

Collaborative Remote Operations Centre Report

Mining and Petroleum Services Centre of Excellence

ICT Roadmap for Minerals and Energy

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Executive summary

An eight month study for a collaborative Remote Operations Centre (ROC) for the minerals and energy sectors in South Australia has been successfully completed and has set the foundation for an information and communications technology (ICT) innovation platform for remote applications.

The aim of the project was to investigate the feasibility of a collaborative, open-platform ROC that could contribute to productivity improvement, cost reduction, workplace safety and an innovation ecosystem for the minerals and energy sectors in South Australia. Development of the target IT architecture for a ROC collaborative software platform was the first of six outcomes. This platform would provide the initial design of a programming interface to enable future innovative ICT applications for the minerals and energy sectors to be easily developed with a specific focus on increasing productivity.

The project team was led by IPACS Power, a South Australian ICT/defence small to medium-sized enterprise (SME) with the support of the University of South Australia (UniSA), OZ Minerals (South Australian based miner) and the Department of State Development.

The ROC project was the first ICT Roadmap for Minerals and Energy Resources (ICT Roadmap) project to be funded through the Mining and Petroleum Services Centre of Excellence (CoE), an initiative of the South Australian Government that supports the development of capabilities in local supply chains to provide high value added products and services to the resources sector nationally and globally.



The ROC project received funding of \$383,000 in January 2014 and built directly on the ICT Roadmap's CSIRO report Scenarios for ICT in Minerals and Energy in 2025 where a collaborative ROC was identified as a key future opportunity for South Australia.

The ICT Roadmap is a joint initiative between the Australian Information Industry Association (AIIA) and the Government of South Australia that aims to foster collaboration between the ICT industry and the mining and petroleum industries.

The ROC project used wireless data transmission via the 3G mobile phone network to securely transmit data from vibration sensors and a video camera on a conveyor drive in the ore crushing circuit at the OZ Minerals Prominent Hill mine in the far north of South Australia to a ROC in Adelaide with the aim of measuring vibration frequencies in the equipment over long periods of time. Changes in frequency can be an accurate measure of a change in the equipment, indicating a fault or an impending failure.

The project team innovatively re-engineered the way the router (that collects the vibration data at the crusher) connected to the nearest 3G mobile tower (receiver) providing a high quality, continuous data stream from a remote location to the ROC in Adelaide. Over a four-month data collection period, mobile transmission failed on several occasions resulting in no data stream for up to four days at a time. When mobile transmission resumed, all the vibration data stored by the on-site server was accurately forwarded to the ROC in Adelaide and no vibration data was lost throughout the project period.

During the project, the team realised it was important to establish a 'test and trial' ROC at UniSA for the purpose of ongoing research and teaching and as a future innovation hub for new remote applications in Adelaide. UniSA welcomed this development and has now committed to the establishment of a 'test and trial' ROC in the School of Information Technology and Mathematical Sciences.

With the establishment of a 'test and trial' ROC at UniSA, a number of global ICT companies have committed to providing hardware and analytics software to the 'test and trial' ROC for the purpose of showcasing their products to mining and petroleum companies and providing a venue for education, training and research in remote operations. It is anticipated that the number of these partner relationships will increase over time. UniSA has also examined the ICT skills needed by future ROC employees.

The longer term aim of the ROC project is to increase the number of globally competitive South Australian ICT companies that deliver high value, best practice solutions to the global resources sector using the collaborative ROC platform.

A major feature of this ROC project has been to work towards the foundation for an open platform with open standards for small and medium enterprise (SME) ICT companies to engage with mid-tier mining companies.

The report that follows will outline the technical feasibility, legal agreements and skills development for a collaborative ROC, the establishment of a university-based 'test and trial' ROC and the important learnings gained by the entire team in the process of understanding the essential elements for successful implementation of a remote operations centre.

OZ Minerals, the mining industry partner in the ROC project, also undertook its own innovation journey in remote operations during the eight-month ROC project and proved to be a genuinely collaborative partner that not only provided access to its crushing equipment for vibration analysis but helped the project team understand the important operational, commercial and cultural requirements of a mining company in Australia. In addition to in-kind support, the company contributed capital to develop the demonstration pilot at the OZ Minerals Adelaide office.

Introduction

What is a Remote Operations Centre?

A shared collaborative remote operations centre (ROC) is a grouping of mid-tier mining companies and their service providers which in some way share a common ICT infrastructure that facilitates remote operations. The ROC is not located geographically near the typically remote operations of the mining company but is strongly connected to the remote locations using a telecommunications network. The ROC is, rather, located in a large centre of population where there are readily accessible specialist skilled staff who can maintain the centre's infrastructure and/or provide specialist services through the centre's infrastructure.

Many of the issues and challenges of remote operations in the Australian context were discussed in a series of papers at Austmine conferences and publications emanating from the Mining Cooperative Research Centre (CRC).¹

The ROC project aimed to define the technical and non technical characteristics of such a centre through consultation with a mid-tier miner and a number of stakeholders which are service providers to mid-tier miners. The project has also constructed an exemplar pilot demonstration of the ROC in conjunction with one mid-tier miner and one service provider. In association with the project, research proposals have been developed from scoping studies funded by the CSIRO Mining Resources Flagship that relate to the secure collection and analysis of data within the ROC. These proposals, if completed, would provide a theoretical basis for the analytics of time series data collected in the ROC to assist companies in making technical and business decisions.

Drivers for the expansion of remote operations in mining

This project has aims and outcomes that are mapped to the ICT Roadmap for Minerals and Energy (ICT Roadmap), a series of reports published on the ICT Roadmap website.² The CSIRO report for the ICT Roadmap is structured under the headings of Megatrends and Scenarios to 2025 for the mining and energy sectors. Whilst the ROC project is focused on mining, some scenarios for the energy sector are also relevant. The ROC project falls under the megatrends of 'From FIFO to LILO' (page 17) and 'Plugged In and Switched On' (page 23).

For the megatrend of 'From FIFO to LILO' there is a prediction that remotely located control rooms will reduce the reliance on Fly-In Fly-Out (FIFO) and corresponding on-site head count and replace it with Log-In Log-Out (LILO). Historical examples cited in the CSIRO report include automation of trucking operations and oil and gas drilling. Productivity gains of 25 per cent are cited following the introduction of remote operations.

Keeping mining and mining services firms in South Australia will largely depend on the state's ability to create an environment where these kinds of increased productivity can be achieved routinely. The ROC project provided an exemplar of how the new IT-focused remote monitoring of mining operations can be staged.

In line with the 'From FIFO to LILO' megatrend, OZ Minerals (industry project participant) has continued to evolve to meet changing business needs by transitioning from a site based FIFO model to maximising the use of regional offices and shared services, allowing access to a wider range of people and resources.

