Remote Operations Centre Stage 2 Project Final report

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Overview

A project to establish a commercial remote monitoring centre in Adelaide for resource companies in South Australia and world-wide, built on an open collaboration platform that could cost-effectively monitor critical assets, has been successfully completed.

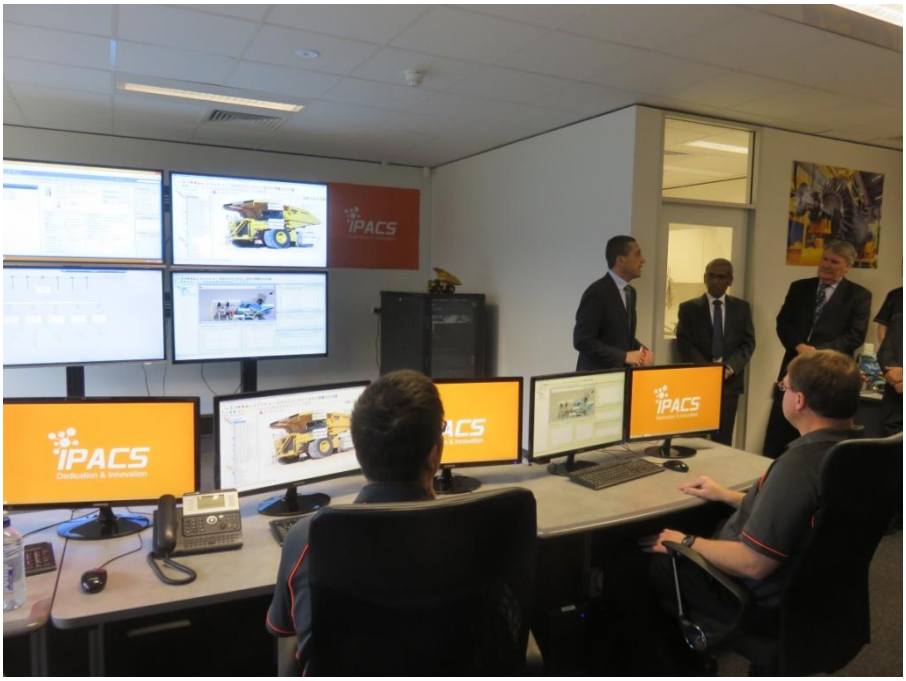
The project received funding from the South Australian Mining and Petroleum Services Centre of Excellence and built upon the successful Stage 1 pilot that confirmed the feasibility of an open platform Remote Operations Centre. The Stage 2 project team was led by IPACS Australia, a South Australian ICT/defence small to medium enterprise (SME), with the support of the University of South Australia, OSIsoft and HP Enterprises.

The Stage 2 project achieved the following important outcomes:

- Establishment of the IPACS Remote Asset Management Centre which was launched by the South Australian Minister for Mineral Resources and Energy, Hon. Tom Koutsantonis, MP in September 2015. The Centre provides lower cost, lower risk specialist access to remote monitoring, new analytics and automation technologies to smaller resource companies that need to achieve similar productivity gains to those achieved by larger miners and oil & gas companies.

- Demonstration of improved asset reliability and availability for two contract miners, Lucas TCS and Thiess. The use of networked sensors and advanced analytic tools clearly demonstrated that continuous monitoring of key assets from the IPACS Remote Asset Management Centre could prevent costly breakdowns via appropriate alerts indicating early maintenance was required.

- Establishment of proven capability by the IPACS Remote Asset Management Centre in the remote monitoring of real-time asset performance of mining vehicles, boilers, smelters, SCADA (Supervisory Control and Data Acquisition) systems and mining fixed-plant infrastructure.



IPACS Centre launched Minister for Mineral Resources and Energy, Hon. Tom Koutsantonis, MP

Introduction

The resources sector globally is currently facing the end of the super cycle and a return to more normal cyclical patterns of demand. Most commodity prices have fallen sharply. In Australia, mining has transitioned from a decade-long construction boom to a production phase where high levels of production are being maintained in many key sectors, despite lower commodity prices.

Lower prices, however, are forcing mining companies to find more cost-efficient ways of reducing operational expenditure while increasing or maintaining output. Finding more cost-efficient ways to conduct business is now an absolute imperative.

BHP Billiton, for example, has adopted a strategy of 'sweating' its assets – extracting as much benefit as possible from the physical assets it already owns [see 1].

Smart ICT applications involving the use of remote sensor data analytics – or keeping tabs on plant equipment from a central office location – will be an important part of the future for the resources sector. Millions of dollars can be saved by avoiding equipment failure and by optimising maintenance schedules to maximise asset availability which in a remote mine can prevent many days of lost production and increase returns from the asset. It can also improve mine safety by keeping workers away from dangerous remote locations and equipment. Long term, remote monitoring and diagnostics will help secure the future of the mining and petroleum sectors.

Tier 1 miners like BHP Billiton and Rio Tinto have used remote monitoring technology to achieve their twin goals of cutting costs and producing more, and both have reported significant success.

*"Automation has gone further and faster than we'd ever have imagined. Not only is it reducing costs and raising efficiency, it's also improved our health, safety and environmental performance."*Sam Walsh, CEO, Rio Tinto, 2015[see 2]

In the main, the Tier 1 resource companies that have developed remote operations technology, networked data collection and analytics based on big data principles, have done so independently, using their extensive internal technical teams and financial resources. Not surprisingly, little detail has been revealed about the implementations, costs or the intellectual property involved in these proprietary data centres.

Smaller resource companies tend not to have the efficiencies of scale to deploy cost-saving technologies in the same way as Rio Tinto and BHP Billiton. Mid-tier miners and contracting companies, many of whom are struggling to survive in the current economic climate, have tight budgets and little appetite for the costs and risks associated with technology innovation. Now, in the urgent race to reduce costs, it is their turn to share in the benefits of harnessing remote operations technology to improve equipment performance.

Background

Remote Operations Centre Stage 1 Project

An initial eight-month study into the establishment of a collaborative remote operations centre (ROC) for the minerals and energy sectors in South Australia was successfully completed in September 2014, providing the foundation for an information and communications technology (ICT) innovation platform for remote applications. In essence, the aim of this project – known as ROC Stage 1 – was to investigate the feasibility of a collaborative, open platform centre remote from the mine site that could more accurately detect faults before they occur, thus reducing maintenance costs, increasing asset reliability, productivity and efficiency, and improving safety.

The project team was led by South Australian Information and Communications Technology (ICT) company, IPACS Australia, with support from the University of South Australia, OZ Minerals (mid-tier miner), CSIRO and the South Australian Department of State Development. It was the first project identified in the *ICT Roadmap for Minerals and Energy* to receive funding from the Mining and Petroleum Services Centre of Excellence – a South Australian Government initiative that supports the development of innovation in local supply chains so they can provide high value-added products and services to the resources sector nationally and globally.

It was proposed that a shared or collaborative ROC, built with an open software architecture, that allowed third party service companies to use the common platform, could make mining companies in South Australia more sustainable by providing a cost-effective remote monitoring service that was reliable and secure and increased asset reliability, decreased equipment maintenance costs and improved safety in a challenging market environment.

