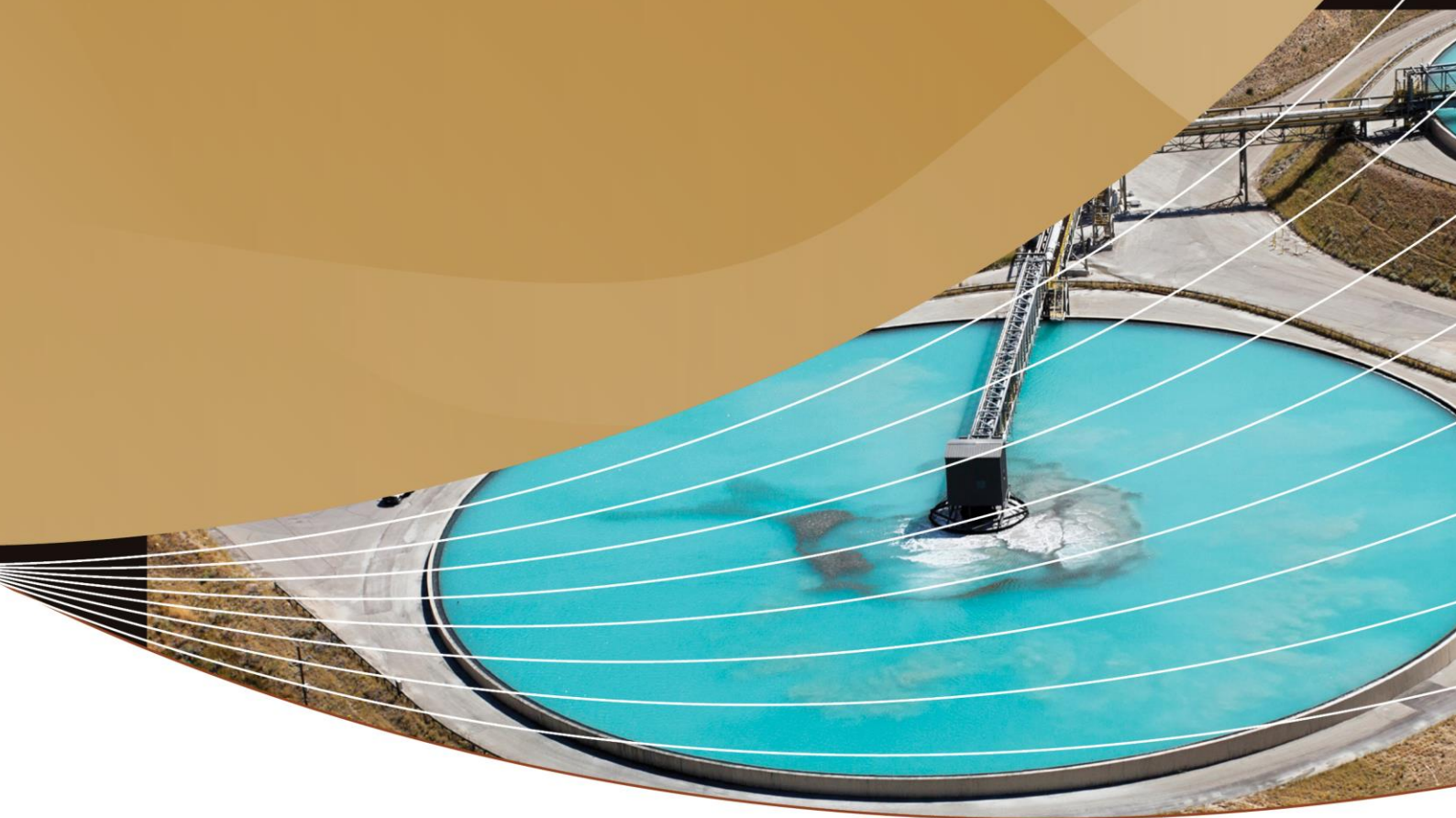


# 2014 ANNUAL REPORT

Sustainable Minerals Institute



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**Professor Peter Høj**  
*President and  
Vice-Chancellor,*  
The University of Queensland

# UQ PRESIDENT AND VICE-CHANCELLOR'S REPORT

**The Sustainable Minerals Institute is an exemplar for harnessing expertise from a range of academic disciplines, and applying it to benefit communities, environments and economies.**

SMI's success depends greatly on the confidence of corporate, community and government partners, and its ability to maintain that confidence at a time of changing industry fortunes marks 2014 as a strong year.

Achievements throughout the year included the entry of Australia Pacific LNG as a new partner of the Centre for Coal Seam Gas, the strengthening of interactions with the Queensland Government and industry to advance deep mineral discovery research, and the attraction of new sponsors for the Deep Mass Mining project.

It takes impressive people to attract strong partners, and it is always pleasing to witness UQ achievers attracting global and national recognition. Fine examples of this included Professor Neil McIntyre of the Centre for Water in the Minerals Industry, who received an Australian Research Council Professorial Fellowship (one of only 12 awarded nationally); and the winners of the Douglas Hay Medal for the best paper in Mining Technology - Dr Alex Catalan and Professor Gideon Chitombo of SMI, and Dr Italo Onederra of UQ's School of Mechanical and Mining Engineering.

Fitting recognition also went to Professor Jim Joy – pioneer of the Minerals Industry Safety and Health Centre – when he was inducted into the International Mining Technology Hall of Fame.

Quality research, and the framing of issues for the resources industry, are at the core of SMI. We saw this play out when a study on the costs to companies of conflicts with local communities was published in Proceedings of the National Academy of Sciences. Completed by the Centre for Social Responsibility in Mining in conjunction with Clark University and the Harvard Kennedy School, it attracted widespread interest.

Importantly, SMI has a growing contingent of knowledge-leading alumni who will help shape a more sustainable global minerals industry. Their ranks grew significantly in 2014, which was a record year for conferral of both PhDs (18) and Masters of Philosophy (10).

It was also a time of impact through continuing professional education, particularly through SMI's role in the International Mining for Development Centre (IM4DC). Since its inception in 2011 as a federally-funded joint venture with the University of Western Australia, IM4DC has delivered short courses to more than 2300 people in Africa, Latin America and the Asia-Pacific.

SMI also made good use of 2014 to prepare its own postgraduate program in Responsible Resource Development, to begin in 2015. The program further signifies the SMI's receptiveness to the changing needs of businesses, communities and regulators.

The Advisory Board plays a key role in counselling the Institute about these and other external demands and expectations, and I thank Charlie Sartain and all members for their service.

I also salute SMI's partners, who have upheld their commitments to research and learning in the face of many competing priorities.

Most of all, I congratulate Chris Moran and all SMI staff and students. By pursuing academic and professional excellence and sharing your knowledge and skills, you encourage sustainability and responsibility in industries that impact on many millions of lives.





**Mr Charlie Sartain**  
Chair, SMI Advisory Board

# SMI ADVISORY BOARD'S REPORT

**The SMI Advisory Board consists of a diverse group of individuals representing industry, State Government and the University Executive, who share a common commitment to the concept of sustainability in the minerals industry through the vision and mission of the SMI.**

I found it interesting to read a note to staff and students at the end of last year from our Director of SMI, Professor Chris Moran, in which he highlighted that the Institute had continued to achieve remarkable industry impact, research output and student completions during the year, with a record number of student graduations from SMI and a record number of international numbers of people attending SMI short courses.

The same note contained a salutary reminder that the Institute was being buffeted by the impacts of a major and protracted industry downturn and change in the sector that was significantly affecting the research income for SMI. For me, the positive side of this message highlighted the resilience of the Institute and the “grassroots” support that the SMI has nurtured in recent years as the pre-eminent sustainability research institute for the global mining industry.

As examples during 2014, the international programs that have been conducted by SMI on behalf the International Mining for Development Centre (IM4DC) and the exciting possibilities being generated through the International Centre for Excellence in Chile (SMI-ICE-Chile) have generated an increased level of engagement and impact with government and industry. The overall message of resilience and broad-based support is important to recognise as SMI navigates through a period of unprecedented change towards a “new SMI”.

And change is definitely upon us. The severe mining industry downturn that continued unabated through the full year forced further rationalisations and cost reduction imperatives on our industry partners, which in turn significantly affected their capacity to continue funding applied research with SMI.

Importantly, companies have been meticulously reassessing their approach towards investment in sustainability. The need for a well-defined, well-articulated value proposition therefore emerged during the year as a critical element in any conversation about further partnering commitments. Fortunately the broad base and scope of research established in recent years across SMI's Centres to some extent helped to buffer the impact of the downturn. But the overall contraction seen across SMI has been substantial, particularly in a major centre like the JKMRC, and this has accelerated the change process initiated as part of the strategic review of SMI and the UQ Academic Board review of the Institute.

The SMI Advisory Board worked with SMI's Director in the initiation of the major review of SMI's strategy in the second half of 2014. This included the important review and revision of the Vision and Mission Statement for the Institute, cognisant of the revisions made to the UQ strategic plan earlier in the year and the changing demands of SMI's other stakeholders.