Historically, mining has employed systems which relied on operator knowledge, with shift by shift planning which resulted in variation in operational performance aligned to rosters. OZ Minerals systems have been developed to the point of real-time performance monitoring with multiple onsite control rooms for open pit, underground mining operations and the processing plant. This has delivered improvements in mining at a tactical level through automated dispatch systems etc. leading to greater productivity and reliability. The processing plant is highly automated, with auto control for key plant systems maximising plant efficiency. This has been in conjunction with centralisation of specialist skills and knowledge, development of real-time scenario reviews and removal of decision-making away from operational pressures. Future planning involves greater levels of automation, sensor deployment and remote control across the business to improve safety with increased mobile plant density and overall productivity.

The second aspect of the transition from FIFO to LILO is the change in the skill base of workers involved in the mining industry. The CSIRO report highlights the need for up-skilling and reskilling in the workforce as maintenance and operation personnel move from site where hands-on skills are more predominant to a remote centre where IT skills will be more important. To this end, as part of the collaborative ROC project, UniSA supported some undergraduate projects where students gained an early understanding of remote operations.

¹ Farrelly et. al 2012, Farrelly and Records 2007 and Bassan et. al. 2008

² www.statedevelopment.sa.gov.au/ictroadmap



The megatrend in the ICT Roadmap called 'Plugged In and Switched On' draws attention to the consequences of large numbers of sensors, referred to as the 'Internet of Things', being plugged into company operations and consequently requiring the analysis of large collections of data. The ROC project has brought together a local company experienced in the creation of large sensor networks in mining (IPACS), a number of UniSA ICT researchers with extensive experience in low-cost sensor integration, big data analytics and diagnostics and a local mid-tier mining company willing to provide data to these sensors (OZ Minerals).

This project has also aligned closely with the ICT Roadmap mineral resources future scenarios of 'Interoperability for Innovation' (page 46) and 'Remote Operations Hub' (page 48) and the energy resources future scenario of 'Monitoring and Control' (page 61).

The mining scenario of 'Interoperability for Innovation' explains the importance of common standards for communication between automated systems in mining particularly for the engagement of small and medium sized suppliers 'offering niche ICT-based services to support automated equipment on site' (page 46). A major feature of this ROC project has been to work towards the foundation for an open platform with open standards for these SME ICT companies to engage with mid-tier mining companies. Applications providing mining services ('dashboards for mining') will be based on a common API for accessing the data generated.

The ICT Roadmap also identifies the possibility of companies with defence-related skills transferring across to serve the mining sector. The SME partner in the ROC project has a history of working in defence. This project has demonstrated how these skills can be transferred to the mining sector through the pilot. The UniSA has long standing links with the Defence Science and Technology Organisation (DSTO) and research leaders who have extensive experience in the mining and defence sectors. This project has leveraged these links.

A 'Remote Operations Hub' (page 48) for mining according to the ICT Roadmap encompasses a broad vision of a complete technology precinct co-locating a range of service providers around hardwired, powerful and scalable computational infrastructure. This would include service provision in virtual reality, immersive experiential learning, infrastructure maintenance and support, communication failsafe systems, remote health provision, virtual learning environments and real time communications.

The ROC project has been focused on one specific service provision, that of remote monitoring of plant to predict breakdowns. This is a first step in achieving the wider aspirations expressed in the above quotation from the ICT Roadmap.

This project has started to define how service providers and mid-tier miners can form business and technical relationships while being geographically remote from the mine site and potentially contractually separated from the mining company (e.g. given the role of major mining contractors). It has focused on the use of more integrated IT systems for remote production and maintenance using low cost sensor deployment.

The project has begun to review the requirements of mining companies and their service suppliers and potential prototype technical standards for the collaborative development of 'dashboards for mining'. The project also identified the emerging skill requirements for a 'Remote Operations Hub' and defined some educational programs to support skill development.

The case for a Remote Operations Centre

The ROC project focused on the goal of establishing a remote operations centre that falls within the South Australian Government's strategic priority of 'Realising the benefits of the mining boom for all'.

In a recent industry presentation, Gavin Yeates, Vice-President, Mine Optimisation with BHP Billiton, discussed how new technologies are changing mining processes and the importance of planning prior to the implementation of automation and how change management is an important challenge at BHP Billiton.

"We're actually at the cusp of moving to what we're calling, 'Next Generation Mining'. This is driven on one hand by technology advances in autonomy and sensing. That coincides with a drive for growth in far more complex, deeper, lower grade ore bodies in an environment where we've got real challenges in operating and capital cost pressures. (Yeates, Austmine 2013).

Mr Yeates shared his belief that the drive is to align production processes with maintenance processes, and standardise what they do and how they do it. The aim is to reduce variation prior to the introduction of further automation.

Shared Remote Operations Centre

There has been a great deal of publicity surrounding the Rio Tinto remote operations centre and to a lesser extent the BHP centre, both located in Perth. However it is important to note that the shared remote operations centre as described in this report is fundamentally different to these well-known projects.

In this collaborative project, we have categorised the different types of remote operations centres based on their functionality and purpose. The four main categories of remote operations centres are:

- Symmetric collaboration and communication centres
- Training and skills development centres
- Remote monitoring centres
- Remote control centres.

In the symmetric collaboration model, which is exemplified by our experience observing the Santos collaboration centre in Adelaide, there are a number of different geographically separated centres which are connected with video collaboration technology.

In the case of Santos, this model reflects both the history of the established Cooper Basin operations and the objective of using communication technology advances to increase business productivity.

Training and skills development was a focus of operations at the Halliburton remote operations centre in San Antonio, United States observed by team members on a study tour in February 2014. This centre also had a monitoring focus.

Remote monitoring is the focus of installations at Energy Australia and AGL in Australia.

Remote control is an important focus of remote operations centres operated by Rio Tinto, BHP Billiton and BP.

Project participants reviewed first hand all these alternatives with the intention of gaining an understanding of the ICT architecture requirements and potential benefits of a shared remote operations centre.

Project purpose

A shared remote operations centre is one that brings together:

- Mining, oil and gas companies
- World-class original equipment manufacturers (OEMs)
- Leading universities
- Research organisations
- Innovative ICT SMEs
- Mining and energy service providers.

Outcomes

Milestone 1 – stakeholder engagement

In the first milestone of this project, a preliminary concept definition of a shared remote operations centre was presented to six leading demand and 12 supply side companies. The project leaders presented the concepts to a number of different companies as shown in Table 1.