The ROC Stage 1Project successfully demonstrated the remote collection, analysis and secure3G mobile transmission of long-term vibration data to a test and trial remote operations centre at the University of South Australia's Mawson Lakes campus in Adelaide. The test centre was able to remotely monitor the performance of assets located 650kmnorth-west of Adelaide at the OZ Minerals Prominent Hill mine site, without any loss of sensor data over the eight-month trial period.

On completion of the pilot project and publication of the Collaborative Remote Operations Centre report in October 2014, IPACS received strong market interest for remote asset management from several contract mining companies.

Based on the success of the ROC Stage 1 Project, the South Australian Mining and Petroleum Services Centre of Excellence provided funding for the Remote Operations Centre (ROC) Stage 2 Project in November 2014so that IPACS could develop a commercial collaborative ROC in Adelaide to deliver services to local, national and global markets. Two contract miners, Thiess and Lucas Total Contract Solutions (TCS), agreed to the delivery of remote monitoring services by IPACS.

Project description

The Remote Operations Centre (ROC) Stage 2 Project– which ran from December 2014 to January 2016saw the establishment in Adelaide, South Australia, of a commercial entity and physical centre capable of providing remote asset monitoring services to the global resources industry.

A project team, led by IPACS Australia, was formed and included the University of South Australia, global IT company HP (provision of IT equipment) and global software development company OSIsoft (provision of analytics software).

The project received $660,000 in funding from South Australia's Mining and Petroleum Services Centre of Excellence. This funding was complimented by private sector funding of $1.4M in cash and in-kind.

A project advisory group consisting of representatives from leading resource companies was established (Appendix 6) to provide high-level project guidance and advice on the future commercial arrangements for the Remote Operations Centre. The group provided valuable feedback on the purpose, target market and structure of the Centre. In early 2015, the project advisory group recommended that the Remote Operations Centre should be renamed the '**Remote Asset Management Centre**' to better align its name with the key demands of potential customers.

A commercial Remote Asset Management Centre was established at Technology Park, in the northern Adelaide suburb of Mawson Lakes, and was officially opened on 4 September 2015by the South Australian Minister for Mineral Resources and Energy, Tom Koutsantonis, MP. (See Press Release in Appendix 2.)

The project team worked with two contract miners –Lucas TCS and Thiess– to provide remote data collection and analysis. Sensors and data concentrators were installed at the Lucas crusher at the Arrium Iron Baron mine and on a Thiess ore truck at the OZ Minerals Prominent Hill mine, both sites located in Outback South Australia. The data collected from the sensors was transmitted back to the Remote Asset Management Centre over secure 3G connections. IPACS engineers were then able to monitor, around the clock, the performance of each company's assets, identify potential equipment faults and help improve plant reliability and profitability.

The Project successfully demonstrated that remote asset management technology could improve the operational efficiency of the two contract miners and could potentially strengthen their competitive position in a low commodity price market. Over a six month period both Lucas TCS and Thiess were provided with alerts to impending failures in the equipment being monitored and were able to organise preventative maintenance.

The Remote Asset Management Centre also provided a demonstration technology platform for innovative ICT companies like OSIsoft to showcase their technology capability and services to the resources sector. Going forward, the Centre aims to deliver lower cost, lower risk access to new analytics and automation technologies as well as remote monitoring to other resource, infrastructure and defence companies in Australia and beyond.

Further information about the ROC Stage 2 project appears in Appendix 3.

How the Remote Asset Management Centre works

A core component of the ROC Stage 2 project was the establishment of the Remote Asset Management Centre by IPACS Australia at Technology Park, Mawson Lakes in Adelaide in March 2015 to provide a physical hub for the delivery of remote asset management services to the initial customers – Lucas TCS and Thiess.

Prior to the establishment of the Remote Asset Management Centre, a review of key relevant technologies required by both the mining and defence industries for remote asset management was conducted by IPACS and the University of South Australia in January 2015. The defence industry was included in this initial review to increase the market scope for the commercial Remote Asset Management Centre's services given the emerging downturn in the mining sector globally with the fall in commodity prices. Also as IPACS Australia had a strong track record in providing asset-monitoring services to the defence sector, the company believed there were some synergies in the requirements of both sectors for remote monitoring.

As a result of the review it was agreed the Centre should immediately focus on delivering asset-based productivity gains and provide a suite of four core technologies as services - IT infrastructure management, physical asset data management, analytics and dashboards. Together these services would provide real-time feedback on the performance of critical assets, wherever they are located.

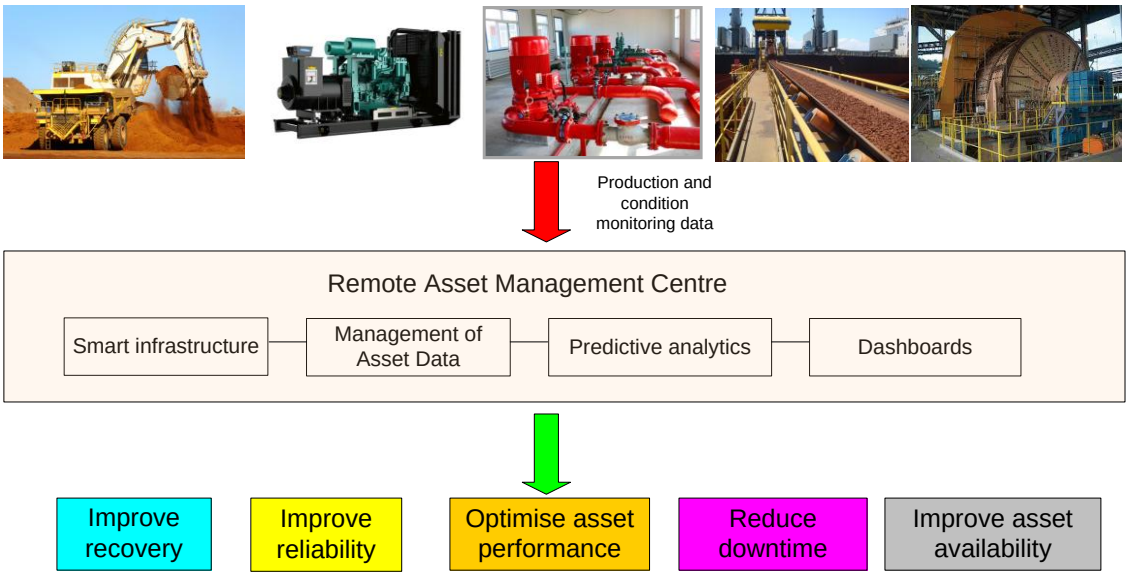


Figure 1: IPACS Remote Asset Management Centre overview

Four core technology capabilities

IPACS designed and constructed a single technology platform for their Remote Asset Management Centre based on cloud technology to enable the collection of remote machine condition data via3G mobile communications and the analysis and display of the data using analytics software and a results dashboard. Four core technology capabilities underpin the Centre's services:

1. *Smart infrastructure*

Smart infrastructure refers to the architecture of the IT network connecting the sensors, data concentrators, routers and servers and the software applications (Cisco AnyConnect, Microsoft Remote Desktop and UltraVNC) that together enable the collection, transmission, storage and analysis of remote sensor data.

The design of the smart infrastructure has been optimised for the secure, reliable and low-cost collection and transmission of remote sensor data across any enterprise and, potentially, from anywhere in the world. It also means customers can login remotely – again, from anywhere in the world.

Smart infrastructure – IT networking architecture

At the Remote Asset Management Centre, the IPACS technical team set up computer networking, virtualisation and IT infrastructure management to allow for the reliable storage and remote access of the data.