The Academic Board Review of SMI in September invited a wide range of submissions, and ultimately presented SMI and UQ with a challenging set of recommendations. SMI management's response to the recommendations was delivered after an extraordinarily comprehensive but necessary communications process initiated by Professor Moran, and the Advisory Board expresses again its sincere appreciation to him for the efforts made in the detailed submissions and responses and in ultimately delivering an action plan coherent with a new strategic direction for SMI.

I would like to express my sincere thanks to all of the SMI Advisory Board members for their valued inputs and advice to SMI during the year, to UQ's Senior Executive for its continued support and recognition of the changes being managed by SMI, and Professor Chris Moran and the SMI leadership team for the leadership in setting SMI on a vitally important change management path.



**Professor Chris Moran**  
*Director, Sustainable Minerals  
Institute*

# SMI DIRECTOR'S REPORT

**The staff and students of SMI and our myriad industry and government advisors have continued to show great support to SMI in a year of rapid change in the resource sector.**

In their preceding reports, the Vice Chancellor, Professor Peter Hoj, and Chair of the SMI Advisory Board, Mr Charlie Sartain, have both highlighted significant research, education and impact successes for SMI in 2014. I am very grateful that the Advisory Board and UQ Executive have continued to show confidence in SMI amid challenging circumstances.

Ongoing decline in prices of most major commodities has resulted in a difficult year for industry-facing research. Most mining companies and related stakeholders have reduced their investment in research and many have decreased their time horizon for impact to the very short term. Initially, rounds of cost cutting dominated company responses but now a more thoughtful agenda for improving productivity is emerging. SMI has been undertaking a new strategic planning process with the result that our strategic intent is clearly pointed towards innovation as a means of improving productivity. The Academic Board Review in late 2014 provided some important criticisms that we have been able to interpret in terms of this strategic intent and to plan an important process of change – we have termed this “Next SMI”.

Next SMI aims to evolve the world’s strongest resource sector sustainability research institute into a more resilient organisation. Critically, Next SMI will form a structure that improves our engagement with industry and its stakeholders. Over time, SMI has become too dependent on a relatively small number of people for engagement, particularly in terms of research revenues. We have not sufficiently mentored junior and mid-career researchers to excel in this endeavour, which is a learned skill based upon experience not just an innate talent. The Next SMI structure will provide a leadership team that has stewardship at the fore to transition us to a larger group of people capable of formulating compelling value propositions and delivering well on the funded projects that result. We will move towards an operating structure that delivers better to our sponsors through improved project lifecycle management with more efficient operational support and increased consistency and transparency in decision-making. Much of this work will be undertaken through 2015 but the seeds of change come from our efforts through 2014 and our maturity in constructively responding to criticisms with energy and an outlook based upon our values and supporting principles.

In looking back at 2014 we see individuals recognised for research excellence and impact. We received a record financial return from government for our research outputs. Our people have lectured all across the globe generously communicating about how countries can benefit from their mineral endowments, showing true knowledge leadership with discernible, documented outcomes for a better world. It is these efforts and achievements that should be our focus when reflecting on the year rather than the trials and tribulations of

industry contraction and the ways in which that has exposed areas for improvement within SMI.

SMI remains the world's largest and strongest research and education institute engaged in resource sector sustainability. The year that was 2014 has delivered to us the opportunity to transform SMI under prevailing conditions and ready ourselves to surge forward when the inevitable turn-around in industry occurs. We will transform our reputation from being a successful, large applied research and education institute into a mature, collaborative and resilient group of people who saw off the industry downturn and thrived as a result.



# SMI LEADERSHIP



**Professor Chris Moran**  
Director  
Sustainable Minerals Institute



**Professor Ben Adair**  
Deputy Director — Technical  
Sustainable Minerals Institute



**Professor David Brereton**  
Deputy Director —  
Research Integration  
Sustainable Minerals Institute



**Victoria Anderson**  
Deputy Director — Operations  
Sustainable Minerals Institute



**Professor Saleem Ali**  
Director  
Centre for Social  
Responsibility in Mining



**Professor David Cliff**  
Director  
Minerals Industry Safety and  
Health Centre



**Chris Fountain**  
Acting Director  
(November – Dec 2014)  
Julius Kruttschnitt Mineral  
Research Centre



**Professor Andrew Garnett**  
Director  
Centre for Coal Seam Gas



**Professor Neil McIntyre**  
Director  
Centre for Water in the  
Minerals Industry



**Professor David Mulligan**  
Director  
Centre for Mined Land  
Rehabilitation



**Professor Margaretha  
Scott**  
Director  
WH Bryan Mining and  
Geology Research Centre



**Professor Wayne Stange**  
Director  
(January – November 2014)  
Julius Kruttschnitt Mineral  
Research Centre



## SMI MISHC

Minerals Industry Safety  
& Health Centre

MISHC is an internationally recognised provider of risk, health and safety research and education for the global minerals industry.

Researchers focus on leading practice systems and procedures to solve existing health and safety challenges. The Centre is working on a number of strategic research initiatives to facilitate resource sector growth and optimise safety. Further, education programs are instilling health and safety management practices as the guiding principle for industry professionals.

## 2014 Report

**While it has been a challenging year for the resources sector, many industry experts have remained committed to sharing their knowledge and expertise to improve mine site health and safety through research.**

IM4DC funded OHS research and training has again had MISHC staff deployed widely across the globe. Danellie Lynas has focussed her attention in Ghana and PNG. Associate Professor Carmel Bofinger has been to Ghana and Zambia. Professor David Cliff has visited Ghana, Colombia, Peru and Indonesia. The courses, which include risk assessments, safety audits and occupational hygiene tests, teach mine inspectors from developing countries how to prioritise their workload to reduce site incidents, demonstrating MISHC's genuine reach around the world.

Professor Robin Burgess-Limerick and Associate Professor Tim Horberry were engaged by the USA National Institute for Occupational Safety and Health, Office of Mine Safety and Health Research to undertake two projects looking at human factors in mining.

Professor Jim Joy, the founder of the Minerals Industry Safety & Health Centre, was inducted into the International Mining Technology Hall of Fame.

Professor Robin Burgess-Limerick, Deputy Director of MISHC, was honoured on November 18th, becoming the second recipient of the Tom Triggs memorial award at the 50th Annual Conference of the Human Factors and Ergonomics Society of Australia in Adelaide. He was successful in being awarded a two year \$236,500 research grant from the Australian Coal Association Research Program for Interface Design for Haul-Truck Proximity Detection Systems.

A human-centred safe design method (EDEEP) developed by MISHC researchers Associate Professor Tim Horberry and Professor Robin Burgess-Limerick in conjunction with the Earth-Moving Equipment Safety Round Table (emesrt.org) has been adopted by Sandvik, a global supplier of mining equipment.

Led by topic leaders Professor David Cliff and Associate Professor Carmel Bofinger the final topic Fitness for Work was completed for the ACARP funded RISKGATE project. The project managed by Associate Professor Philipp Kirsch, was awarded the AUSIMM Jim Torlach Health and Safety award for 2015.

Under the leadership of Dr Maureen Hassall MISHC is investigating the future of risk management research and education in partnership with the School of Chemical Engineering.

Professor Cliff provided expert testimony to the Hazelwood Mine Fire Inquiry in Victoria.



## SMI BRC

WH Bryan Mining &  
Geology Research Centre

BRC is an applied research centre which continues to build on its existing reputation for practical innovation in mass mining and a demonstrated global leadership in deep mine development and operation. The Centre is focused on industrial research solutions for active and future mines and has a mandate to advance total deposit knowledge (ore and waste; geological and geotechnical).

### 2014 Report

**BRC has three complimentary applied research programs that are focused on decreasing geological and mining risk to offset the effects of resource depletion and improve productivity.**

**Applied Geology – developing a comprehensive understanding of all facets of the ore deposit (waste and ore).** This program supports resource stewardship at both a mine and regional scale by conducting innovative applied research. Mine scale research is focused on achieving greater effectiveness during current open pit mining. It targets better and faster estimation of the rock mass response to different mining processes, with the objective of reducing cost and improving productivity (e.g. reducing double handling, energy and treatment costs, and by supplying a more consistent mill feed).

Research in 2014 included innovative coal cast blasting trials, a joint JKMRC-BRC-JKTech project. It aimed to increase cast percentage significantly (at least 30 to 40%) at open pit coal mines in order to improve dragline productivity and reduce strip cycle times, without compromising safety or high-wall stability and avoiding additional coal damage. Coming to completion, this project has been able to demonstrate impact by exceeding proposed cast targets. Supercast designs have been refined repeatedly in response to declining commodity prices, and are now delivering impressive results for as little as 20% additional energy.

Regional scale research, while relatively new in SMI-BRC, has significantly expanded its focus from one of strengthening government institutional capabilities to include advancing the discovery of deep and large ore bodies. Professor Margaretha Scott and a SMI-BRC team were awarded a grant through the Queensland Government's Future Resources Industry Priorities initiative to advance Deep Discovery research in North-west Queensland. The new joint project between industry, the State government and SMI-BRC recognises that efficient exploration for deeper ore bodies requires a mining-influenced methodology so as to reduce the chance of mineralisation being discovered that cannot be mined for mining engineering reasons. With discovery rates continuing to decline in Australia, a new strategy is required by Australian Geological Surveys to promote exploration of deep deposits. By combining technical data and expertise from multiple disciplines – geoscience (exploration and mine), engineering, and finance – a better-informed business understanding of the possibility for mining deeper deposits in a region will be developed, effectively focussing deep exploration efforts.