Table 1: Stakeholder engagement companies

Demand side	Supply side overseas	Supply side with local presence in South Australia
ConocoPhillips	PacWest	HP
BHP Petroleum	Schlumberger	Petrosys
Santos	Santrol	SRA
BHP Olympic Dam	Rail Commission of Texas*	Fyfe
Energy Australia	Halliburton	Schneider Electric
Beach Energy		Indago Partners
OZ Minerals		SAGE Automation

**regulator of the oil & gas and mining sectors in Texas*

The main recommendation to come from discussions with demand-side companies was to focus on asset maintenance and asset optimisation during production. Halliburton suggested integrating multiple sources of data. Santos emphasised focusing on collaboration between the central office and remote sites, utilising technology as an enabler, taking a staged approach with key concepts built up step-by-step while learning about the impacts of changes. ConocoPhillips and Petrosys suggested a shared inventory management system for the oil and gas industry in the Cooper Basin.

Summary of suggested directions for the collaborative ROC:

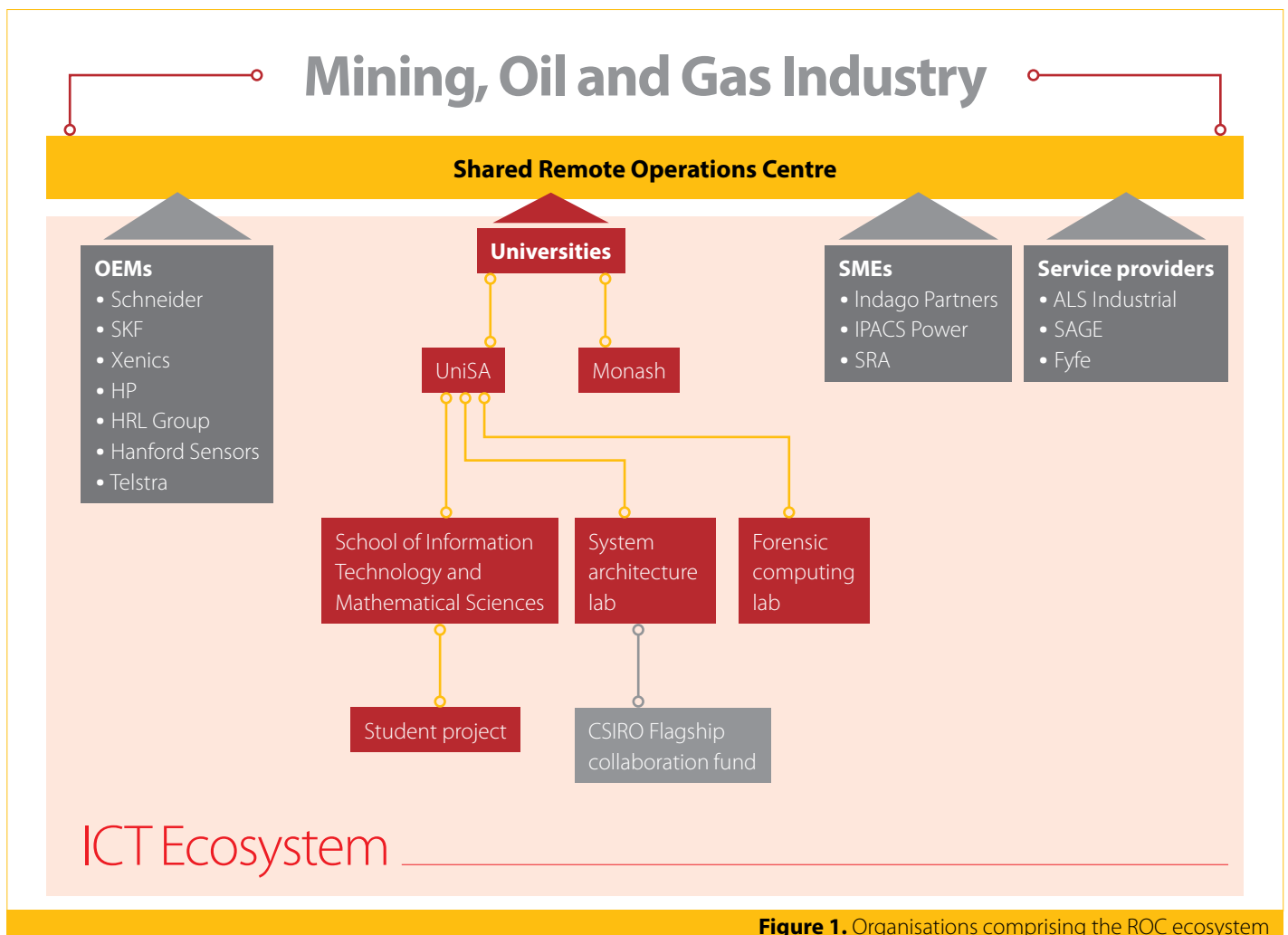
- Intelligent asset maintenance during the operations phase of unconventional gas extraction that allows for forward planned maintenance (Halliburton)
- Integration of multiple sources of data by the ROC to gain new value-adding insights for asset maintenance (Halliburton)
- Implementation of remote operations centres should be staged in a continuous process (Santos)
- Low cost shared inventory management for oil & gas operators in the Cooper Basin (suggested by ConocoPhillips and Petrosys).

Milestone 2 – ICT ecosystem, potential business models and prototype legal agreements

The objectives of the second milestone of the ROC project included construction of an ICT ecosystem, development of a potential early business model and drafting key types of legal contracts that could be used in future by a collaborative ROC to engage with local companies.

ICT ecosystem

To establish an ICT ecosystem model for a collaborative ROC, leading OEMs, SMEs, universities and the CSIRO were engaged during the project (Figure 1).



With UniSA, the ROC project engaged at multiple levels including a student project investigating cloud computing in the processing of data collected from a ROC and two joint projects with the CSIRO on security issues and the analysis of time series data, using both statistical methods and standard business intelligence tools. The project team also engaged with Monash University to explore the remote operations of a camera-based technology for coal-fired power station optimisation. The companies shown in Figure 1 on page 7 are all interested in participating in a collaborative ROC project.



Potential ROC business model

As part of the ROC project, IPACS did some initial desk work developing a potential ROC business model based on a process used by an Australian Tier 1 miner.