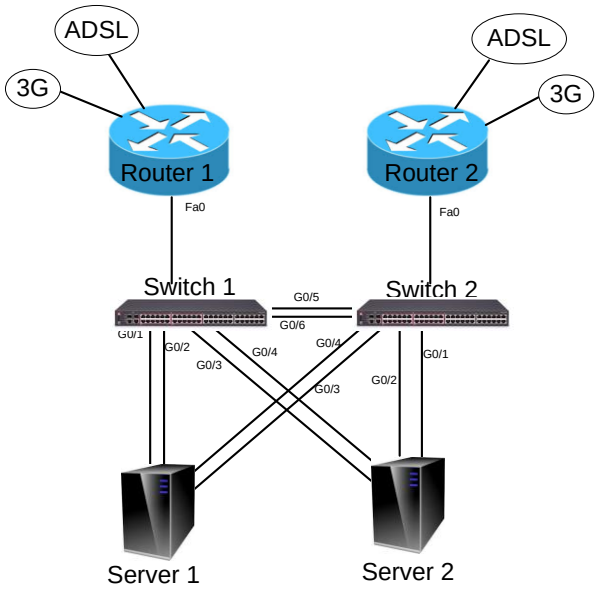


Figure 2– Remote Asset Management Centre - IT Infrastructure setup

The computer networking architecture is illustrated (Figure 2). The Centre has two servers, two switches, two routers, two ADSL lines and two 3G connections which, together, provide complete redundancy. When one of the servers, routers, switches or internet connections fails, the second one takes over. This means that customer data is always safe and secure. Installation of VMware cloud and virtualisation software enables Centre engineers to launch hundreds of virtual machines for multiple customers on demand.

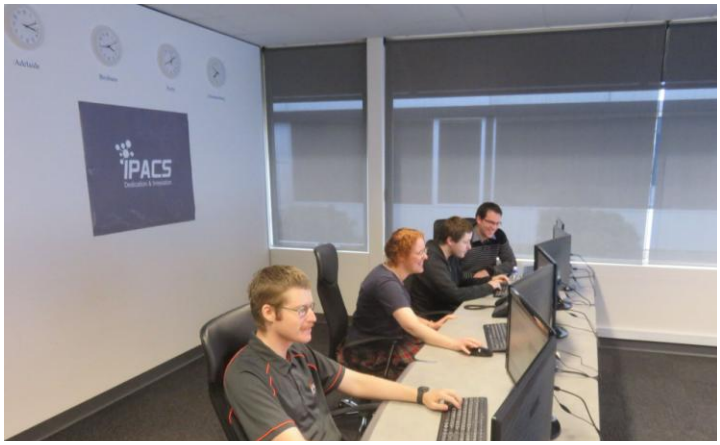
Smart infrastructure – Applications

The smart infrastructure suite of applications allows sensor data to be remotely accessed in real time, by engineers employed or engaged by each customer. CISCO AnyConnect and Microsoft Remote Desktop enable remote login. UltraVNC, an open-source technology, allows remote administration and remote desktop login for Microsoft Windows. UltraVNC is also available on mobile platforms.

2. Management of asset data

Modern sensors generate a stream of data that forms a time series. Over time, the quantity of such data grows exponentially and this needs to be managed. IPACS developed specific expertise to manage and structure this data and ensure it is tailored to the asset need. They called this the 'Asset Framework'.

OSIsoft software was installed for the management of enterprise-wide 'time series' data in the context of the asset framework. There is also the ability to merge data from multiple SCADA systems.



The Remote Asset Management Centre can now provide large-scale secure and reliable data management with an understanding of specific asset frameworks. It also provides horizontal integration of data across multiple customer assets using OSIsoft technology.

3. Predictive analytics for asset performance

The predictive analytics capability of the Remote Asset Management Centre was established to allow customers to make timely and accurate asset planning decisions.

IPACS developed predictive analytics services that provide algorithms to transform raw sensor data into easily interpreted information to analyse and diagnose asset condition and performance. IPACS engineers developed skills in designing and interpreting analytics specific to asset maintenance. This means asset conditions can be monitored, potential faults identified and customers advised so that potential faults can be rectified before they result in major machine breakdowns and, potentially, lost revenue.

4. Asset Performance Dashboard

IPACS paid special attention to developing expertise in making complex data, such as analytical algorithms, easy to use and accessible on any platform in any location. Their software engineers designed and developed graphical user interfaces and dashboards that could beviewed and understood company wide – by operations teams as well as busy executives in the boardroom.

By combining remote operations with remote asset management, the IPACS Centre allows customers to optimise both their operations and their maintenance.

Data to Decisions at the IPACS Remote Asset Management Centre

The IPACS Remote Asset Management Centre at Mawson Lakes, Adelaide, now offers a fully integrated technology-as–a-service in real-time monitoring, analysis and reporting on asset performance for resource, infrastructure and defence sector companies.

The IPACS Centre can collect and host live and historical SCADA, machine health data, production data and online real-time condition monitoring data from mines, power stations, oil &gas facilities and remote assets in general. Engineers at the Centre are able to review the data on a timely basis and prepare alarm reports. The alarm reports can be translated into actionable items and promptly dispatched to a client's maintenance teams. (Figure 3)

Data is also directly accessible by remote customers and specialist engineering companies that have been contracted by the Centre or the customer. IPACS has established arrangements with specialist engineering companies that provide independent accredited advice to customers on the state of their equipment. The IPACS Centre can also provide a team of engineers qualified to setup monitoring systems and analyse data, removing the need for individual companies to develop their own in-house expertise and employ their own engineers.

One of the key learnings of the ROC Stage 2 Project was an understanding of the importance of managing the transition to remote asset management.

Transitioning to new technology like remote asset management can be a challenging process for miners and contract miners. They might have existing long-term contractors or in-house engineering teams using hand-held technology to monitor equipment in the field. The benefit of a Remote Asset Management Centre is that a team of highly qualified engineers is always on hand to monitor sensor data and provide analysis and timely alerts without the safety risks of having people travelling in remote locations. IPACS now recommends a well-defined change management framework to enable customers to move logically, step-by-step, from their existing maintenance methods to those based on the IPACS Asset Management Centre's technologies.

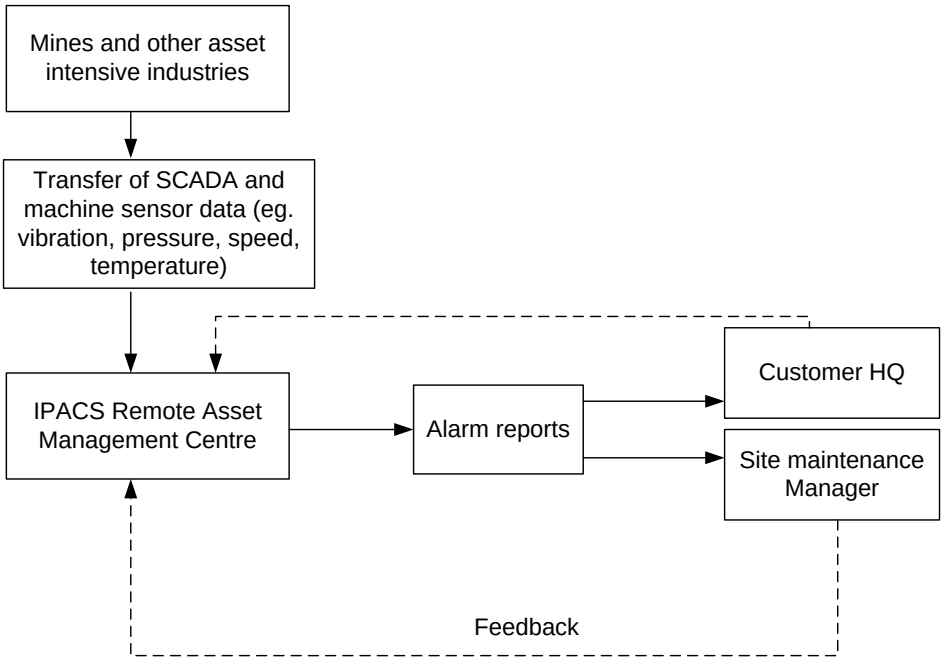


Figure 3 - Information flow from a mine through the IPACS Remote Asset Management Centre to the customer