This project has major implications for the metalliferous sector in Australia in

terms of resource-replenishment.

In addition, Professor Scott was invited to the Expert Group Meeting (EGM) on Geology and Minerals Information Systems for Africa, from 9-11 July 2014, at the United Nations Conference Centre in Addis Ababa, Ethiopia.

**Deep Mass Mining – transitioning mass mining to deeper, much higher capacity operations.** This program is focused on fostering 'step-change' advances in technologies that manage engineering risks and underpin higher capacity mining in deeper frontier settings (where higher rock stress regimes, stronger rock masses, higher temperatures, and very thick overburden present new challenges, and where upfront capital investments will be potentially very large).

Professor Gideon Chitombo continued to maintain the high profile of the Mass Mining Technology (MMT) series, holding an outstanding industry workshop in Cloncurry in 2014 with over 30 industry representatives attending, many of whom were internationally based. Professor Chitombo also increased sponsor support for MMT3 with a total of nine companies contributing to the project. In recognition of the exceptional nature and significant industry impact of the long-running MMT series Professor Chitombo was nominated by UQ for the 2014 Business Higher Education Round Table Awards in the category of 'Best Research and Development Collaboration'. SMI-BRC research won the Douglas Hay Medal for 2014 on the application of the Hybrid Stress Blasting Model.

**Orebody Decision Science - applied geostatistical modelling and forecasting of risk to value.** This program is focused on capturing and communicating information on variability and uncertainty (deposit, human/physical capital, externalities) for informed planning, design, operating decisions and financial advantage. It recognises that mineral deposit data and associated mine-site data will be as important to production as are labour and capital, because of the interplay of deposit properties with plant, equipment, human resources performance, and with external social and market drivers.

Professor Rodney Wolff continues to lead CRC ORE's theme 3 "Integrated Mining Project Evaluation in a Risk Framework: Faster and Robust Decision-making" considering evaluation of mine projects in the presence of multiple capital and operational alternatives, linking with large geometallurgical data sets. This project focuses on major industry challenges including extracting key information from large, diverse data sets, including reconciling and simplifying data sampled with different density and support; accelerating computation of planning options; subjecting mine plans to externalities, such as market price for metal; and obtaining robust evaluations of alternative plans.





## SMI JKMRC

Julius Kruttschnitt Mineral  
Research Centre

The JKMRC was established at the UQ in 1970 and is renowned for its plant-based applied research projects that have significantly advanced industry characterisation, modelling and simulation in mineral processing circuits as well as pioneering the discipline of geometallurgy. The Centre also has a strong tradition for its post-graduate students to conduct significant portions of their work in operating plants. To date, the JKMRC has graduated 242 RHD students, who have typically gone on to become technology leaders in the industry.

### 2014 Report

**2014 was a difficult year for JKMRC, reflecting the difficulties faced by the minerals industry as a whole. The proposed extension to the geometallurgy project was unable to attract sufficient industry funding. Unfortunately, the difficult times meant that several staff members left us when their contracts expired.**

Professor Wayne Stange stepped aside from the role of director of the JKMRC to focus on business development, and Dr Chris Fountain was appointed acting director.

Research progressed on several major projects, including the current extension of the P9 project, the Rio Tinto CAMS project, and the AngloAmerican Centre for Sustainable Comminution. The CAMS project came to the end of its five-year term at the end of 2014.

In addition, a major new project was initiated with Metso Minerals (Chile) SA, known colloquially as the “Next Generation Concentrator” project. This project has the potential to involve other industry partners and is focussing on innovations that can provide significant reductions in capital and operating costs.

Notable achievements during the year included the completion by Tim Napier-Munn of his book *Statistical Methods for Mineral Engineers*. This book is based on the popular courses that Tim has been running over the years and has been a response to the demand by many people whom have taken the course. The book captures his accumulated knowledge and wisdom in the area.

During the year, five students were awarded MPhil degrees for their research theses, and a further three were awarded PhDs.

Kate Tungpalan received the 25<sup>th</sup> Ian Morley prize. The presentation was attended by Ian Morley’s son, Don Morley, and daughter, Colyn Storer. The anniversary presentation was attended by several past recipients of the award.



## SMI CWiMI

Centre for Water in the  
Minerals Industry

CWiMI conducts research on the measurement, monitoring and modelling of water in the context of resource extraction, their surrounding environments and regional communities to direct sustainable water management. Its four research themes are: water management; hydrology and hydrogeology; society and water; and hydrochemistry and aquatic ecology.

### 2014 Report

**CWiMI Director, Professor Neil McIntyre, was awarded a prestigious Professorial Future Fellowship by the Australian Research Council, on Water Sensitive Mining. The project will build on previous research to develop new knowledge about how the value of water can be shared in mining regions. The research will develop the scientific and decision-support basis for a new level of water stewardship by mining companies and land and water governance bodies.**

CWiMI celebrated 10 years of operations. An event was held with past and present staff members, students and advisory board members. SMI Director Professor Chris Moran was the Centre's first director in 2004 and was well placed to explain the rationale behind the creation of an interdisciplinary centre that focussed on water's operational, social and environmental considerations within the mining context.

Laura Sonter was the only student invited to be part of a panel of experts at a telecoupling workshop in Switzerland, hosted by the Global Land Project. Telecoupling is a new area of research within remote sensing and land use and aims to understand the connections between coupled human and natural systems. Laura's PhD conferral occurred December 2014 and she has now started a post-doctoral research fellowship with the University of Vermont, USA.

Dr Wenying Liu received a Dean's Award for Research Higher Degree Excellence for her PhD thesis *A Quantitative Risk-Based Approach for Improving Water Quality Management in the Minerals Industry: Flotation as an Example*, submitted 2013. Wenying is currently working on her second postdoctoral research fellowship at the University of British Columbia, Canada.

The Office of Water Science released Dr Sue Vink's work on the groundwater springs in the Surat and Bowen Coal Basins within the Great Artesian Basin. The result was a two volume series focusing on the history, ecology and hydrogeology of the Great Artesian Basin Springs in four supergroups. The project team surveyed hundreds of springs that had not previously been surveyed, including those with both a high conservation ranking and Environmental Protection and Biodiversity Conservation Act 1999 (EPBC) listing.

CWiMI continued its involvement in training on leading practice water management, with Neil McIntyre and Natasha Danoucaras running a two-week Water in Mining summer school for final year students at the University of Los Andes, Bogota. Neil and Natasha delivered lectures and oversaw a case study project where the student teams developed a mine water management plan. With Colombia facing rapid expansion of large-scale mining, such students will be relied upon to develop sustainable solutions to major water challenges.



CWiMI, in partnership with the Centre for Coal Seam Gas, delivered on milestones for three projects. The Water Quality Atlas project created visualisation and analytical tools with the aim of enabling non-specialists to extract, analyse and view water chemistry and geology data simultaneously. The Groundwater Uses project achieved better estimates of abstraction volumes for non-CSG related activities in the Surat and Bowen Basins. The estimates are critical inputs to numerical models that are currently used to assess the potential impacts of CSG production on groundwater resources. Similarly the Recharge project sought to improve estimates of groundwater recharge in the Surat Basin for use in models through a better understanding of the mechanisms of recharge.



## SMI CSR

Centre for Social  
Responsibility in Mining

CSR works with industry, communities and governments to improve social performance and deliver better outcomes for all mining stakeholders. CSR has developed a unique team of anthropologists, sociologists, economists, natural resource specialists, political scientists, systems engineers and technical specialists who are committed to bridging the divide between technical, physical and social sciences.

### 2014 Report

**2014 was an expansion year for CSR in terms of its staff size and revenues increasing by 40% due to several new projects that have emanated from our diversification strategy. Despite the financial downturn in the mineral industry, we were thus able to have a higher project activity base albeit with lower margins, which will lead to some consolidation in 2015.**

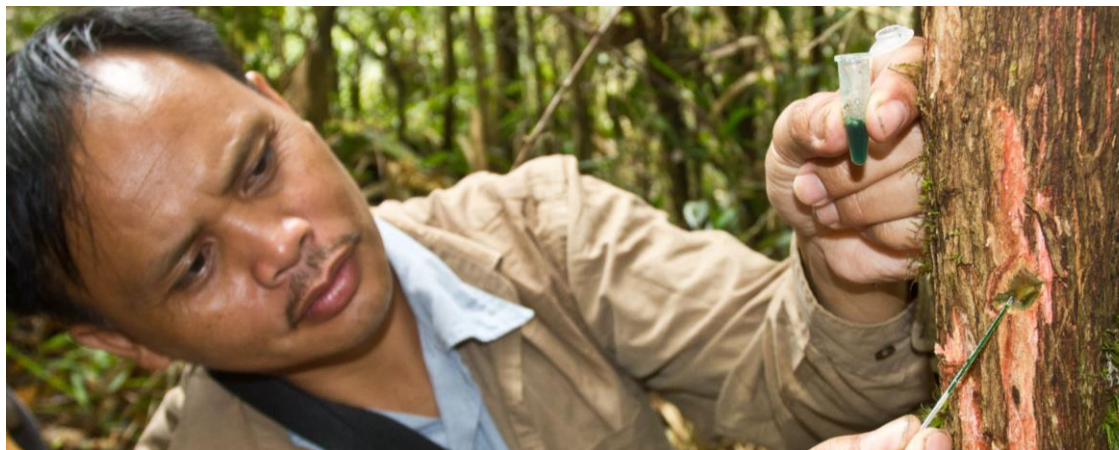
Our outreach to international development donors continued to pay off with new projects commissioned by the Organization for Economic Cooperation and Development (OECD); The UK Department for International Development and the United Nations Development Programme, totalling over \$400,000. Such activity leveraged our delivery of several projects for the International Mining for Development Centre (IM4DC) that UQ and UWA have co-hosted.

