operation that I visited was able to identify, through simple regression analysis, that an increase in exhaust temperature indicated that a specific engine component would soon need to be replaced. Before the analysis, this component would cause failures, but by identifying this leading indicator the mine could replace the engine component before it caused failure. This was part of increasing its availability from 65% to 85%."

However, David Andrew, lead consultant at VCI, cautions that despite the push for 'big data', the concept of collecting data for data's sake is generating push-back across a variety of companies. He comments: "The feeling is that, as per other business initiatives, unless there is a solid business case then it is superfluous work. As the science of data increases towards more tangible gains, this will shift."

TRENDS

Currently, only large mining companies are using integrated remote operations centres. However, as the benefits of operating such centres are better understood and communicated across the mining industry, it is expected that smaller mining companies could consider their implementation as well.

Darryl Hockey, general manager of external affairs at Roy Hill Holdings, says: "It will become more mainstream once the industry gets past the perception that it is all about technology, and instead grasps the significant benefit that can be delivered from an integrated single optimised business."

Of course, these centres will come in different forms and sizes based on companies' needs. It is likely that at first there will be a significant increase in local automation and control, with big data collected at sites being used to better integrate and optimise mine and mill operations, and improved reporting being made available company-wide.

Harris states: "As the local improvements are effected, gradual migration of local tasks to centralised or outsourced control centres will continue to increase."

Efficiency gains that the large companies are chasing will also become available for smaller companies, particularly considering that remote autonomous equipment will become standard over the next few years. Smaller mining companies will also benefit from the lessons learned by the majors to lower the implementation cost and develop strategies for maximised return on investment.

Johnson says: "Another trend will be increased collaboration and workflows to outside experts. While the largest miners may have much in-house expertise, we see linkages to services provided by experts in particular technologies, such as energy management or vibration monitoring, to be key."

The current model of bespoke design and development of these centres, and the associated processes and skills, is usually out of the reach of a small company due to the level of change and capital required. The future of such centres for smaller companies could come from the development of a standardised and open integrated operations centre platform that can be purchased 'off the shelf'.

Andrew suggests: "A standardised platform could be implemented across numerous companies, similar to a SAP system, providing the majority of the value for a fraction of the price. The necessary support services and processes ecosystem would have a chance to naturally develop due to the open nature of the system."

Another option is that smaller operations or single-mine operators could team up to establish an integrated/remote operations centre for a single geographical area that has multiple mines and operators to optimise the logistics – essentially it would become an outsourced provider of mine management across multiple mines in a single area.

THE FUTURE

All current indicators suggest a continued trend toward increasing automation, connectivity and the ability to handle large amounts of data, and

Transferring control to a remote centre can enable better sharing of skills and knowledge

"The concept of collecting data for data's sake is generating push-back across a variety of companies"

Centralised data monitoring can make it easier for companies to optimise their operations

Photo: Schneider Electric

Photo: Honeywell

Operating large and complex machinery from a comfortable office brings benefits in safety, staff retention and efficiency

with this, the increasing ability to centralise operations control.

Technical advances in equipment-monitoring technology and the deployment of unmanned equipment such as driverless trains, haul trucks, drills and potentially survey drones, which require limited human activity on site, will further increase the appeal for opening integrated/remote operations centres.

As collaborative and video communication technology develops further, the available resource pool will be much wider and greater, and there will also be the capacity for international inputs.

Harris says: "It is likely that local control will give way to regional control, which will in turn move to global control. The rate of implementation will depend on the degree of benefit the control is shown to deliver compared to the ever-decreasing cost of implementation."

Improvement in automation technologies, communications and the ability to access large amounts of live data across long distances will make it possible to open global integrated remote operations centres.

Global operations centres also have the potential to minimise nightshift work, as the main operations can be handed over to time zones where the work day is starting. Highly mechanised and/or automated mines can ultimately be operated from anywhere.

A global approach would be possible from a technical standpoint, provided sufficient availability and capacity of communications is available. Inie explains: "A global approach needs to address cross-jurisdictional control and accountability.

"In many instances, the legal/social licence to operate along with the benefits of local expertise, language, environmental and cultural awareness will mean that a global approach may not always be appropriate. We see the potential to federate/tier regional and product centres of excellence, with more common support functions across multinational organisations."

There will always, or at least for the foreseeable future, be some need for in-person interaction at the mine site, but that will diminish. Centralisation of expertise in hubs is going to continue as it increases the depth of specialisation. There will, however, be a need for 'generalists' in the field who can tap this global expertise and translate it into action.

The future of operations could consist of brilliant generalists in the field who can learn quickly, supported by remote specialists (from any location) housed in an integrated remote operations centre.

"The future of operations could consist of brilliant generalists in the field who can learn quickly, supported by remote specialists"

Vale looks for Extreme edge

Hexagon Mining's plan to deliver the mining industry's first non-proprietary management information system (MIS) for open-pit operations control and dynamic optimisation – and a new information-rich supervisory platform – is moving closer to commercial realisation.

Rodrigo Marinho, the COO of Hexagon subsidiary Devex Mining, says initial deployments at Vale's Itabira iron-ore mine complex in Minas Gerais, and Norsk Hydro's Paragominas bauxite operations in Pará, both in Brazil, are progressing well and should confirm Extreme's readiness for broader market release later this year.

"Extreme is the first mine asset-management system with an open and extensible architecture that allows clients or third-party suppliers to develop specific functionalities to expand control and performance," Marinho said at Hexagon's recent customer event in Las Vegas, US.

"What we're trying to do is the same as open-platform communications data access (OPCD) in general industrial automation, for the mine operation itself. The [mine] platform needs to be open – we need to not only think about, but achieve, technological convergence, and not only have a platform that is able to take anything new that appears, but really anything imaginable. It should be easy, and open."

OPCD, basically open connectivity in industrial automation, works outside the mine-mobile fleet operations space because interoperability is assured by non-proprietary open standards developed over many years. This high-level interoperability extends to mine processing plants and other fixed operational centres.

The mobile environment and connected mine operations centre represent the 'new frontier' in mining for technology convergence and performance optimisation.

Extreme is used to monitor and manage a mine's systems, equipment (fixed, mobile, auxiliary and productive), mining fronts and even people and their activities: no activity performed in the mine needs to be without control and supervision.

"We're trying to bring the consolidated automation practices of general industries to the mining operation," Marinho said. "This enables us to deal with many different sources of data to create information for a better decision process. What we are bringing to the market is the concept of a mobile automation control system."

Marinho said Itabira had more than 30 'assistance systems' (including fleet management), each with a specific role and aim, and from different suppliers. "Until recently it seemed impossible to integrate all these systems into one matrix," he said.

"We convinced [Vale] to pull apart their own initiative of creating a new supervisory system to get our platform to cover their needs. Extreme was selected as a solution for mobile process automation.

"Vale now plans all the activities for auxiliary services in the mine, monitoring them in real time using a realistic 3-D environment. The project we started with them in 2011 has solved the management gaps of the fleet-management system in use, and the auxiliary equipment operators now have better KPIs, improving the productivity of the whole mine.

"The maintenance people can now access the same information in the same way as the operational and planning people are. It makes a big difference in the end."