Customer case studies

Introduction

A key aim of the ROC Stage 2 Project was to demonstrate to local mining sector customers that remote monitoring and analysis could decrease their asset maintenance costs. Remote operation centres are reported to be one of the key initiatives for reducing operating costs and increasing productivity by major resource companies in their efforts to remain globally competitive.

Two customers – Lucas TCS and Thiess - were identified after approaches were made to key METS (Mining, Equipment and Technology Services) and contract mining companies. It was important for the success of the ROC Stage 2 Project that critical equipment 'pain-points' were selected for remote monitoring. IPACS engineers worked with company representatives to identify the critical issues. Lucas TCS reported that the high number of breakdowns of its crusher at the Arrium Iron Barron mine was its biggest problem; while Thiess believed the ability to extend the life of the planetary gearboxes in their mining trucks at OZ Minerals Prominent Hill mine would deliver significant cost savings.

Both companies' issues were addressed using the IPACS Remote Asset Management Centre's technologies and access to its highly skilled engineering staff – expertise they could not independently justify or afford.

A network of sensors and data concentrators was installed on the identified equipment at the two mining sites. Each concentrator had a 3G modem and router. Data was transferred from each site via a secure Virtual Private Network (VPN) to servers at the IPACS Remote Asset Management Centre in Adelaide. Engineers at the Centre monitored and analysed the performance of the equipment remotely in near real-time.

1. Lucas TCS at Iron Baron Mine

Lucas Total Contract Solutions (TCS) is a South Australian privately owned company which specialises in civil and contract mining, quarrying, crushing, civil engineering and waste management. Lucas TCS is a respected player in the field of mining and civil contracting, with more than400 qualified and experienced personnel and one of the largest plant and equipment fleets in South Australia.

The company operated Arrium's Iron Baron mine and mobile crusher on the Eyre Peninsula in South Australia throughout the duration of the ROC Stage 2 project. The mobile crusher had an output of 500 tonnes per hour but the screens within it are the single point of failure in the entire operation. A screen mechanical drive failure had the potential to bring the operation to a halt, an unplanned shutdown and a massive hit to production. Before the project, Lucas TCS had experienced two such unplanned failures a year.

The goal was to remotely monitor the performance of the crusher from Adelaide so that early warning signs of mechanical failure could be detected. IPACS instrumented the entire mechanical drive using vibration sensors and installed a data acquisition server and 3G modem on the crusher.

On a mobile crusher, the entire platform vibrates. This was problematic because excessive vibration could damage cables and dislodge the 3G modem and data concentrator boxes. To minimise the effect of vibration, IPACS designed customised mounting brackets which they had specially fabricated. Figure 4 shows the mounting bracket.

Figure 4 – The mounting bracket was specially designed and fabricated.

The network of sensors and data concentrators was installed and commissioned at Lucas TCS's operation at Iron Baron on July 14 -15, 2015.

The mobile crusher drive's performance was monitored in real-time from the Remote Asset

Figure 5: Installation of IPACS sensors and data acquisition system at Arrium's Iron Baron mine

Management Centre in Adelaide. By way of example, a bearing fault on the crusher gearwheel #3 was identified and immediately reported to the customer. As can be seen in Figure 6, the overall vibration recorded on gear wheel #3 was significantly higher than the vibrations recorded across all other components of the drive train. Lucas TCS then scheduled planned maintenance on the drive. Preventing an unplanned shutdown was a major saving for the company.

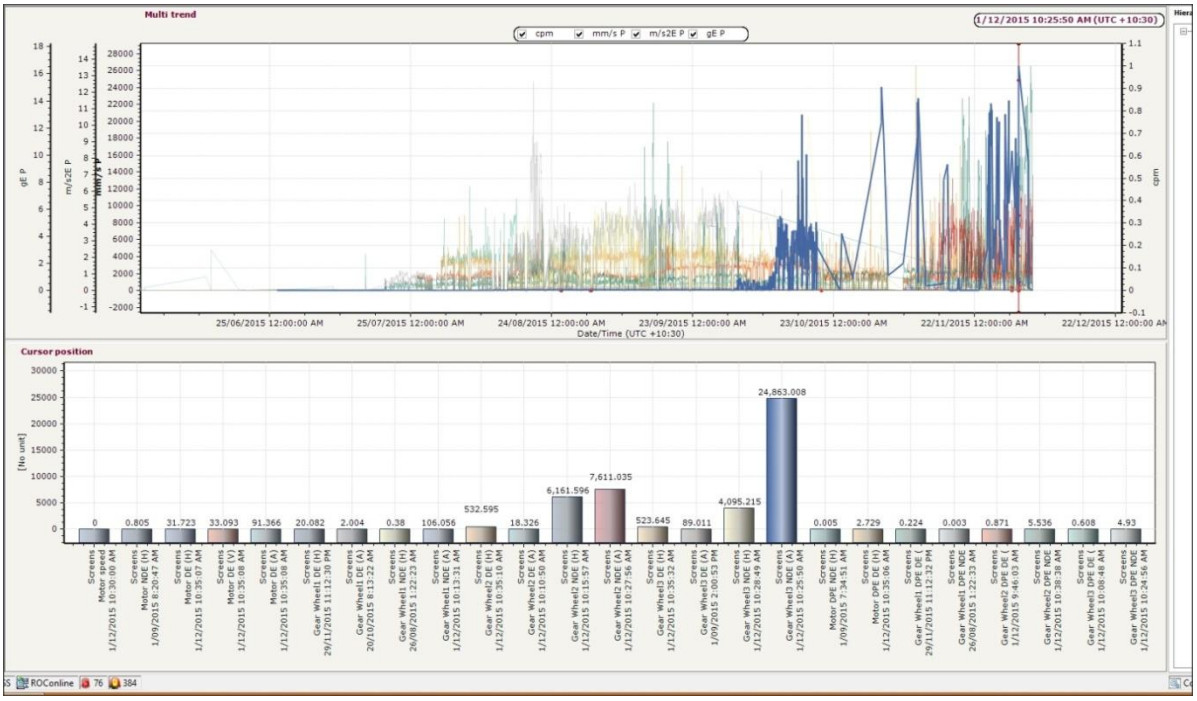


Figure 6 -Overall vibrations for the mobile crusher drive train

The top plot shows the cumulative vibration recorded across all components of the drive train. The lower plot shows the vibrations recorded at each component of the drive train.