CSR's landmark study on the fiscal and non-fiscal contributions of mining in Madagascar's economy was completed for the World Bank group and launched at workshops in Antananarivo, the country's capital, towards the end of 2014. This research, coupled with other research in Africa conducted by the centre is in preparation for a book on *Africa's Mineral Fortune* which will be prepared in the coming year.

We continued to develop the Indigenous Enterprise Initiative with the appointment of world-renowned Aboriginal scholar Marcia Langton as Adjunct Professor at UQ. Professor Langton specifically asked for her UQ appointment to be based at CSR and is collaborating in particular with us on a project pertaining to Indigenous Agreements with Rio Tinto.

CSR's work in Latin America also continued to gather further momentum with our partnerships with universities in Peru and Chile and the implementation of our \$250,000 Ford Foundation project on social inclusion around mining in Colombia.

Our first ever downstream project was also completed for Apple Inc. focusing on the social aspects of the rare earths supply chain in China which was carried out in partnership with the Chinese Academy of Sciences and builds on CSR's capacity for research on industrial ecology. We also joined a major infrastructure research consortium led by the Wharton School of Business at the University of Pennsylvania. CSR was able to leverage these projects for the highest peer-reviewed publication productivity as well in our centre's history which also positions us well for 5 major Category 1 competitive grant proposals totalling over \$1.5 million submitted in 2014.



## SMI CMLR

Centre for Mined Land Rehabilitation

CMLR addresses the minerals industry's environmental challenges with quality science, and translates research outcomes into practices that lead to continual improvement of rehabilitation and protection of environmental values. CMLR's focus is preventing, minimising and remediating mining environmental impacts by providing research, education and professional development in the sustainability area, and engaging with community, government and industry globally.

### 2014 Report

**2014 was a year of positive outcomes from a research output and engagement perspective, but also provided some challenges for future planning given the industry downturn and trend to reduce the level and longevity of investment in environmental research and innovation.**

The current and emerging research strengths and focus of CMLR were developed into four themes in 2014, with opportunities identified and impacts made across all areas:

#### ***Environmental Contaminants***

The concept-testing stage of the collaborative and cross-disciplinary NextMine™ Designer Tailings project was completed and discussions with the industry globally are underway for the next stage of validation through site implementation and testing.

#### ***Landform Stability and Evolution***

Installing greater risk-reduction in 'soil' cover designs and testing new equipment to measure substrate water suction at depth in reconstructed cover profiles were new introductions to the industry in 2014.

#### ***Soil-Plant Systems***

Drawing on multiple disciplinary skills, advancing cost-effective and robust mine tailings remediation has been a very promising activity throughout 2014. Capturing knowledge from understanding the establishment of 'natural hardpan' layers has allowed a purposefully designed closure strategy for tailings dams to be developed.

#### ***Landscape Ecology***

Rehabilitation 'report cards' that provide greater accuracy in the reality of rehabilitation performance have now been developed and tested. In addition, UAV field testing performance and sensor outputs have been advanced. The development of new, compact platforms has enabled rapid and cost-effective deployment and image and data capture in remote and difficult landscapes - from the heat of Kakadu to the height of Mt Kinabalu.

CMLR organised and chaired the 2<sup>nd</sup> International Life-of-Mine Conference with AusIMM during the year, an event that attracted over 260 participants from 27 countries. The Centre also hosted the world's first "phytomining" workshop, bringing together experts from the USA, Canada, UK, China, Indonesia, Philippines, Papua New Guinea, France, New Zealand and Australia to discuss the future of this unique technology.

New international partnerships and projects with government, academe and research organisations in Korea, Peru, Finland and France were initiated throughout the year, and as a part of the contribution to the IM4DC program, CMLR hosted 21 participants from 12 developing countries for a month-long course on Environmental Management in Mining.

Finally, research publications and higher degree completions for 2014 were the highest to date, and we were very proud of our seven MPhil and PhD graduates and the support provided by the advisory teams to these early career researchers.



## SMI CCSG

Centre for Coal Seam Gas

CCSG is a whole-of-sector, rather than discipline focused research centre. Founded in 2011, it is funded by UQ and the gas industry. The Centre is advised by a strategic advisory board which is chaired by a representative of the VC/Provost and includes representatives from gas industry and the Queensland regulator.

### 2014 Report

**The CCSG funds world class applied research focusing on a portfolio of projects that address the demand for new and improved scientific knowledge in the gas sector.**

It is a virtual centre with research projects spanning the areas of water, geoscience, petroleum engineering and more broadly social performance. Each area has a Chair who manages the portfolio. This multi-disciplinary approach aims to assist the sector in balancing the needs of the community, government and industry.

The Centre also plays a key role in meeting the educational needs of the Australian onshore gas industry. It helps support a Masters in Petroleum Engineering which is delivered by the UQ, School of Chemical Engineering in partnership with the Institute of Petroleum Engineering at Heriot-Watt University in the UK. In addition, the Centre has developed and delivered tailored training and seminars to industry and the Queensland regulator, in areas ranging from well engineering to geostatistics and has also hosted visiting scientists and key academics from the US to share on lesson from their onshore developments.

Over 55 researchers from 18 UQ schools and centres along with 26 RHD students and four major national and international collaborators are engaged in CCSG research. In addition, approximately \$1.5 million of Centre funds have been allocated to research infrastructure to further build capability at UQ (Chemical Engineering, Earth Sciences and CWiMI). Highlights from 2014 include:

- Asia Pacific LNG joined the centre meaning that all the major CSG companies are now engaged with UQ in research.
- The successful completion of the Water Chemistry Atlas prototype software (CWiMI and ITEE). The Water Atlas can successfully produce 3D visualisations of water chemistry and geological data. It is designed to address key technical questions regarding spatial and temporal regional water quality trends and provide valuable information to government, industry and the community.
- Other completed projects included the thermal stimulation of coal to enhance production (Chemical Engineering), the nature of public discourse in the media (Journalism and Communications) and a comparative assessment of 30 years of CBM development in the USA with early Australian CSG experience (a joint project between CCSG and the University of Texas).

- Centre Chairs set up and organised a quarterly Gasfields Water Researchers Forum and Gasfields Social Science Researcher Forum, both of which aim to connect University and CSIRO researchers active in the field to stimulate scientific sharing and cross-learning.
- The Centre, along with CSIRO, hosted a briefing to the Queensland parliament on the social, economic and environmental impacts of, and the science behind, Australia's onshore gas development. The event was sponsored by the Minister for Natural Resources and Mines.
- The development of a new directory of onshore natural gas research. The directory, compiles recent, current or planned projects in all areas including geology, water, coexistence and social and environmental impacts.
- Twenty-two students commenced the Masters of Petroleum Engineering in 2014 and the first Masters students from the previous intake completed the course in December, 2014.

The year concluded with the annual Research Review event which showcased the Centre's research to an audience of over 130 people from government, community, industry and university stakeholders.

Since the inception of the Centre, the external environment has changed significantly. By the end of the year, the oil price had fallen to under \$50/bbl with implications for confidence in 2015. In addition, first gas was exported by QGC in early January and the three major CSG-LNG developments are coming to the end of their major construction phase with long-planned staff reductions well underway.





**SMI NextMine™**  
Innovation Through Connection

**SMI NextWorkforce**  
Professional development  
for a sustainable future

NextMine™ is the transformational strategic initiative through which the SMI will assist the minerals industry to address major challenges that have the potential to limit the responsible development of the sector. NextWorkforce is the complementary professional education and learning initiative that will equip industry professionals to meet the challenges facing the industry.

## 2014 Report

**Across the global minerals industry a number of major challenges are emerging for which there are no off-the-shelf solutions and the way forward is not always clear.**

Examples include:

- Deeper and lower-grade ore bodies
- Difficulties in obtaining social and community acceptance of mining activities
- Geopolitical complexities in emerging mining regions
- Environmental impacts of mining activities and mine legacy planning

Through the NextMine™ initiative, SMI is bringing its globally unique discipline breadth to these challenges. By working together across disciplines, SMI's collective knowledge and expertise will assist in the identification of new approaches to deliver stepwise, real-world improvements.

NextMine's™ focus is not just on new technologies, but also on the more effective utilisation of existing technology through better linkages between business functions, across the different stages of the mining process, and between mines and other stakeholders in the spatial environment.