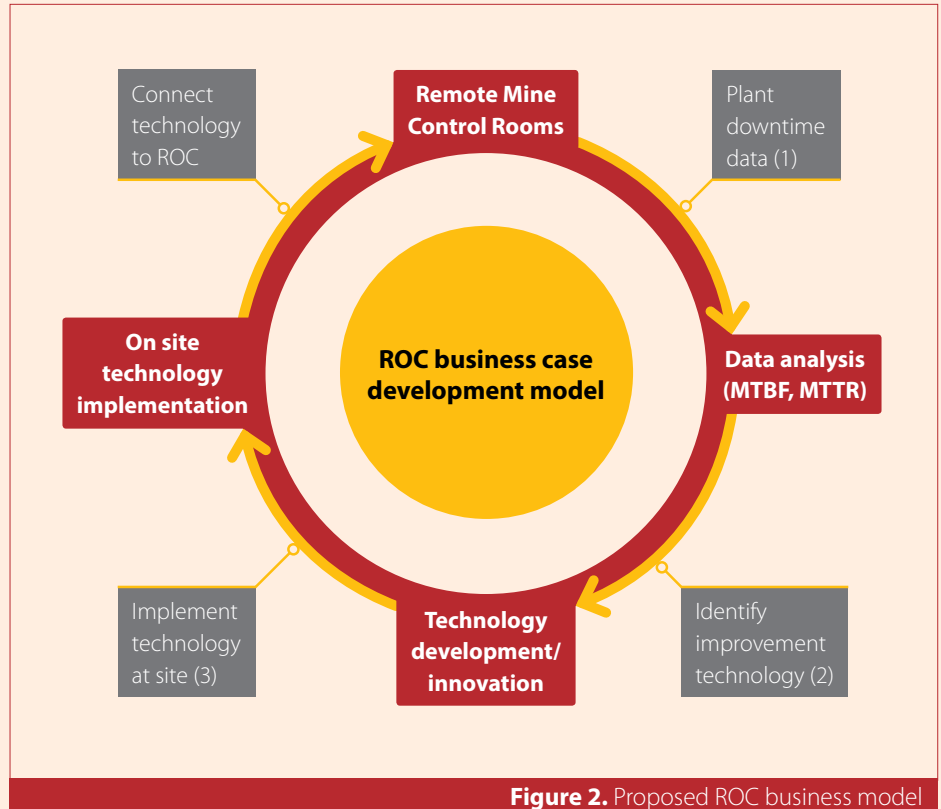


Figure 2. Proposed ROC business model



The stages in this proposed model (Figure 2) involve (1) collecting Mean Time Between Failures (MTBF) and Mean Time To Repair (MTTR) from the various local mine control room data; (2) identifying opportunities for technical solutions to solve the identified problems and (3) constructing or acquiring the technological implementations for deployment on site.

In the longer term, the ROC project aims to examine whether this sort of deployment can be implemented through a collaborative ROC using shared infrastructure for production monitoring as well as maintenance.

The core business functions and target markets for services offered by a future collaborative ROC will need further development. The key questions outlined in Table 2 may help drive future collaborative ROC commercial options. Commercial entities with different business models may seek different forms of commercial engagement, ranging from mine operators 'purchasing' a 'service' not already undertaken (i.e. a new form of condition monitoring) through to service providers who have multiples of the same equipment onsite or elsewhere at multiple sites, and have limited remote monitoring in place, taking advantage of collaborative ROC infrastructure or a specific service.

ROC prototype legal agreements

Six types of legal agreements relevant to a shared ROC were developed during the project.

- 1. Data use agreements** - contracts defining how confidential and copyright material is created stored and transferred inside the shared remote operations centre.
- 2. Non-disclosure agreements (NDA)** - overarching contracts that protect confidential information from being disseminated outside the partners in the centre.
- 3. IP agreements** - define how the benefits from new intellectual property generated as part of ROC research and development activities will be shared amongst the partners of the centre.
- 4. Casual work agreements** - define conditions under which casual independent software developers or other independent casual labour will be engaged on work related to the centre.
- 5. Consulting agreements** - contracts for engaging professionals on work related to the centre.
- 6. Collaboration agreements** - set out the roles and responsibilities of partner organisations involved with the centre.

Commercial and legal risks with the 'collaborative' ROC approach were also identified that will require further study (Table 2). The development of legal and commercial frameworks and the ICT architecture that can support the use of sensitive production data in a collaborative ROC is viewed as very important.

Table 2 - Key questions generated during the ROC project

Topic	Key questions for a collaborative ROC
Commercial	<p>How will intellectual property (IP) be protected? Can IP be shared?</p> <p>How will risk and liability be shared and managed?</p> <p>How will the contractual arrangements work?</p>
ROC Services	<p>What function(s) will a collaborative ROC offer a commercial mining or energy operation?</p> <p>What client organisational changes will be required to accommodate ROC input?</p> <p>Is the ROC service aimed at mining contractors, other service suppliers or end user clients?</p> <p>What physical and data structure should it have?</p> <p>Is this a commercial or research based entity?</p> <p>What entity, or entities, will own and manage the centre?</p>
ICT Architecture	<p>How will data be securely collected, transmitted and stored?</p> <p>How will data be returned to the client?</p> <p>Who has access to the data?</p> <p>How will each company limit its potential exposure in a multi-user environment?</p>



Milestone 3 – ICT architecture

In milestone 3, the ICT architecture was developed and implemented. The purpose behind the establishment of a ‘test and trial’ ROC at UniSA was to allow for the development and testing of data integration and analysis without the need to address the stringent access requirements for the corporate IT system at OZ Minerals in the short timeframe the project had to work within. This ‘test and trial’ ROC will also provide a future innovation hub with longer term access for students, researchers and smaller innovative ICT companies for research, teaching and testing of new products and services.

Further consideration will need to be given to key questions relating to data access and security (Table 2) for the collaborative ROC in the next project stage.

Milestone 4 – Network architecture

The ICT architecture for the ROC was developed and implemented. The ICT architecture consisted of a ‘test and trial’ ROC at UniSA and a related exemplar Operations Centre at OZ Minerals.

Every remote operations centre is highly dependent on its data communications network. Figure 3 shows the network architecture developed during the ROC project for the secure 3G transmission of IPACS sensor data. IPACS installed a 3G modem and router at the Prominent Hill mine to transmit live data via a virtual private network (VPN) link to the ‘test and trial’ ROC at UniSA. For the purpose of demonstrating live vibration analysis data feeds from the crushing equipment at Prominent Hill, a secure VPN link

was established between the ‘test and trial’ ROC at UniSA and the exemplar Operations Centre at OZ Minerals.

Future value from a collaborative ROC will be maximised through the seamless integration of differing data sources. Thus, understanding and resolving data source integration challenges with client data will be important.