"As remote monitoring technology becomes more available and cheaper for industry it will get adapted to more and more applications, more and more equipment. If the data can be brought back to a centralised location it will help us in reducing costs." **Ben Lucas, CEO, Lucas Total Contract Solutions**

2. Thiess at Prominent Hill mine site

Thiess is the world's largest contract mining company, with a technical and operational services capability and projects across Australia, New Zealand, Indonesia, Mongolia, Botswana and, more recently, Chile. Thiess is the open pit mining operator at the Prominent Hill copper and gold mine owned by OZ Minerals. Thiess use Caterpillar 793D dump trucks at the Prominent Hill mine site. Each has two planetary gearboxes that, as per the Original Equipment Manufacturer (OEM) recommendations, are rebuilt every 20,000 hours. The cost of each rebuild is $180,000. The goal of the project was to extend the life of the planetary gearboxes by 25 per cent.

The project presented a number of technical challenges. The planetary gearbox is situated on the exterior of the wheel hub and the dump truck operates in a harsh environment. The sensors and data concentrators had to be fitted robustly and the casing had to withstand high temperatures and dust.

The IPACS technical team designed a customised solution. Sensors were placed at various locations on the differential and interior of the wheel hub and a new, industrially hardened data concentrator box was designed, built and installed inside the driver's cabin. An IPACS engineer and a Thiess electrician installed and commissioned the sensors, data concentrators and the 3G modem/router at the mine site in late July 2015.

IPACS used 3G mobile communication to transmit data from the Caterpillar dump truck operating at the Prominent Hill mine site to the Remote Asset Management Centre 650 km away in Adelaide. Over the six month measurement period, there was no loss of data.

In Figure 8, the top graph shows the high overall vibrations detected on the POS3 Planetary gearbox during the load haul and dump cycle. A sudden impact resulted in a significant increase in vibrations

Figure 7: Installation of IPACS sensors and data acquisition system on a Thiess Caterpillar 793D truck at Oz Minerals Prominent Hill mine

of the planetary gearbox (See lower graph). Depending on the severity of the impact, such an event can lead to a breakdown in the short to medium term. It is therefore important to constantly monitor the performance of the planetary gearbox and ensure it is safely brought down for maintenance ahead of impending failure.

Figure 8 -Vibrations recorded from the Caterpillar 793 Dump truck. The top graph shows the high overall vibrations detected on the POS3 Planetary gearbox during the load haul and dump cycle.The lower graph shows how a sudden impact resulted in a significant increase in vibrations of the planetary gearbox.

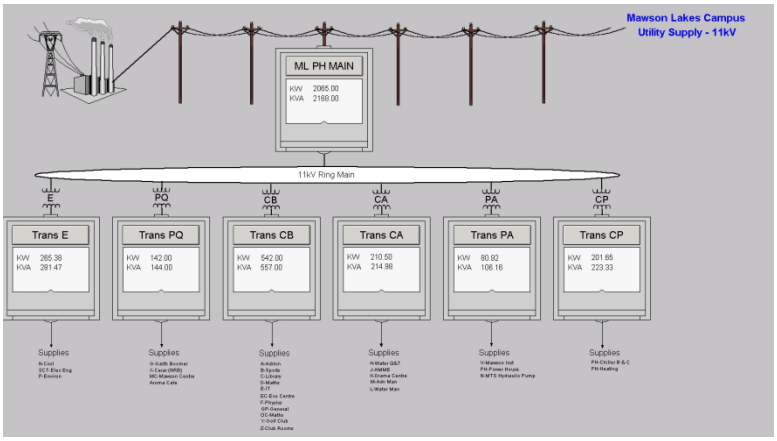
IPACS was able to remotely monitor the performance of the Thiess dump truck from Adelaide in real time. Its engineers identified and reported vibration problems within the differential and planetary gearbox which were reported back to Thiess and the necessary repairs were carried out at the appropriate time.

3. University of South Australia (UniSA)

The University of South Australia's Facility Management Unit manages the building infrastructure for six campuses spread across Adelaide and country South Australia. Each campus operates a separate production and energy management system. The Facility Management Unit uses BACnet, a communications protocol for building automation and control network sand the Niagara Framework, a software platform that integrates all the data collected from the university's building assets.

The University wanted to increase equipment availability and reduce costs across all its assets. The Facility Management Unit determined that a lack of access to key production data in real-time was limiting the timely identification of potential faults. They had already installed a large number of sensors distributed over a wide geographical area that generated production (SCADA) data. The Facility Management Unit wanted an integrated interface that would help them visualise and analyse all their SCADA data.

During the project, the Niagara Framework was used to transfer the SCADA data into an SQL database. OSIsoft technology was then used to extract data from the SQL database and display the results on a dashboard. Figure 9 illustrates the architecture of the implementation.



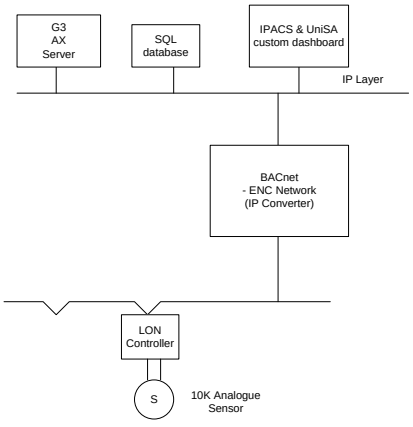


Figure 9a - IPACS custom dashboard for the UniSA Facilities Management System. Figure 9b - UniSA Facilities Management System Architecture developed on the OSIsoft PI System

As a result of this project, the University of South Australia's Facility Management Unit is able to access, visualise and analyse real time data from across its extensive network of assets. Using the IPACS technology it is possible for the Facility Management Unit to identify potential faults and incorporate specific alarm systems.

Once installed, these alarms will be further analysed by Facilities Management staff and appropriate action taken. The outcome is expected to be a significant reduction in the cost of maintenance of the University of South Australia's assets.

"IPACS has a unique vision for remote asset management that involves future technological developments in sensing, data management, analytics and dashboards." **Associate Professor David Kearney, University of South Australia**

Additional research and development

During the ROC Stage 2 project, the high cost and complexity associated with the installation of wired sensors was identified as the biggest limitation to the mass adoption of the Remote Asset Management Centre's technology. The high cost of installation is also the reason sensors are rationed to a relatively small number of monitoring points which limits the amount of data available for analysis.

IPACS decided to commence a program of technology innovation to enable the mass, low-cost deployment of highly engineered sensors. The company is currently partnering with the University of South Australia's School of Information Technology & Mathematical Sciences to develop low-cost wireless sensors with embedded analytics that can be integrated into existing mining IT infrastructure.

Figure 10 - Prototype wireless sensor designed and developed as part of the project

Wireless sensors with embedded analytics have the potential to solve three long-standing problems:

1. As they analyse data at site, transmission of huge amounts of data collected by each sensor in machine-condition monitoring is avoided. This would significantly increase battery life which is currently a major cost and logistics issue.
2. By decreasing the need for large quantities of expensive engineering time for installation, many more wireless sensors could be deployed at a decreased cost. More sensors means more interactions can be observed between machines providing a more accurate picture of the maintenance needs of the whole site, and between similar sites worldwide owned and operated by the same company.
3. All machine maintenance could be conducted in planned site-wide shutdowns, rather than in response to breakdowns.