SMI is using internal funding to seed projects under the NextMine™ umbrella with the aim of demonstrating that a connected approach is an effective way of addressing major industry challenges and opportunities.

To date, three projects have been completed:

- 'Designer Tailings': Addressing the management of tailings and waste across the value chain
- The application of industrial ecology principles to the rare earth supply chain
- The deep in-situ recovery of minerals

A fourth project, 'Common Ground', commenced in 2014. The focus of this project is on developing more effective planning frameworks and supporting tools, to inform planning decisions in resource-intensive regions.

The focus of NextWorkforce activities in 2014 has been on designing a new, integrated, postgraduate coursework program on Responsible Resource Development. University approval for this new program was obtained in late 2014.

# TECHNOLOGY TRANSFER AND COMMERCIALISATION



JKTech Pty Ltd is wholly owned by UQ and is the technology transfer company for SMI, commercialising research outcomes from the Centres of the SMI. Commercialisation is conducted via spin-off companies, sales of IP and technology licensing, as well as through JKTech's suite of products and services that are delivered to the global resources industry. Often, SMI IP is incubated within JKTech's products and services, thereby enhancing its value prior to commercialisation by external parties. JKTech works closely with researchers to determine the optimum commercialisation pathway for research outcomes that have commercial potential.

JKTech delivers economic and social value to the global resources industry via innovative technology products and services. The expertise in technology based consulting, laboratory services, software, specialist equipment and professional development is implemented to improve the profitability, sustainability, social responsibility and safety culture of resource operations globally.

During 2014, JKTech's operations continued throughout the world, but with a particular emphasis on South America, Africa, the Middle East and Asia.

JKTech's Chilean subsidiary (JKTech South America SpA) is in its early stages of business development and continues to provide a steady flow of projects for both the Chilean and Australian business units of JKTech. During 2014, SMI and JKTech worked collaboratively to ensure UQ's successful application for grant funding from InnovaChile Corfo ('CORFO') for the establishment of a Chilean based International Centre of Excellence (SMI-ICE-Chile). Current Centre participants include UQ, Universidad de Concepción based in Chile and JKTech South America SpA. The objective of the Centre is to carry out research and development, technology transfer and commercialisation activities that will in turn have a high national and international impact for Chile, and that strengthen Chile's research and development capabilities. The Centre will be administered by UQ.



JKTech South America SpA entered into the Grant Agreement with CORFO in June 2014 for an eight-year term. The contract signing ceremony took place at the Australian Ambassador's residence in Santiago.

In the global delivery of consulting projects in 2014, JKTech expanded its commodity experience to diamonds, carrying out a Mine-to-Mill® Optimisation Project for a diamond operation in Southern Africa where the validation work confirmed significant increases in mill throughput and concentrate production.

In 2014, Rio Tinto announced its Processing Excellence Centre to the world – a project that JKTech has been heavily involved in from its inception, including JKTech Processing Specialists on a full-time basis. This relationship with Rio Tinto has also extended to their new Mining Excellence Centre, involving JKTech Mining Specialists.

JKTech began a significant partnership with gold producer in the Middle-East in 2014, covering the mining and processing areas of the business. The initial stage of the project has led to a number of opportunities for ore fragmentation, ore pre-concentration, comminution circuit optimisation, retreatment of waste streams and enhancement in gold leach recoveries. The work program will continue into 2015.

JKTech began a technical partnership with a mining company with operations in South-East Asia with an extensive continuous improvement program that has now extended across mine sites. JKTech's Geometallurgy Specialist developed performance predictions within the block model based on the resource definition drilling, while JKTech's Mining Specialists were engaged to optimise the blast performance so to maintain throughput when harder and more competent ore was encountered.



In 2014, JKTech's SMI Knowledge Transfer business unit launched with SMI the inaugural Mining Leaders' Program, designed specifically to enable discipline managers to make the transition from Technical Specialist to a General Manager level either at site or corporate level. The program was designed around three

central themes critical to optimising current and future mining performance:

- the transition to high performing mining leadership
- the business of mining and optimising operational performance, and
- the creation of new value through transformation and innovation.

The first cohort of the Mining Leaders' Program was made up of twenty participants from ten companies (African Barrick Gold, Anglo American, Barrick, BMA, JKTech, MMG, NewGold, Ok Tedi Mining, Resolute Mining Limited and Sandvik) and four geographies (Africa, Australia, North America and Oceania).

As one of two commercialisation companies within UQ, JKTech continues to work with both researchers and industry alike to identify the best commercialisation pathways for thought-leading, cutting edge breakthroughs as well as enhancements to processes, technologies and methodologies for the global resources industry. JKTech, SMI and UQ continue to collaborate into the future, to provide ongoing benefits and returns to UQ by way of financial returns, reputational enhancement, and strong industry engagement and relationships.



# STUDENTS

## Research Higher Degree Graduates

Education programs offered through SMI are recognised internationally for their rigorousness and relevance for mining professionals. In 2014, 28 SMI Research Higher Degree students graduated, with 18 PhD and 10 MPhil being awarded – the largest number of graduates since SMI became an enrolling unit in 2008.

**Mr Zhengling Xiong** – WH Bryan Mining and Geology Research Centre  
*Relationship Between Temperature Derivatives and Electricity Futures*

**Dr Adebayo Aderounmu** – WH Bryan Mining and Geology Research Centre  
*Copula-based dependence modelling of price spikes and contagion-like effects in Australian electricity markets.*

**Ms Shasha Jiang** – CMLR  
*Copper and Zinc Adsorption by High Temperature Biochars of Pine and Jarrah and Influences of Solution pH and Salinity*

**Dr William Hitchcock** – Minerals Industry Safety and Health Centre  
*The relationship of gas evolution and odour to the stages of coal self-heating*

**Dr Mai Vo** – Centre for Social Responsibility in Mining  
*Government-managed Resettlement in Vietnam: Structure, Participation and Impoverishment Risks in the Case of the Thach Khe Iron Ore Mine*

**Dr Hector Parra Galvez** – WH Bryan Mining and Geology Research Centre  
*Blast induced fragment conditioning and its effect on impact breakage and leaching performance*

**Dr Thi Mai Thanh Nguyen** – Centre for Water in the Minerals Industry  
*Synergy and Trade-off Potentials between Water and Energy Targets in Mine Water Management: an Exergy-Energy Approach*

**Dr Daniel Tuazon** – Centre for Social Responsibility in Mining  
*A structured approach for integrating sustainable development principles into the decision-making processes at minerals processing operations*

**Mr Paul Toor** – Julius Kruttschnitt Mineral Research Centre  
*Quantifying the Influence of Liner Wear on SAG Mill Performance*



**Dr Antony Van der Ent** – Centre for Mined Land Rehabilitation

*Plant diversity and foliar elemental profiles in relation to soil chemistry and altitude on ultramafic edaphic islands in Kinabalu Park (Malaysia)*

**Mr Graham Long** – Julius Kruttschnitt Mineral Research Centre

*Production of a Low Arsenic Copper Concentrate from a VMS Ore*

**Dr Carol Bond** – Centre for Social Responsibility in Mining

*Mining and Peace: Paradox or Paradigm Shift?*

**Dr Yumei Du** – Centre for Mined Land Rehabilitation

*Characterize Foliar Uptake of Zinc Hydroxide Nitrate as a Potential Foliar Zinc Fertilizer on Leaf Surface*

**Dr William Hancock** – WH Bryan Mining and Geology Research Centre

*Gravity flow of rock in caving mines: Numerical modelling of isolated, interactive and non-ideal draw*

**Mr Armando Rodrigues** – Julius Kruttschnitt Mineral Research Centre

*Grinding of Itabirite Iron Ore in Autogenous and Semi-Autogenous Mills.*

**Dr Bronwen Forsyth** – Centre for Mined Land Rehabilitation

*Understanding the Long-Term Seepage Geochemistry of Base Metal Mine Tailings in a Semiarid Subtropical Climate, Mount Isa, Australia*

**Dr Michael Scott** – WH Bryan Mining and Geology Research Centre

*Evaluation of Energy-Efficiency, Emission Pricing and Pre-Concentration for the Optimised Development of a Au-Cu Deposit*

**Ms Rebecca Wolfgang** – Minerals Industry Safety and Health Centre

*Managing Whole-body Vibration in the Surface Mining Industry*

**Mr Wayne Rogers** – WH Bryan Mining and Geology Research Centre

*Understanding blast movement to optimise grade control practices at Ahafo Gold Mine in Ghana*

**Dr Bianca Newcombe** – Julius Kruttschnitt Mineral Research Centre

*Characterising and predicting the performance of an industrial flash flotation cell*

**Mr Fraser Burns** – Julius Kruttschnitt Mineral Research Centre

*Development of a regrind-flotation pre-treatment methodology for the carbon-in-leach circuit of a copper-gold processing plant*

**Mr Yunjia Liu** – Centre for Mined Land Rehabilitation

*Effects of magnetite removal on the distribution and speciation of Arsenic in copper tailings and its accumulation in native grass*