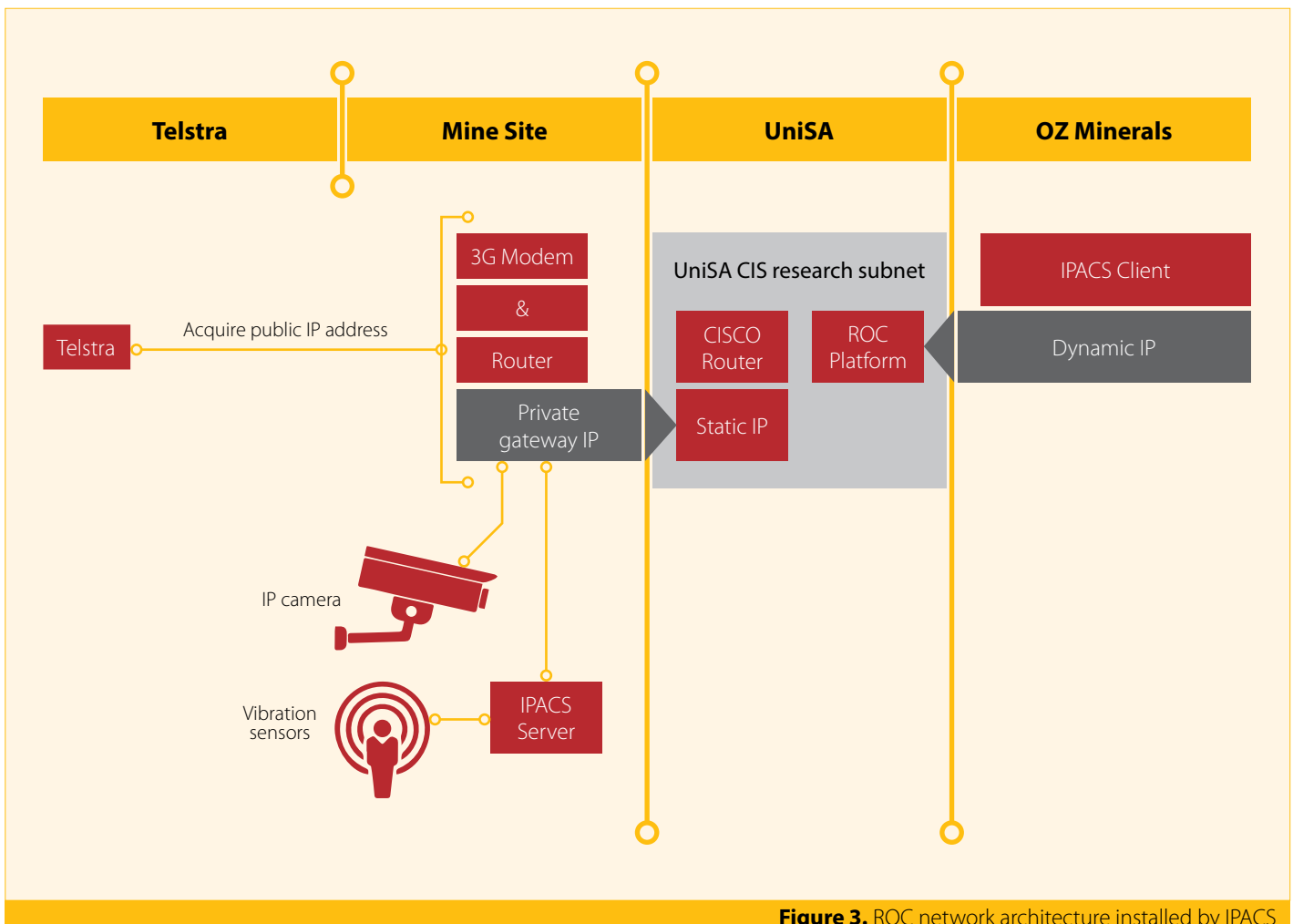


Figure 3. ROC network architecture installed by IPACS

Milestone 5 – Implementation

The pilot implementation of condition monitoring at the site involved the supply and installation of vibration sensors on the main feed conveyor drive to the processing plant, a camera that overlooked the drive, an IPACS router and a 3G modem at OZ Minerals Prominent Hill mine. Figure 4 shows the physical installation on site.

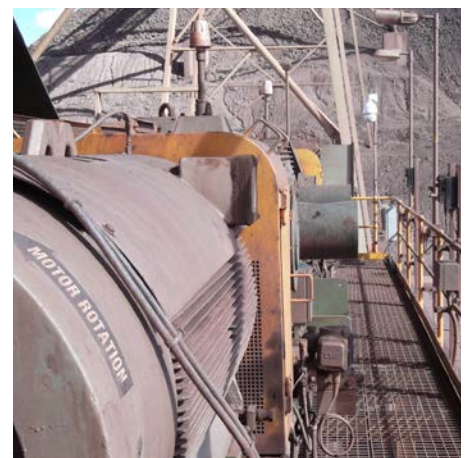


Figure 4. Installation of IPACS condition monitoring on site. (Clockwise from top left) a. sensor install b. camera install c. overview of the conveyor drive with main stockpile in background d. networking (left) and sensor processing cabinets (right)



The IPACS server collected and processed vibration data acquired from the sensors while the 3G modem enabled 3G transmission of data from the router and camera to the 'test and trial' ROC established at UniSA. At the time of writing more than four months data had been successfully collected.

The ROC project team innovatively engineered the network communications so that data integrity was always maintained for the data collected from the distributed vibration sensors. Network equipment controls were developed to automate network availability processes along with store and forward functionality. This ensured complete data sets were maintained without human intervention when network interruptions occurred between the ROC and the remote site. Over the four-month data collection period this proved invaluable as several interruptions occurred on the communications link to the remote site, some of which lasted several days. When mobile transmission resumed, all vibration data stored by the router was accurately forwarded to the ROC in Adelaide and no vibration data was lost throughout the project period.

An exemplar operations centre was also established at OZ Minerals corporate office in Adelaide. In addition to vibration and camera data, live view-only SCADA plant data and underground operational technology/information technology convergence data from Prominent Hill was received.

In addition, the CSIRO Minerals Resources Flagship provided UniSA with \$40,000 in research funding to investigate security issues for a collaborative ROC and to study the applicability of statistical methods and standard business intelligence tools to time series data acquired from a mine site.

The ROC project team also supported a student project at UniSA to investigate the use of cloud computing in the processing of the sensor data collected.

Valuable learnings were gained during the collaborative ROC project which, if implemented during a second stage project, would increase future outcome value and reduce execution risk. These include:

- Engage with key project participants during project scope development - prior to project funding allocation - to ensure outcomes and expectations are aligned in terms of the project budget, timelines, deliverables and outcomes
- Engage people with experience in establishing ROCs in an advisory capacity. This would help fast track the project by taking advantage of previous learnings and reduce risk
- Develop legal and commercial frameworks to allow market sensitive production data to be used by a collaborative ROC service provider (and allow the involvement of third parties including research organisations and universities)
- Develop ICT architectures and protocols to support secure exchange of production data between a ROC service provider and a customer. The ICT architecture needs to recognise complexities with existing security architectures typically used in Operational Technology networks/environments

- Adopt robust project management methodologies and project stage minimum standards, and ensure some team members have project management and commercial experience.