Through its work with the University of South Australia, IPACS plans to develop a new generation of systems, technologies and methodologies for the remote monitoring of the condition of physical equipment in the resources sector.

As part of the ROC Stage 2 project, a prototype wireless sensor was designed and developed (Figure 10). The casing was developed using 3D printing. A vibration test rig was also built and the performance of the wireless sensor was tested against the performance of a wired sensor. The results of the tests indicated that the wireless sensor performance is comparable to the wired sensor performance. IPACS and UniSA believe a low-cost wireless sensor suitable for deployment on physical assets can be developed by mid-2017.

Conclusion

In the future, mining operations will increasingly be driven by technological advances in sensing, autonomy, analytics, robotics and optimisation.

The new IPACS Remote Asset Management Centre's capabilities, built on an open collaboration platform, extend from the installation of sensors on critical assets to the collection, reporting and management of large-scale sensor data and the provision of alarms to enable predictive maintenance to be undertaken in a timely manner ahead of a potentially catastrophic breakdown. In this way the IPACS Remote Asset Management Centre can engage with resource sector companies to reduce their operating costs, increase their productivity and improve their workplace safety.

As part of the ROC Stage 2 project, Lucas TCS' mobile crusher at the Arrium Iron Baron mine and a Thiess Caterpillar 793D dump truck at OZ Minerals Prominent Hill mine were monitored and vibration data transmitted to the IPACS Remote Asset Management Centre and analysed over a six month period without any loss of data. Several faults were identified in real-time for both customers. The faults were identified, tracked and the companies advised appropriately. As a result, preventive maintenance was carried out in time that prevented several critical and costly machine failures.

IPACS is currently working with a broad range of companies including equipment suppliers, OEMs (original equipment manufacturers), contract miners and data analytics companies to develop customised solutions for the monitoring needs of mining and oil & gas companies based on the collaborative Remote Asset Management Centre platform.

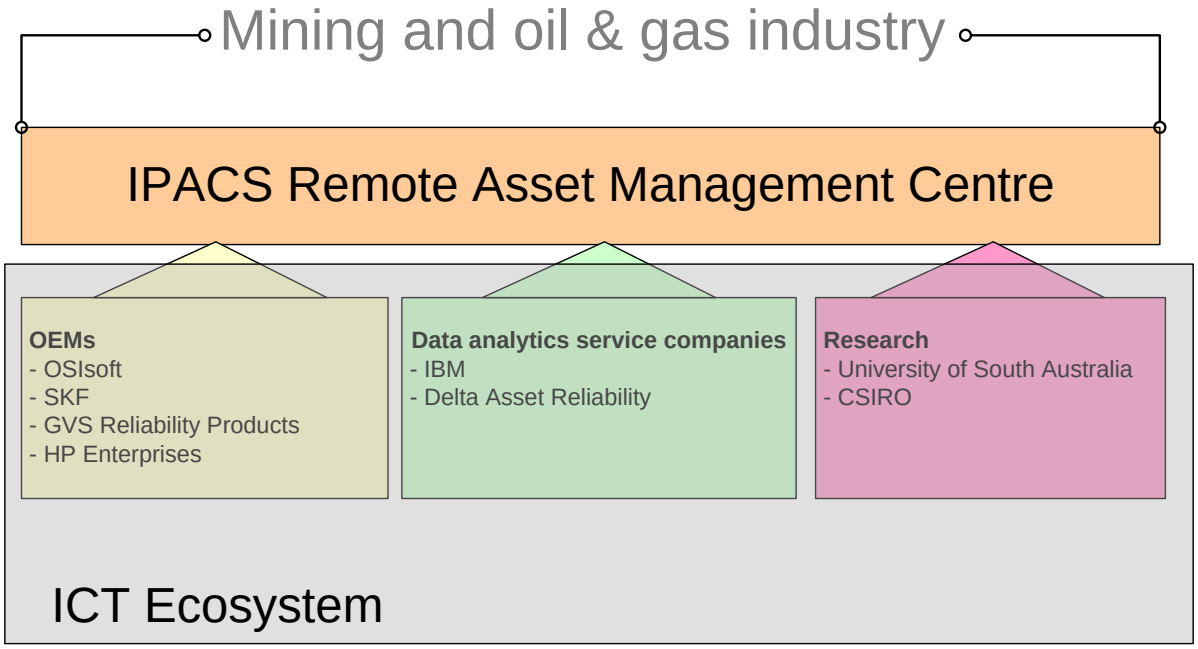


Figure 11 – IPACS Remote Asset Management Centre provides an open collaboration platform enabling companies to collaborate on monitoring solutions

At time of writing, commercial discussions are under way with a number of national and international mining and oil & gas operators and supply chain contractors for remote asset management services. Recent interest has been also expressed by a number of defence companies

that want to understand how the Remote Asset Management Centre could assist in the early detection of potential machine failures across their dispersed critical assets.

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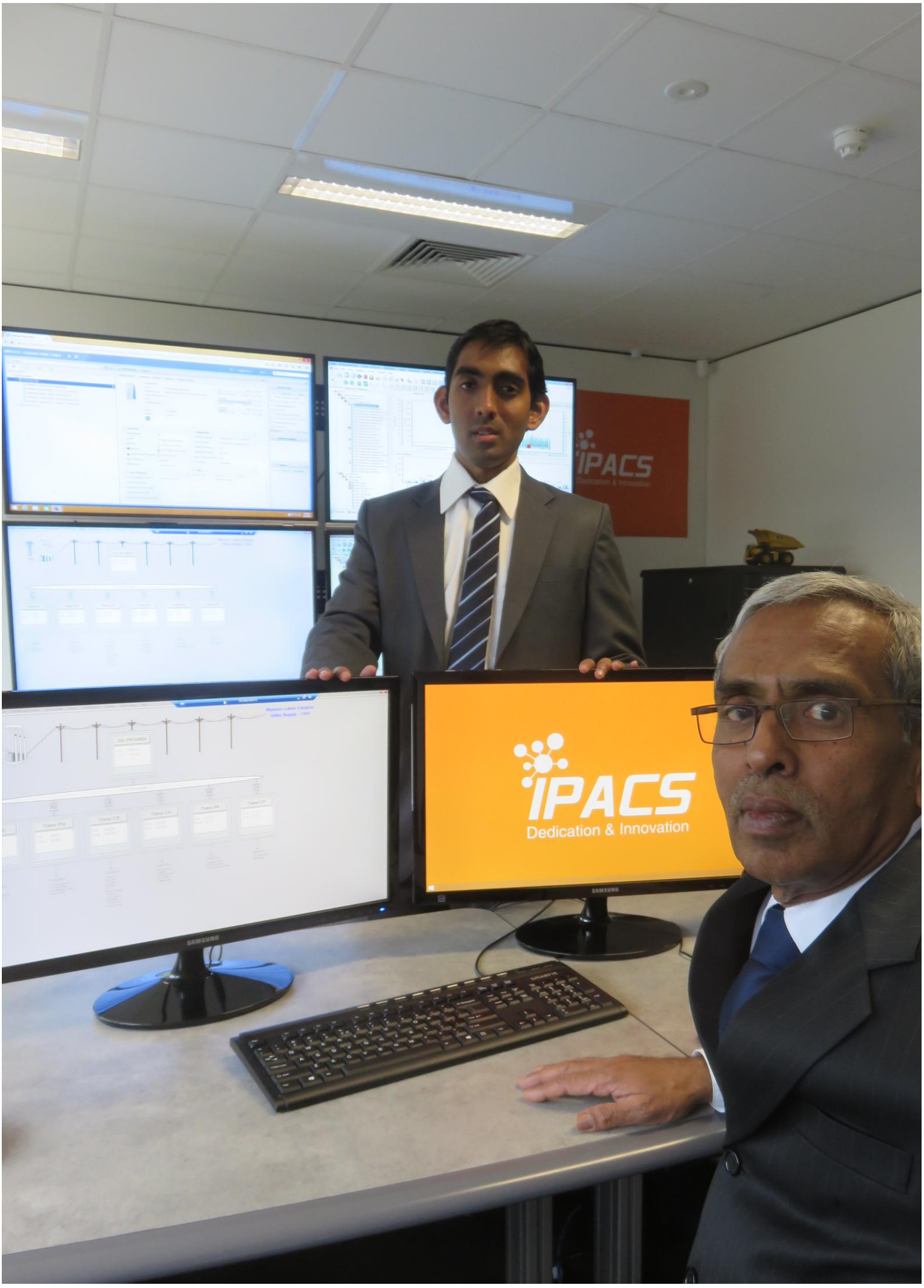
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Appendix 1