**Dr Blanca Isabel Buitrago Franco** – Centre for Social Responsibility in Mining

*Building Sustainable Communities: Enhancing Human Capital in Resource Regions - Colombian Case*

**Dr Mitesh Chauhan** – Julius Kruttschnitt Mineral Research Centre

*Investigation of a mineral flotation separability test for ore characterisation in geometallurgy*

**Dr Munkhzul Dorjsuren** – Centre for Mined Land Rehabilitation

*Phosphorus Distribution in Base Metal Mine Tailings and Availability for Native Plants in a Semi-Arid Environment*

**Mr Chris Akop** – Julius Kruttschnitt Mineral Research Centre

*Developing a Bulk Circuit Suitable for Chalcopyrite-Pyrite Ores with Elevated Pyrite Content in Copper-Gold Ore Treatment*

**Dr Hoang Phong Pham** – Centre for Mined Land Rehabilitation

*Chemical and stable isotope investigation of sources, transport and release of contaminants in acid mine drainage, Mount Leyshon, Queensland, Australia*

**Dr Laura Sonter** – Centre for Water in the Minerals Industry

*Global Driving Forces of Intensive Land Use Change from Steel Production in Brazil's Iron Quadrangle*

# STUDENT AWARDS

## Ian Morley Award 2014

2014 was the 25th anniversary presentation of the Ian Morley prize, which went to Kate Tungpalan. The Ian Morley prize is greatly valued by JKMRC students, and acknowledges the best overall performance by an RHD student, not only in their research work, but in their contributions to the cultural life of the JKMRC. Ian Morley's son, Don Morley, and daughter, Colyn Storer, attended the special presentation of this award.

## 2013 Dean's Commendation List for RHD Excellence

The UQ Graduate School instituted the Dean's Award for Research Higher Degree Excellence in 1998. This award gives formal recognition to outstanding PhD and MPhil graduates who have demonstrated excellence in a research higher degree and who have been commended by independent examiners for substantial contribution to their field of research. No more than 10% of research higher degree graduates are recognised in this way each year.

Nominations are taken early in the new year for graduates who received their degree the preceding year. Dr Wenying Liu (CWiMI) and Dr Gerson Sandoval (JKMRC) were nominated in 2014 for the 2013 Dean's Commendation List for RHD Excellence, and both received this special award.

Three students from SMI have been nominated in 2015 for the 2014 Dean's Commendation List for RHD Excellence.





# AWARDS

## Professor Jim Joy

Professor Jim Joy, the founder of the Minerals Industry Safety & Health Centre, was inducted into the International Mining Technology Hall of Fame for his renowned risk management expertise in the global mining industry. This award is bestowed upon individuals or small groups that have pushed the boundaries of innovation and R&D to bring new solutions to the mining industry.

Professor Joy created the Global Minerals Industry Risk Management (G-MIRM) program, which was developed out of project with Anglo American and is now a benchmark for safety in the industry around the world.



## Professor Neil McIntyre

CWiMI Director Professor Neil McIntyre was awarded a prestigious Professorial Future Fellowship by the Australian Research Council to help mining projects be more water sensitive. The Fellowship award of \$898,000 will enable CWiMI to develop the science behind better water stewardship in the mining industry.

The project will produce applied research that supports a catchment-based approach to water management to benefit the environment, industry and society as a whole. The work will not only look at water management on individual mine sites but also how mining interacts with catchments and other water users over the whole mine life cycle. This type of research is essential if resource-rich regions in Australia and beyond are to be developed with sustainability as a goal, and for mining to live more comfortably alongside other strategically important water and land users.

## Douglas Hay Medal

BRC research was awarded the 2014 Douglas Hay Medal for the best paper in Mining Technology on the application of the Hybrid Stress Blasting Model (HSBM).

HSBM is an innovative explosive rock interaction model developed in conjunction with Itasca USA. This international industry sponsored project formed part of an applied PhD research by Dr Alex Catalan to demonstrate the potential benefits of preconditioning by confined blasting on cave performance, along with fellow researchers Professor Gideon Chitombo and Dr Italo Onederra from UQ's School of Mechanical and Mining Engineering.

### **Professor Robin Burgess-Limerick**

The Deputy Director of MISHC was honoured by becoming the second recipient of the Tom Triggs memorial award at the 50th Annual Conference of the Human Factors and Ergonomics Society of Australia in Adelaide. The award is made by the society for "a major systematic programme of human factors and ergonomics related research that has led to demonstrable improvements in the safety, efficiency and/or usability of systems, products and/or environments." The award recognises the program of research Robin has conducted since 2005 aimed at improving the safety of mining equipment.



# PROFESSIONAL SERVICE

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## **Dr Patrick Audet**

Agriculture, Ecosystems and Environment, *Editorial Board*

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## **Professor Alan Baker**

Agrochimica, *Editorial Board*

Environmental Geochemistry and Health, *Editorial Board*

Environmental Pollution, *Editorial Board*

International Conference on Environmental Changes and Conservation of Plant Diversity, Baku, Azerbaijan, *International Advisory Committee Member*

International Journal of Phytoremediation, *Editorial Board*

International Phytotechnology Society, *Board of Directors*

International Seminar on Mine Closure, Cornwall, UK, *International Organising Committee and Technical Committee Member*

Journal of Environmental Sciences (China), *Editorial Board*

Land Contamination and Reclamation, *Editorial Board*

Pedosphere, *Editorial Board*

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## **Dr Thomas Baumgartl**

Applied Clay Science, *Editorial Board*

International Soil and Water Conservation Research, *Editorial Board Member*

Soil and Tillage Research, *Editorial Advisory Board*

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## **Professor David Brereton**

Australian Council of Learned Academies, *Member*

Engineering Energy: Unconventional Gas Production, *Expert Working Group on Securing Australia's Future*

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## **Professor Robin Burgess-Limerick**

Ergonomics Open Journal, *Editorial Advisory Board and Guest Editor Human Factors in Ergonomics for the Minerals Industry*

Human Factors and Ergonomics Society of Australia Inc, *Minerals Industry Special Interest Group Chair*

International Ergonomics Association, *Mining Technical Committee Chair*

International Ergonomics Association Melbourne 2015 Congress, *Organising Committee Member*

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**Professor Frank Carrick**

Central Queensland University Koala Research Centre Advisory Board, *Member*  
Environment Protection and Biodiversity Conservation Act Referral Guidelines for the Koala Expert Panel, *Member*  
Species Survival Commission of the International Union for Conservation of Nature – Marsupial and Monotreme Specialist Group, *Member*

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**Professor Gideon Chitombo**

Innovative Technologies and Concepts for the Intelligent Deep Mine of the Future, *Advisory Board Member*  
Networks of Centres of Excellence on Ultra Deep Mining Network, *Expert Panel Member*

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**Professor David Cliff**

Australian Occupational Health and Safety Education Accreditation Board, *Academic Representative*  
National Research Council Board on Human Systems Integration's Mine Safety: Essential Components of Self-Escape, *Member*  
OHSSc Program Advisory, *Committee Member*  
Queensland Underground Coal Mines, *Organising Committee Member for level one emergency simulation exercises*  
Safety in Mines Testing and Research Station Advisory Board, *External Board Member*  
Technical Steering Committee for the Coal Mining Abatement Technology Support Program, *Alternate Member*

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**Dr Natasha Danoucaras**

Minerals Council of Australia Water Working Group, *Member*

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**Dr Daniel Franks**

Centre for International Minerals and Energy Law, The University of Queensland, *Fellow*  
International Association of Impact Assessment, *Co-Chair Social Impact Assessment*  
International Journal of Minerals Policy and Economics (Resources Policy), *Editorial Board Member*  
International Symposium on Resettlement and Livelihoods, 2014, *Program Committee Member*  
Mining Business School, Universidad Católica del Norte, Chile, *Adjunct Professor*  
Steel Stewardship Forum External Advisory Panel, *Member*  
Ulula, *External Advisor*  
United Nations Sustainable Development Solutions Network, Good Governance of Extractive and Land Resources Thematic Group, *Member*

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**Professor Andrew Garnett**

AgForce, CSG Water Field Day, Miles, *Public Forum Independent Chair*  
American Association of Petroleum Geologists – CBM GTW (2014), *Convener*  
Australian Standards, International Organization of Standardization Mirror Committee in Carbon Capture and Storage, Cross-cutting issues – ISO/TC265/WG5, *Member*  
CCS Program, UQ Energy Initiative, *Director*  
Centre for International Minerals and Energy Law, The University of Queensland, *Fellow*  
Combined American Association of Petroleum Geologists and Geological Society of London Carbon Capture and Storage Conference (2014), *Technical Committee Member*  
IEA CCS Technology Roadmap (2013), *Expert Advisor*  
IEAGHG International CCS Summer School, Nottingham, UK, *Panel Lead Project Integration*  
IQPC Process Safety Management, Brisbane, *Conference Chair*  
The Promised Land: The Future of Coal Seam Gas in Victoria, *Conference Chair*  
South African Carbon Capture and Storage Project Advisory Committee, *Chair*  
Unconventional Gas – energy savior or environmental problem? *Public Forum Independent Chair*