One difficulty faced by the ROC project team was the need for longer than an eight-month time period to establish the full benefits of the collaborative ROC. Santos indicated that planning alone on their collaboration centre lasted more than a year. Further investment of time and resources beyond this initial project is needed to establish a collaborative ROC on a commercial basis.

New skills required for remote operations

Preliminary work was conducted by the School of Information Technology and Mathematical Sciences at UniSA on the range of generic IT-related skills required for remote operations. These include:

- Data science
- Application development
- System integration
- Systems administration
- Automation - technical
- Sensors - technical
- Networking
- Security
- Cloud computing.

Current work on skills development for remote operations

Kinetic Group Worldwide (Kinetic Group 2014), a skills advisor to the resources sector in Australia and elsewhere, released a report 'Automation for Success' (McAree and Lever, 2010) that drew attention to the workforce issues impacting the sustainability of increased automation. The report identified a skills gap related to automation. They noted that the skills and knowledge required for automation are unique and not well covered by existing skills development programs. They also noted a need to better determine the skills and knowledge that will be required as a result of accelerated technological change in both equipment and the associated IT systems.

They identified a new role of automation technician and suggested this be recognised by the industry. Detailed work has been conducted on this role including an overview (Mining Industry Skills Centre 2011a) and a list of skills and tasks (Mining Industry Skills Centre 2011b) to be performed in such a role. This raises the interesting question as to the feasibility of any one technician being trained in all the tasks identified across many disparate trades. Refer to Appendix 1 for details of job ads recently placed by Santos for positions in its Collaboration Centre that require a range of IT skills.

Innovation opportunities for a collaborative Remote Operations Centre

It is the aim of this collaborative ROC to become an innovation delivery platform driving innovation in the minerals and energy sectors whilst allowing SMEs to contribute into a common remote centre rather than having to establish separate relationships with each mining, oil and gas company. The standardisation of contractual arrangements such as data use agreements enables faster and more agile innovation than would otherwise be the case. This is a significant opportunity for a shared ROC where structural barriers can be broken down by providing innovation and commercial opportunities to SME members of the South Australian ICT ecosystem.

South Australia is home to a dynamic ICT industry comprising world-class universities, leading OEMs, innovative SMEs and start-ups. Nevertheless, on a global scale the ICT sector in the state has not achieved ground breaking technology innovation within a dynamic ICT ecosystem on par with the United States, the United Kingdom and other Australian cities.

A number of structural barriers appear to have prevented the various parts of the ICT ecosystem in South Australia from realising their true potential in the minerals and petroleum services supply chain – with the notable exceptions of companies like Maptek, Codan, Petrosys, SRA and SolveIT (recently acquired by Schneider Electric). The ROC project aims to identify and break down these structural barriers by providing mining and petroleum innovation and commercial opportunities to members of the South Australian ICT ecosystem.

Conclusion

Mining in South Australia (in common with trends elsewhere) is dependent on decreasing costs through increased productivity to counter the challenges associated with increasing deposit depths, geographically remote locations and cyclic commodity prices. For example, iron ore companies continue to experience pressure as the commodity prices drop. It has been publicly reported that Fortescue Metals Group with large iron ore operations

in Western Australia has been able to reduce costs from around \$90 to \$74 per tonne. Rio Tinto and BHP Billiton have reported even larger cost savings.³ But smaller companies in South Australia may not have the scale efficiencies to deploy cost saving technologies in the same way. The shared ROC could provide a rich source of expertise for smaller mining companies to draw on to improve productivity and increase safety.

A shared or collaborative ROC could make mining companies in South Australia more sustainable in an increasing cost environment. The next step in addressing this challenge will be undertaken via the Stage 2 ROC project that will lead to the development of a commercial collaborative ROC in Adelaide.

³ MiningNewsPremium.net Iron ore red zone for second-tier miners Tuesday, 9 September 2014

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Summary of ROC project results

Table 3

- Implemented industry feedback to focus on integration of multiple sources of data to improve asset maintenance
- Established an ICT ecosystem to support the collaborative ROC
- Drafted six types of legal contracts:
 - Executed a contract with SKF
 - Executed a research contract with UniSA
 - Executed a contract with OZ Minerals
- Developed and implemented the collaborative ROC ICT architecture
- Implemented a secure and reliable ROC network using 3G with:
 - Vibration sensors fitted to a conveyor mechanical drive
 - Camera that overlooked the drive
 - IPACS router and a 3G modem

IPACS router collected and processed vibration data from the sensors while the 3G modem enabled 3G transmission of data from router and camera to the 'test and trial' ROC at UniSA
- Established a 'test and trial' ROC at UniSA for longer term research and teaching
- Obtained \$40K research funding to investigate security issues for a collaborative ROC from CSIRO Minerals Resources Flagship provided to UniSA
- Supported a student project at UniSA to investigate use of cloud computing in processing the sensor data collected

Collaborative ROC - opportunities and benefits

Table 4

Organisation	Structural barriers	ROC Opportunities	Potential ROC Benefits
Universities	<ul style="list-style-type: none"> Lack of access to live data for research and teaching 	<ul style="list-style-type: none"> Establishment of the test and trial ROC at UniSA with live data feeds 	<ul style="list-style-type: none"> Align research and training with industry needs Develop innovative ROC applications for industry
Analytics and optimisation software OEMs	<ul style="list-style-type: none"> Inability to sell to mid-tier and tier 3 miners 	<ul style="list-style-type: none"> Demonstration of technology at the test and trial ROC 	<ul style="list-style-type: none"> Showcase technology to mid-tier and tier 3 miners
SMEs and start-ups	<ul style="list-style-type: none"> Limited exposure to mining operators and contractors Inability to demonstrate skills and technologies to target audience 	<ul style="list-style-type: none"> Demonstration of technology at the 'test and trial' ROC Industry round tables Mining and Petroleum App development competitions 	<ul style="list-style-type: none"> Demonstrate technology at the 'test and trial' ROC Make industry connections at round tables
Tier 1 miners	<ul style="list-style-type: none"> Limited appetite for risk from ICT innovation - particularly from SMEs 	<ul style="list-style-type: none"> Risk can potentially be reduced through access to the 'test and trial' ROC 	<ul style="list-style-type: none"> Exposure to well-designed and tested ICT innovation technologies from SMEs
Mid-tier and Tier 3 miners and contract miners	<ul style="list-style-type: none"> Limited budget and appetite for risk arising from ICT projects unless a strong business case demonstrates a positive outcome Lack of scale to maximise the benefits of ICT innovation 	<ul style="list-style-type: none"> Risk can potentially be reduced through access to the 'test and trial' ROC 'Test and trial' ROC will showcase innovative ICT technology applied to live data Industry round tables will showcase innovative ICT technologies 'Test and trial' ROC will support skills development 	<ul style="list-style-type: none"> Access to new ICT innovation in mining and petroleum Access to proven ICT technologies Increased competitive global market position ROC operations training courses will upskill staff in mining and petroleum companies