Project partners and supporters

Project partners

- IPACS Australia
- Lucas TCS
- Thiess
- Hewlett Packard Enterprise
- OSIsoft
- University of South Australia School of Information Technology & Mathematical Sciences

Project supporter

- South Australian Mining and Petroleum Services Centre of Excellence

Appendix 2

The media release announcing the launch of the Remote Operations Centre resulted in 42 separate media enquiries from around the world.

News Release

SOUTH AUSTRALIA Government of South Australia

Treasurer Tom Koutsantonis

Minister for Finance
Minister for State Development
Minister for Mineral Resources and Energy
Minister for Small Business

Tuesday, 8 September, 2015

Remote sensor technology drives major cost savings for resources sector

Resource companies will be able to shave millions of dollars from their costs by using remote sensor technology showcased at the new Remote Operation Centre in Adelaide's north.

Speaking last Friday at the official opening at Mawson Lakes, Minerals and Energy Resources Minister Tom Koutsantonis congratulated local company IPACS Australia on developing the technology underpinning the new centre.

Mr Koutsantonis said the new remote operation centre is a further example of the State Government's commitment to realising the full potential of South Australia's mineral resources and energy assets.

"In an economic environment of sharply lower commodity prices, it is vital that South Australian businesses embrace technological innovations that can deliver more cost-efficient operations," he said.

"Companies using the Remote Operations Centre will be able to more accurately detect faults before they occur, which reduces maintenance costs and increases reliability, productivity and efficiency.

"That will drive increased competitiveness for mid-tier mining service companies, which are the backbone of our resources and energy operations in South Australia."

The Remote Operation Centre is one of the foundation projects under the Mining and Petroleum Services Centre of Excellence.

The State Government has contributed $660,000 towards the $2.074 million centre, which IPACS Australia has established with contributions from the University of South Australia, HP, OSIsoft and their pilot customers, Lucas TCS/Arrium and Thiess/OZ Minerals.

Remote sensor data analytics – or keeping tabs on plant equipment from a central office location – can save millions of dollars by avoiding equipment failure, which in a remote mine can cost many days of lost production.

Managing Director of IPACS Australia Pty Ltd Kailash Nath Sriram said people were familiar with the benefits of remote monitoring centres in sectors like traffic flow management, through to the centralised monitoring of water levels and water quality.

"Now, we are monitoring the real-time asset performance of mining vehicles, boilers, smelters, SCADA systems and mining fixed-plant infrastructure for some of the world's largest miners and contract miners," he said.

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Appendix 3

Remote Operations Centre Stage 2 Project – Background, objectives, outputs and intended project outcomes

Title: **Remote Operations Centre Stage 2**

Background
This is the 2nd stage of the successful Remote Operations Centre (ROC) Project funded by the Mining and Petroleum Services Centre of Excellence. In Stage 1, a test and trial ROC was established with a mid-tier miner, university and a South Australian ICT SME to demonstrate the remote collection, analysis and 3G transmission of long-term vibration data.

Objectives
In the ROC Stage 2 Project, the team will work with several South Australian contract miners to implement networked data collection using sensors and data concentrators spread across more than one geographic location. The team will establish a project advisory group consisting of tier 1 mining and energy companies to provide high-level project guidance and advice on the future commercial arrangements for the ROC. In addition, there will be a new analytics and data visualisation component for the ROC that will apply advanced software tools to the data collected from remote assets at the mining operations.

Outputs
Outputs include the display of all analysed results using a dashboard and the establishment of a commercial ROC in Adelaide.

Intended Outcomes
1. Improve the operational efficiency of South Australian based miners and industry contractors to strengthen their competitive position in an environment dominated by sharply declining commodity prices.
2. Deliver a commercial collaborative ROC to provide ongoing remote analytical services at a lower cost and with lower risk access to new analytics and automation technologies.
3. Establish a path for innovative ICT companies to deliver technology and services to the resources sector through the ROC.

Appendix 4

Mining and Petroleum Services Centre of Excellence's funding criteria for the Remote Operations Centre (ROC)Stage 2 Project

CoE Criteria	**Remote Operations Centre Stage 2 Project**
Builds on existing South Australian comparative advantage, either in terms of research, industry or natural endowments	This project supports South Australian based copper and iron ore miners. It includes research and development from UniSA in analytics and big data, leverages the skills of local branches of large IT multinationals and a local ICT SME.
Has industry funding or in-kind support	This project is backed by significant industry financial support and technical expertise. It is anticipated that additional technical support from other ICT multinationals will be provided during the project.
Will have material impact and is an identified priority for industry	The report –Scenarios for ICT in Minerals and Energy in 2025 (prepared by CSIRO, July 2013) identified remote operations as a key technology for cost reduction and future global competitiveness for South Australia.
Solves problems which industry can't solve itself, for reason such as incomplete or asymmetrical information or common resources and public goods problems	Mid-tier mining companies, their contractors and suppliers have limited budgets and appetite for risk arising from IT innovation. Remote operation technology, networked data collection and analytics based on big data principles have shown their merits in reducing costs for the Tier 1 miners who have used their extensive internal technical teams and resources to achieve these results. Unfortunately, the details and IP of these implementations are closely held by the Tier 1 organisations. Mid-tier companies have only very limited access to such technology. The costs and associated innovation risks are too high for individual mid-tier miners. This project will provide access for the participating mid-tierminers and contract mining companies and like-minded organizations to a demonstration of remote operations, networked data collection and analytics. The commercial collaborative ROC platform will be able to provide lower cost, lower risk access to new analytics and automation technologies.
Has multiple partners and requires a collaborative approach	This is a software engineering project that requires specialist IT products for data integration and analytics. OSIsoft and HP respectively are providing

	these. Sensors will be installed on equipment at remote mine sites by IPACS. UniSA will design and implement analytics applications and dashboards. Software integration for data collection and dashboard applications will be carried out by IPACS. Lucas TCS and Thiess will provide access to their equipment for remote monitoring. No single partner is equipped to carry out the project on their own. IPACS, UniSA and HP have a recent history of collaboration in the ROC Stage 1 project.
Can be publicly reportable	Subject to consultation, final reports will be made public.