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**Dr Longbin Huang**

Australian Soil and Plant Analysis Council, *Queensland Representative on Executive Committee*  
International Conference on Contaminated Land, Ecological Assessment and Remediation,  
Chuncheon, South Korea 2014, *Scientific Committee Member*  
International Symposium of Soil and Plant Analysis, *Scientific Committee Member*

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**Dr Deanna Kemp**

Expert Panel for the International Council of Mining and Metals New Member Review Process,  
*Member*  
International Gender Reference Group, *Founding Member*  
Journal of Corporate Social Responsibility and Environmental Management, *Editorial Board Member*  
Journal of Development Studies Research, *Editorial Board Member*  
Journal of Extractive Industries and Society, *Editorial Board Member*  
Reference Group for IPIECA (oil and gas industry body) on the integration of human rights into  
Environmental, Social and Health Impact Assessment processes, *Member*

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**Dr Matthew Krosch**

Australian Entomological Society, *South East Queensland Regional Councillor*  
Entomological Society of Queensland, *Member*

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**Professor Chris Moran**

Expert Panel for Major Coal Seam Gas Projects, *Member*  
Mine Water and Environment, *Associate Editor*  
Resources Sector Supplier Advisory Forum, *Member*  
Underground Coal Gasification Independent Scientific Expert Panel, *Chair*  
Centre for International Minerals and Energy Law Advisory Board, *Member*  
Leading Practice Sustainable Development Program for the Mining Industry Steering  
Committee, *Member*  
World Federation of Engineering Organizations Mining and Sustainability Task Force, *Member*  
Journal for Cleaner Production, *Subject Editor: Sustainability in the Resources Sector*

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**Professor David Mulligan**

Alligator Rivers Region Technical Committee, *Independent Member*  
Buller Coal Escarpment Mine Project, *Independent Peer Review Panel Member*  
International Affiliation of Land Reclamationists, *Australian representative*  
International Seminar on Environmental Issues in Mining (Enviromin), Santiago, Chile, *Co-chair*  
Life-of-Mine International Conference, Brisbane, Australia 2014, *Organising Committee Chair*

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**Associate Professor Barry Noller**

National Association of Testing Authorities, *Environmental Technical Group Member and Assessor (Water and Soil Analysis)*  
Queensland Nickel Pty Ltd, *Independent Science Panel Member*

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**Associate Professor Will Rifkin**

Commonwealth Office of Learning and Teaching, *National Assessor for Teaching Awards*  
Science and Mathematics Network of Australian University Educators, *Steering Committee Member*  
University of Sydney, School of Physics, *Honorary Associate Professor*

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**Professor Margaretha Scott**

Australian Institute of Mining and Metallurgy, *Member*  
International Symposium on Mineral Exploration, Division of Exploration Technology in Mining  
and Materials Processing Institute of Japan, *Organising Committee Member*  
Queensland Exploration Council, *Academic Working Group – Member*  
Society of Economic Geologists, *Member*

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**Professor Jim Underschultz**

Australian National Low Emissions Coal, *Research and Development Science Leader*  
International Standards Carbon Capture and Storage Committee, *Working Group Member*  
Standards Australia Carbon Capture and Storage Mirror Committee, *Member*  
The Peter Cook Centre for Carbon Capture and Storage Research (University of Melbourne)  
Science Advisory Committee, *Member*

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**Corinne Unger**

AusIMM Community and Environment Society, *Committee Chair*

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**Antony van der Ent**

International Conference in Serpentine Ecology, Kota Kinabalu, Malaysia 2014, *Organising Committee Member and Scientific Committee Member*

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**Associate Professor Sue Vink**

Coal Seam Gas water use proposals in the Queensland Murray-Darling Basin: Impacts on aquatic ecosystems, *Steering Committee Member*  
Fitzroy Basin Association Partnership for River Health Science Panel, *Member*  
Healthy Headwater Coal Seam Gas Water Feasibility Study, *Advisor*  
Queensland Resources Council Water Group, *Science Advisor*  
Water in Mining Conference, *Organising Committee Member*

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**Dr Tony Webster**

AusIMM Heritage Committee, *Corresponding Member*

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**Professor Rodney Wolff**

Applied Stochastic Models in Business and Industry, *Editorial Board*  
Computational Statistics, *Editorial Board*

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**Dr Alan Woodley**

Minerals Council of Australia Water Working Group, *Member*



# PUBLICATIONS

As part of the 2014 Academic Board Review into SMI, an analysis of the Institute's publications was undertaken that showed SMI is leading a global increase in the formal literature on sustainable development as it relates to mining and minerals. This is evidenced by a search of the two dominant citation databases Thompson Web of Science and Scopus. A search on "sustainable development" was restricted to "articles" from 1987 to July 2014 and then refined to only include papers with "mining or mineral". Only four institutions appear in all search lists, i.e. the broader search of SD and the more refined search, viz. the Chinese Academy of Sciences, The University of Queensland, Beijing Normal University and The University of British Columbia. UQ was first in both databases and the majority of papers from UQ were authored or co-authored by SMI people.

As well as encouraging publication through strategies at the level of individuals, SMI has undertaken to organise and Chair conferences and to take on editing roles in Special Issues/Volumes to increase productivity and profile. Examples of Special Issues/Volumes that have recently been led by SMI staff:

- Impact Assessment and Project Appraisal – *Human Rights and Project Appraisal*, SMI Editor D.Kemp (CSRM)
- Agriculture, Ecosystems & Environment (2012) *Recent advances in restoration ecology: Examining the modern Australian agro-ecological and post-mining landscapes*, SMI Editors P. Audet and D. Mulligan (CMLR)
- Resources Policy (2013) *Cumulative impacts in resource regions*, SMI Editors D. Franks (CSRM), D. Brereton (CSRM/SMI) and C Moran (SMI).
- Journal of Cleaner Production (2014) *The sustainability agenda of the minerals and energy supply and demand network: an integrative analysis of ecological, ethical, economic, and technological dimensions*, SMI editors C. Moran (SMI), N. Kunz (CWiMI)

With regards to the last of those special volumes (Journal of Cleaner Production), SMI has strengthened itself considerably in terms of meeting the goal of a cogent definition of sustainability. The statement was derived from a significant process of internal engagement, dominantly through a series of SMI Connect Sustainability Forum meetings. The statement has been positioned as part of a comprehensive two-paper introduction to a Special Volume of the Journal of Cleaner Production (IF 3.5) consisting of over 80 papers edited by the SMI Director, a former PhD student of SMI and a colleague from The University of South Australia. Through this, we have been able to fill a significant literature gap in terms of how one might go about the process of assessing progress towards sustainability by establishing a foundation of practical and usable definitions.

Following is a list of Institute and Centre publications for 2014.

Brereton, D. (2014) Is the seeming paradox resolvable? Some reactions to Professor Hodge's paper. *Journal of Cleaner Production*, 84 37-38. doi:10.1016/j.jclepro.2014.08.100

Kunz, N. C. and Moran, C. J. (2014) Sharing the benefits from water as a new approach to regional water targets for mining companies. *Journal of Cleaner Production*, 84 469-474. doi:10.1016/j.jclepro.2014.02.053

Mitchell, P., Bradbrook, M., Higgins, L., Steen, J., Henderson, C., Kastle, T., Moran, C., MacAulay, S. and Kunz, N. (2014) Productivity in mining: Now comes the hard part, a global survey

Moran, C.J., Lodhia, S.K., Kunz, N.C. and Huisingh, D. (2014) Sustainability in mining, minerals and energy: new processes, pathways and human interactions for a cautiously optimistic future. *Journal of Cleaner Production* 84: 1-15

Moran, C. J. and Kunz, N. C. (2014) Sustainability as it pertains to minerals and energy supply and demand: a new interpretative perspective for assessing progress. *Journal of Cleaner Production*, 84: 16-26. doi:10.1016/j.jclepro.2014.09.008

Vo, M. and Brereton, D. (2014). Involuntary resettlement in the extractive industries: Lessons from a Vietnamese Mining Project. In Evi Fritriani, Francisca Seda and Yesi Maryam (Ed.), *Governance of extractive industries: assessing national experiences to inform regional cooperation in Southeast Asia*, 36-61 Jakarta, Indonesia: Pernerbit Universitas Indonesia (UI Press).

## SMI BRC

WH Bryan Mining &  
Geology Research Centre

Aderounmu, A. and Wolff, R. (2014) Modelling dependence of price spikes in Australian electricity markets. *Energy Risk*, February: 60-65

Akram, S., Sharrock, G.B. (2014) Mechanics of conglomeratic rocks, *Int. J. Numer. Anal. Meth. Geomech* (submitted under review).

Bahaaddini, M., Sharrock, G.B., Hebblewhite, B.K. (2014) Combined photogrammetry and numerical modelling to predict the shear behaviour of rock, *J. Engineering Geology* (submitted under review).