Project plan, objectives and project team

Table 5

Project plan consisted of four stages:

1. Stakeholder engagement

- Present a preliminary definition of proposed collaborative ROC to mining and energy companies for feedback

2. Business model construction

- Develop prototype contractual arrangements for the collaborative ROC

3. Technical IT architecture definition

- Define the technical ICT architecture of the collaborative ROC
This needed to encompass an interface between the private ICT facilities of stakeholders and a private cloud shared between all ROC participants

4. Exemplar platform construction

- Construct a small scale demonstrator of the collaborative ROC

Project objectives

- Construct an innovation delivery platform
- Develop a target ICT architecture
- Identify important needs of an initial mining demand customer
- Determine the ICT skills needed by future ROC employees

Project team

- Project Sponsor – Department of State Development, Government of South Australia
- Project Leader – IPACS (ICT/defence SME)
- Research Partners – UniSA, CSIRO
- Industry Partner – OZ Minerals
- Technology Partners – HP, OSISoft, SKF

Project aim, vision, components

Table 6

Aim

Investigate the development of a commercial, sustainable ROC for the minerals and energy sectors in South Australia on a collaborative platform.

Vision

Establish a collaborative ROC as a platform for building a South Australian ICT innovation ecosystem for the minerals and energy sector.

Components

Collaborative ROC consists of:

- Innovative SMEs
- Leading South Australian based original equipment manufacturers (OEMs)
- World class universities
- Research organisations
- Minerals and energy suppliers and operators

Project components

- Real-time application of existing technology at a trial site that sends data to a collaborative, innovative ROC platform to test how the ROC works
- Develop and document the shared understanding of the elements of the journey to inform the development of a commercial, sustainable collaborative ROC
- Legal framework for a future sustainable collaborative ROC
- Project collaboration between a mining company (OZM), university (UniSA), ICT SME (IPACS) and the Government of South Australia

Project summary

The project aims to investigate the development of a commercial, sustainable Remote Operations Centre (ROC) for the minerals and energy sectors in South Australia on a collaboration platform.

Objective

Investigate the feasibility of a collaborative, open-platform ROC in Adelaide that contributes to productivity improvement, cost reduction, workplace safety and an innovation ecosystem for the minerals and energy sectors in South Australia.

Outcomes

- Developed a target architecture of the ROC collaborative software platform
- Determined whether OEM primes will contribute to the project
- Identified important needs of an initial mining partner
- Developed the legal framework for sustained commercial operations
- Determined the ICT skills needed by future ROC employees
- Designed a programming interface to enable innovative applications on the ROC platform

Outputs

- Conceptual technical design for a collaborative ROC
- Demonstration of the ROC in operation for potential collaborative partners
- Final report on technical feasibility, legal framework and skills development

Criteria to be part of the CoE work program

- Builds directly on the ICT Roadmap's CSIRO report, Opportunity Identification and Future Scenarios to 2025 where a collaborative ROC was identified as a key future opportunity for South Australia
- Builds on comparative advantage in ICT and defence software in SA, has industry in-kind support (OZ Minerals), has multiple partners (OZ Minerals, UniSA, IPACS and Department of State Development) and requires a collaborative approach

Project Governance

- Project sponsor: Dr Paul Heithersay; Project manager: Susan Andrews; Technical lead: Dr Vinay Sriram; Project implementation team: Dr Vinay Sriram, IPACS, A/Prof David Kearney, UniSA, Sean Fitzpatrick, John Penhall & Brad Winks, OZ Minerals; Project sponsor for OZ Minerals, Brian Kilgariff; Project Advisory Group: DSD, IPACS, UniSA, OZ Minerals

Budget and funding sources

Project funding is provided by Mining and Petroleum Services Centre of Excellence. OZ Minerals has agreed to provide in-kind support.

Timelines and milestones

Project implementation by 30 June 2014. Final reporting by 30 September 2014. Funding agreement signed 17 January and project commenced 28 January 2014. Definition of project scope commenced with a visit to OZ Minerals Prominent Hill mine on 19 February 2014. Project Definition workshop on 28 March 2014. ROC live demonstration to key stakeholders on 14 August 2014.

Website www.statedevelopment.sa.gov.au/ictroadmap

Mining and Petroleum Services Centre of Excellence Table 8

The Mining and Petroleum Services Centre of Excellence provides a pathway for mining and energy companies, research institutions and South Australian businesses to work together to find solutions that will make the state's resources globally competitive.

The Centre of Excellence supports the development of local supply chains to enable South Australian-based companies to compete nationally and globally, providing high value-added products and services to the resources sector.

Centre of Excellence criteria for funding projects

- Builds on South Australia's existing comparative advantage, either in terms of research, industry or natural endowments
- Has industry funding or in-kind support
- Will have material impact and is an identified priority for industry
- Solves problems which industry can't solve itself, for reasons such as incomplete or asymmetrical information or common resource and public goods problems
- Has multiple partners and requires a collaborative approach
- Can be publicly reportable

Website www.statedevelopment.sa.gov.au/what-we-do/mining-and-petroleum-services-centre-of-excellence

Appendix 1

Santos collaboration centre job ads (jobseeker.com.au)

Collaboration Centre Support Analyst – Adelaide SA

Job Description

About Santos

Santos is a major Australian oil and gas exploration and production company with high quality assets and projects throughout Australia and the Asia-Pacific region. The company is one of Australia's largest domestic gas producers, supplying to all mainland Australian states and territories and oil and liquids to domestic and international customers and has the largest Australian exploration portfolio by area of any company. Santos is also developing a multibillion-dollar project to convert Coal Seam Gas (CSG) into Liquefied natural gas (LNG) at our world-first Gladstone LNG plant. Santos has more than 2,800 Australian-based employees working across its operations, and country offices in Indonesia, Papua New Guinea, Vietnam, India, Bangladesh and Tajikistan. Santos has a total market capitalisation of approximately \$12 billion, making it one of Australia's top 30 companies.

About the role

Be part of a new era in Santos Collaborative Working Practices; apply your hands on technical and high level interpersonal skills in this dynamic role.

You will be responsible for:

- Business facing role
- Adelaide based with ad hoc site travel
- Great culture, positive work/life balance.

The EACCs (Eastern Australia Collaboration Centres) herald a new era in Santos Collaborative Working Practices, bringing together personnel and information from multiple locations and assets, and providing the ability to work better as an overall team, with the advantage of leading technology. Within your role as EACC Support Analyst, you will be responsible for providing business support to Santos Operations to define, deliver and support Collaboration Centre Systems (Babelfish, Eyevis, VC, Videro WPM).