Appendix 5

Remote Asset Management Centre – Opportunities and benefits

South Australia is home to a dynamic ICT industry comprising world-class universities, leading OEMs, innovative SMEs and start-ups. A number of structural barriers prevent the various parts of the ICT ecosystem in South Australia from realising their true potential in the minerals and petroleum services supply chain. The ROC Stage 2 Project aimed to break down some of these structural barriers by providing access to innovation and commercial opportunities to members of the SA ICT ecosystem.

	Structural barriers	**ROC Opportunities**	**ROC Benefits**
Universities	• Lack of access to live data for research and teaching	• Establishment of the IPACS ROC with live data feeds	• Align research and training with industry needs • Develop innovative ROC applications for industry
Analytics and Optimization software OEMs	• Inability to sell to mid-tier miners	• Demonstration of their technology at the IPACS ROC	• Showcase their technology to mid-tier and contract miners and other industry sectors like defence
SMEs and Startups	• Limited exposure to mining operators and contractors • Inability to demonstrate their skills and technologies to target audience	• Demonstration of their technology at the IPACS ROC • ROC presentations at industry events • ROC data provided to resource sector hackathons	• Ability to demonstrate their technology at the IPACS ROC • Understand ROC benefits through participation at industry events and hackathons
Tier 1 Miners	• Limited appetite for risk from ICT innovation particularly from SMEs	• Risk associated with new innovation will be reduced through live demonstrations at the IPACS ROC.	• Exposure to well-designed and tested ICT innovation technologies from SMEs
Mid-tier Miners and Contract Miners	• Limited budget and appetite for risk arising from ICT projects • Lack of exposure to the benefits of ICT innovation • Inexperienced ICT staff	• Risk will be reduced through access to the IPACS ROC. • The ROC will showcase innovation technology applied to live data streams. • The ROC will support skills development in remote monitoring and analytics.	• Reduced risk • Access to ICT innovation in mining and petroleum • Reduced costs, improved efficiency and reliability through use of proven ICT technologies • Increased competitive global market position

Appendix 6

Project advisory group

A project advisory group consisting of representatives from EnergyAustralia, Santos, OSIsoft, Midas Environmental Technologies and University of South Australia was established.

Members

Mr. Philip Leesong – Operator/Maintainer, EnergyAustralia's Hallett Power Station

Mr. Stuart Miller –Project Manager, Santos Eastern Australia Collaboration Centre

Mr. Ian Smith – Account Manager South Australia and Northern Territory, OSIsoft

Mr. Robert Mencel –Co-founder, Midas Environmental Technologies

Associate Professor David Kearney– Associate Professor of Computer Science, University of South Australia

Appendix 7

Remote Asset Management Centre Capabilities

Online (24/7) condition monitoring

Client access to live vibration data

Client access to historical machine health information

ISO Level 3 vibration analysts

Horizontal integration of data across multiple SCADA systems

Predictive maintenance

Training in vibration analysis

Reports in clear, easily understood formats

Appendix 8

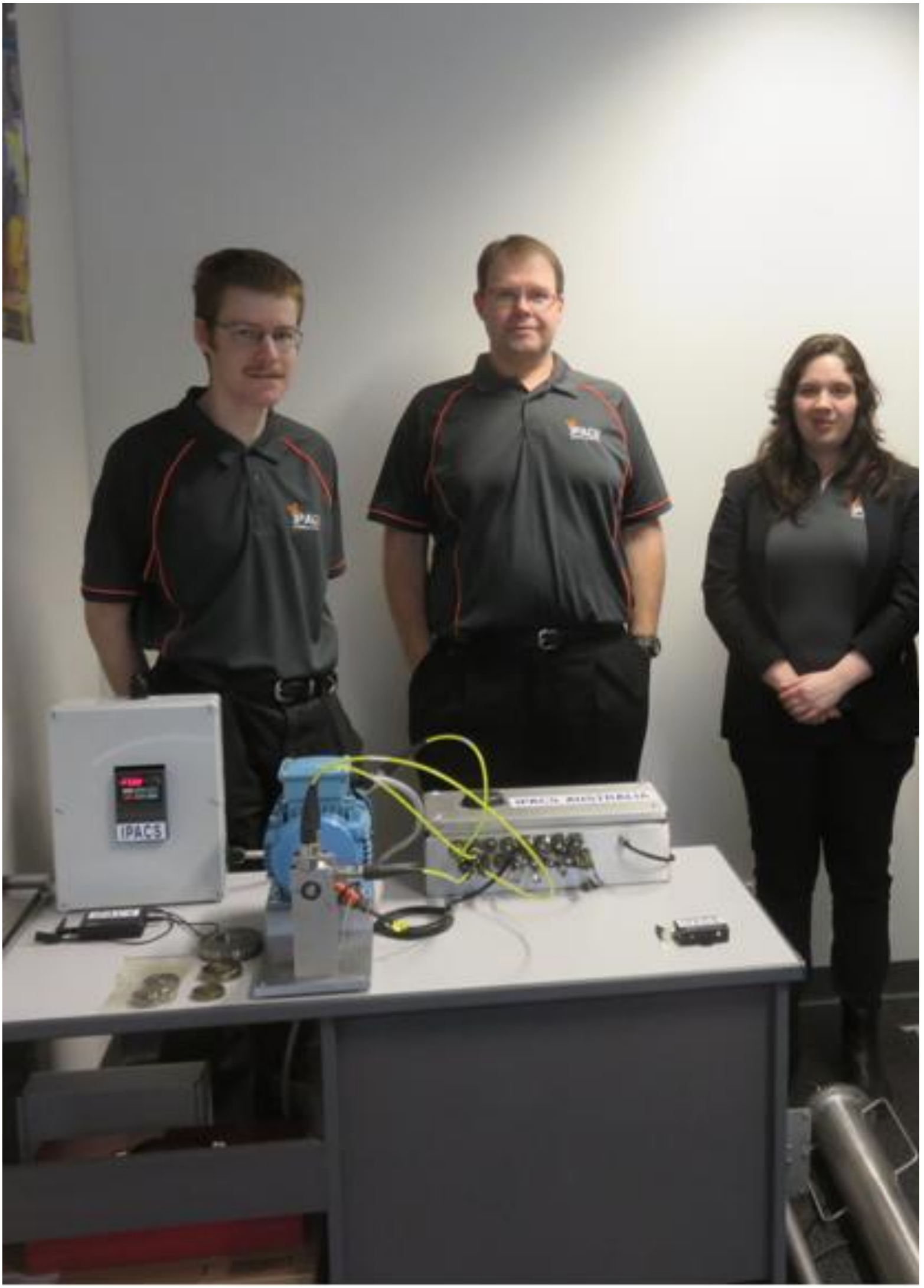
Mining and Petroleum Services Centre of Excellence

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

The South Australian Government has committed $10 million over five years as innovation seed funding toward the development of strategically important capabilities in areas such as:

- Deep resource exploration and deep mining
- Next generation minerals processing
- Leading practice in mine rehabilitation and environmental protection
- Mine to mill optimisation, ore selection and pre-concentration, mine logistics
- Automating the resource sector through innovative ICT applications across the entire mining lifecycle
- Leading practice in multiple land use policy and community engagement
- Deep gas well operations and training.

Further information and current project details can be found at http://www.statedevelopment.sa.gov.au/resources/mipo/coe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