Chitombo, G, Webster, A (Ed), Murphy, T, and Puscasu, R., January (2014) *Geology and Mass Mining Project, Bi-Monthly report, November–December 2013 PowerPoint Format.*

Chitombo, G, Webster, A (Ed), Murphy, T, and Puscasu, R., March (2014) *Geology and Mass Mining Project, Bi-Monthly report, January–February 2014 PowerPoint Format.*

Chitombo, G, Webster, A (Ed), Murphy, T, and Puscasu, R., April (2014) *Geology and Mass Mining (GMM) Project Bi-Monthly report: March–April 2014 In PowerPoint Format.*

Chitombo, G, Webster, A (Ed), Murphy, T, and Puscasu, R., August (2014), *Geology and Mass Mining (GMM) Project: Second (April 2014) Technical Progress Report, Unpublished research technical report to project sponsors, August 2014. T. Webster (Ed).*

Chitombo, G, Webster, A (Ed), Murphy, T, and Puscasu, R., August (2014) *Geology and Mass Mining (GMM) Project Bi-Monthly report: June–July 2014 In PowerPoint Format.*

Chitombo, G, Webster, T (Ed), Murphy, T, and Puscasu, R., November (2014), *Geology and Mass Mining (GMM) Project: Second (April 2014) Technical Progress Report, Unpublished research technical report to project sponsors, August 2014.*

Chitombo, G, Webster, T (Ed), Murphy, T, and Puscasu, R., November (2014), *Geology and Mass Mining (GMM) Project: Third (November, 2014) Technical Progress Report, Unpublished research technical report to project sponsors, November 2014.*

Golev, A., Scott, M., Erskine, P.D., Ali, S. H., and Ballantyne, G. R. (2014) Rare earths supply chains: Current status, constraints and opportunities, *Resources Policy*, Volume 41, September 2014, 52–59

Lisitsin, V., Porwal, A. & McCuaig, T. (2014) Probabilistic fuzzy logic modeling: quantifying uncertainty of mineral prospectivity models using Monte Carlo simulations. *Mathematical Geosciences*, 46(6): 747-769

Liu, S. Anh, V., McGree, J., Kozan, E. and Wolff, R. C. (2014) A new approach to spatial data interpolation using higher-order statistics. *Stochastic Environmental Research and Risk Assessment*, doi:10.1007/s00477-014-0985-1

Middleton, A., Uysal, I., Bryan, S., Hall, C. & Golding, S. (2014) Integrating 40Ar–39Ar, 87Rb–87Sr and 147Sm–143Nd geochronology of authigenic illite to evaluate tectonic reactivation in an intraplate setting, central Australia. *Geochimica et Cosmochimica Acta*, 134: 155-174.

Parra, H. (2014) Effect of blast induced fragment conditioning on impact breakage strength. *Mining Technology (TIMM A)*

Puscasu, R. (2014). Integration of artificial neural networks into operational ocean wave prediction models for fast and accurate emulation of exact nonlinear interactions. In David Abramson, Michael Lees, Valeria Krzhizhanovskaya, Jack Dongarra, Peter M. A. Soot (Eds.), *Procedia Computer Science. 14th Annual International Conference on Computational Science, ICCS 2014, Cairns, QLD, Australia, (1156-1170). 10-12 June 2014*

Singer, D.A., (2014) Base and precious metal resources in seafloor massive sulfide deposits: *Ore Geology Reviews*, 59 66–72. doi: 10.1016/j.oregeorev.2013.11.008

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Minerals Industry Safety  
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# SMI BOARDS REPRESENTATION



**Chair: Charlie Sartain, Sartain Enterprises**

Professor Chris Moran, The University of Queensland  
Professor Max Lu, The University of Queensland  
Mike Oswell, Anglo American  
Donovan Waller, Anglo American  
Brandon Craig, BHP Billiton Mitsubishi Alliance  
Colin Moorhead, Newcrest Mining  
Ken Ramsey, Newmont Asia Pacific  
Paul Dowd, Resources and Engineering Skills Alliance  
Brett Heyward, QLD Dept of Natural Resources and Mines  
John McGagh, Rio Tinto  
Michael Wright, Thiess



**Chair: Don McKee**

Professor Margaretha Scott, The University of Queensland  
Professor Chris Moran, The University of Queensland  
Brian Hall, AMC Consultants  
Bob Bryan, Australian Property Growth Fund  
Gavin Yeates, BHP Billiton  
Brad John, Geological Survey of Queensland  
Dan Wood, Highlands Pacific Group  
Colin Moorhead, Newcrest Mining  
Peter Forrestal, Glencore



**Chair: Professor Chris Greig, The University of Queensland**

Professor Andrew Garnett, The University of Queensland  
Professor Chris Moran, The University of Queensland  
Tony Knight, Arrow Energy  
Rick Wilkinson, Australian Petroleum Production and Exploration Association  
Rebecca Pickering, APLNG  
Per Johansson, QGC  
Paul Wright, QGC  
Anne Lenz, QLD Department of Environment and Heritage Protection  
Brett Heyward, QLD Dept of Natural Resources and Mines  
Randall Cox, QLD Dept of Natural Resources and Mines  
Christine Williams, QLD Dept of Science, Information Technology, Innovation and the Arts  
Stephen Keleman, Santos

## SMI CMLR

Centre for Mined Land Rehabilitation

### Chair: Peter Roe

Professor David Mulligan, The University of Queensland  
 Professor Chris Moran, The University of Queensland  
 Mary-Anne Crawford, Centennial Coal  
 Peter Smith, Environment Action  
 Mike Slight, Mike Slight and Associates  
 Suzanne Davis-Hall, Klohn Crippen Berger  
 Dean Ellwood, QLD Dept of Environment and Heritage Protection  
 Ross Browning, Downer EDI Mining  
 Peter Eaglen, Rio Tinto  
 Paul Smith, Sibelco Australia  
 Michael Looker, The Nature Conservancy  
 Pieter Swart, Glencore

## SMI CSR

Centre for Social Responsibility in Mining

### Chair: Christine Charles

Professor Saleem Ali, The University of Queensland  
 Professor Chris Moran, The University of Queensland  
 Professor Ove Hoegh-Guldberg, The University of Queensland  
 Professor David Trigger, The University of Queensland  
 Derek Flucker, Aboriginal Enterprise, Exploration and Energy  
 Ramanie Kunanayagam, BG Group  
 Ron Brew, Newcrest Mining  
 Serena Lillywhite, Oxfam Australia  
 Murray Swyripa, Rio Tinto  
 Lisa Pollard, QLD Dept of State Development, Infrastructure and Planning  
 Frances Hayter, Queensland Resources Council

## SMI CWiMI

Centre for Water in the Minerals Industry

### Chair: Kristina Ringwood, Environmental Resources Management

Professor Neil McIntyre, The University of Queensland  
 Professor Chris Moran, The University of Queensland  
 Professor Jurg Keller, The University of Queensland  
 Clare Cote, Anglo American  
 Erika Korosi, BHP Billiton  
 Scott Diggles, Rio Tinto  
 Chris McCombe, Minerals Council of Australia  
 Darren Moor, QLD Dept of Natural Resources and Mines

## SMI JKMR

Julius Kruttschnitt Mineral Research Centre

### Chair: Mark White

Professor Wayne Stange, The University of Queensland  
 Professor Chris Moran, The University of Queensland  
 Barun Gorain, Barrick Gold  
 Steve Liddell, BHP Billiton  
 Andrew Logan, Newcrest Mining  
 Rob Dunne  
 Chris Goodes, Rio Tinto

**Chair: Greg Chalmers, Jellinbah Resources**

Professor David Cliff, The University of Queensland

Professor Chris Moran, The University of Queensland

Mike Oswell, Anglo American Australia

Greg Dalliston, CFMEU Mining and Energy Division

Peter Newman, Downer EDI Mining

Gavin Lind, Minerals Council of Australia

Paul Harrison, QLD Dept of Natural Resources and Mines

Jason Economidis



# FINANCIAL STATEMENT

## Income and Expenditure Statement

January 2014 to December 2014

Revenue	End of Year Actuals \$
University	11,488,172
Research and Consulting	24,397,003
Other	2,153,451
Total Revenue	38,038,626
Expenditure	
Salaries	25,278,140
Non Salary	10,695,528
University Corporate Overheads	4,393,857
Total Expenditure	40,367,525
<b>Operating Surplus/(Deficit)*</b>	<b>(2,328,900)</b>
SMI Funding	%
Industry	55%
Government	33%
Research Funding Bodies (eg CRC ORE, CSIRO, AMIRA) and Industry Funding Bodies (eg ACARP, MCA, QRC)	10%
Non-Government Organisations	1%
Other Industry	1%
SMI Top 10 Company Contributors 2014	% of Total Revenue
Rio Tinto	14%
Australia Pacific LNG	7%
Glencore	5%
Santos	4%
Centennial Coal	4%
Anglo American	2%
Sibelco	2%
Arrow Energy	2%
Newcrest Mining Limited	1%
BG Group	1%

The table above indicates gross revenue flows. A significant portion of the \$11.5m University revenue is returned to the University to cover various University Corporate Overheads.

University of Queensland Research and Innovation (UQRI) defines research as the creation of new knowledge and/or the use of existing knowledge in a new and creative way so as to generate new concepts, methodologies and understandings. This could include synthesis and analysis of previous research to the extent that it leads to new and creative outcomes.

Activities that do not meet the UQRI definition of research are considered consulting. Other revenue sources refer to those not covered by the above categories and include trading revenue and membership fees.



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