This is a business facing role where you will provide support in the various collaboration suites across Eastern Australia, including remote sites such as across the Cooper Basin. The role is based in Adelaide, however will see you travelling on an ad hoc basis out to field sites, and will provide you with the opportunity to build a diverse range of professional relationships.

Part of the responsibilities within your role will also be:

- Application content development for the collaboration suites across East Australia
- System enhancement
- Development of data sources to provide a rich mixture of data for the collaboration suites
- Dashboard development using various visualisation tools
- Training of users on the collaboration suite technology and solutions
- VC/AC support
- Documentation and reporting
- Process and system improvement in line with business requirements.

To be successful in this role you will:

Ideally be tertiary qualified in either IS, Mathematics, Science or Engineering and will have significant experience within IT&T in a corporate environment. Oil and gas industry experience will be highly regarded.

From a technical perspective, you will be able to demonstrate significant experience with Enterprise Information Systems, web technology, HTML, JAVA, .NET and the MS Office suite of products.

Your interpersonal skills will be developed to a high level, and you possess the ability to effectively communicate complex technical concepts to a wide variety of people and will be adept at identifying opportunities for improvement based on business requirements and requests.

Technical Analyst – Collaboration Systems

You will provide business support to Santos Operations to define, deliver and support Collaboration Centre Systems.

Your key responsibilities will be to:

- Provide technical support of the Collaboration Centre systems (both in office and field locations – travel is required)
- Provide system administration and system development for the Collaboration Centre Suites, systems include, AMX, Dundas, Spotfire, Dashboard Tools, Digital Signage Tools, SQL Databases, etc.
- Provide solution design and deliver projects to upgrade and enhance systems
- Maintain training material and conduct training courses
- Develop business relationships with IS, Business and System Vendors.

Desired Skills and Experience

To be successful in this role, you will have:

- Tertiary qualification in IS, Mathematics, Science or Engineering, and a minimum 3 years' oil and gas industry experience with IT and technical exposure
- Superior analytical and problem solving skills, exceptional communication skills, strong customer service focus and team work approach
- Experience with video conferencing technology, and be proficient in producing reports/dashboards/webpages using HTML, JavaScript, C# (.NET), SQL, SSRS, SSIS, Adobe Suite and the MS Office suite of products.

Appendix 2

ROC project partners

IPACS Australia

IPACS Australia Pty Ltd is an Australian privately owned company established in 1997 in Adelaide, South Australia. IPACS has a substantial customer base across a diverse range of industries throughout Australia, Europe and Asia. In Australia, IPACS has developed several leading edge products and technologies especially for the Australian Defence Force.

IPACS specialises in multi-signal data acquisition, signal processing and analytical/diagnostics software complimented with matrix processing of complex images. IPACS provides process/machinery performance optimisation services through the examination of dynamic machine signatures. IPACS designs and develops high technology tools for the analysis of machinery condition and performance.

From 2002 to 2008, IPACS led a joint venture with Tenix, Australia's largest defence contractor, for technology demonstration across the aviation and maritime platforms. IPACS is currently developing solutions for some of Australia's largest mining companies. IPACS also develops and maintains custom built simulation platforms, using customisable embedded processors, for the test and evaluation of complex defence systems integration and upgrades.

IPACS Power Pty Ltd, a wholly owned subsidiary of IPACS Australia Pty Ltd, designs, manufactures and supplies advanced embedded clean coal technology, based on its acclaimed high speed infrared theomorphic imaging algorithms.

www.ipacsaustralia.com.au

OZ Minerals

OZ Minerals is an Australian-based modern mining company that owns the Prominent Hill mine and Carrapateena project, both located in South Australia. The Prominent Hill mine is located 650 kilometres north-west of Adelaide and 130 kilometres south-east of Coober Pedy. Carrapateena is located 250 kilometres from Prominent Hill and 160 kilometres north of Port Augusta.

Prominent Hill is a copper-gold mine that includes open pit and underground operations. Prominent Hill produces a high-grade copper concentrate, containing copper, gold and silver, which is sold to customers in Asia and Europe.

OZ Minerals employs a direct workforce of 380 people. Prominent Hill has a workforce of approximately 1,400, with the majority being contractors' employees.

With an experienced team, a strong balance sheet and well performing assets, OZ Minerals is well positioned for the future.

www.ozminerals.com

University of South Australia

School of Information Technology & Mathematical Sciences

The School is the largest information and communications technology provider in South Australia, and is regarded as one of the leading applied mathematics departments in Australia.

It offers undergraduate, honours and postgraduate degrees in mathematical sciences, data science, information technology, software technology, games and entertainment design, systems administration, cloud computing, business systems, software engineering and multimedia. It is home to three research centres: Advanced Computing Research Centre, Centre for Industrial and Applied Mathematics and Phenomics and Bioinformatics Research Centre. Australia's first Industry Doctoral Training Centre within the school trains PhD students in applied mathematical and statistical techniques through innovative industry-based projects.

www.unisa.edu.au/it-engineering-and-the-environment/information-technology-and-mathematical-sciences

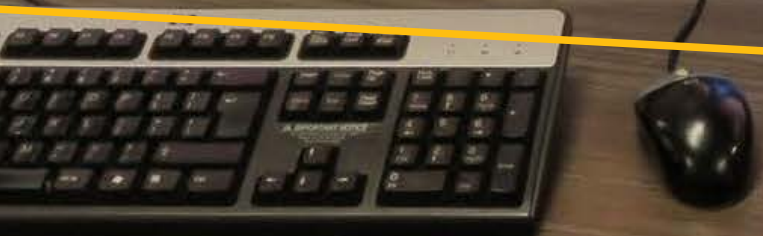
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South Australia

Centre of Information Technology,
Engineering and the Environment.

unisa.edu.au/itee





The **Department of State Development** drives economic growth and job creation. The department works with business, the education sector, community and other partners to create and build industry and employment opportunities across the state.

The department is responsible for the state's growing resources and energy portfolio, our transformation to high-value manufacturing, skills formation, employment and science.

It also focuses on skills development, job creation, business development and sustainable employment for Aboriginal people. It develops and emphasises government policy that promotes Aboriginal affairs and supports young Aboriginal people and those living in regional and remote South Australia.

The department supports businesses and individuals in regions across the state, recognising their challenges and opportunities.

The Department of State Development is positioning South Australia to capitalise on our high growth, high-value sectors, including mineral and resources, information and communications technology, defence, agribusiness, advanced manufacturing and renewable energy.

Combining industry and workforce functions into a single department harnesses the full range of government services, delivery functions and support activities to drive economic transformation and wealth.

www.statedevelopment.sa.gov.au

Disclaimer

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