

2013 ANNUAL REPORT

Sustainable Minerals Institute



THE UNIVERSITY
OF QUEENSLAND
AUSTRALIA



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

At The University of Queensland (UQ) we place great importance on our partnerships involving the resources sector, as they have a positive impact for millions of people across Queensland, throughout Australia, and globally.

The Sustainable Minerals Institute (SMI) is a flagship for such partnerships, and has earned a reputation for education and research programs that can contribute to the social, environmental and economic bottom lines of companies and communities associated with mining.

This is exemplified by the SMI's success towards the end of 2013, in being invited to establish a research, commercialisation and engagement venture in Chile. Part of the Government of Chile's International Centres of Excellence program, it will be known as SMI-ICE-Chile and will aim to fundamentally improve the productivity and environmental signature of Chilean mining.

With Universidad de Concepción as its key Chilean partner, SMI-ICE-Chile will draw significantly on the technology transfer and consulting expertise of JKTech. We foresee it offering many opportunities to industry partners.

For UQ, this signifies substantial progress in institution-wide efforts to collaborate more closely with Latin American communities, businesses and governments. Our aims are to contribute to their development strategies, and help build local capacity through education, research and technology transfer.

The SMI's manifest successes in industry engagement also encourage UQ to aim higher in attracting investment from non-government sources. Co-investment with business, not-for-profits and philanthropists helps ensure that UQ's work is highly relevant to the broader community, and that the outcomes reach people worldwide. SMI's success in reducing the Anglo American mine site fatalities rate by 63 per cent in four years is just one indicator of the immense impact the Institute has had globally.

Importantly, such outcomes demonstrate the benefits that can flow from links between Australian universities and the private sector. If adapted widely across the economy, such links would help secure Australia's future competitiveness.

Together with SMI staff and students, our partners have enabled the success stories featured in this report – and many more.

I applaud the corporations whose investments in innovation have continued during a challenging period for the sector, as these are times when farsighted investment in R&D and education is arguably most necessary. Similarly, the ongoing guidance and support of the SMI Advisory Board has been pivotal to the Institute's achievements.

I congratulate Chris and all of his team, and look forward to being impressed by SMI's future contributions to social, environmental and economic prosperity, which will underpin the sustainability of the global resources sector.



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.

During 2013 the Board resolved to improve the coordination with the Advisory Boards of SMI's research Centres. In addition to overseeing the implementation of more streamlined reporting to both the SMI Advisory Board and the Centre Boards during the year, the SMI Executive and Board representatives had the opportunity to share views and strategic issues with Centre Advisory Board Chairs and Centre Directors at a strategy roundtable in August. This initiative will be followed up during 2014.

SMI's research Centres have been tremendously successful in addressing particular sustainability challenges within the minerals industry, through applied research on key issues identified by industry. The Institute also continues to demonstrate its impact through its Centres' direct involvement in two significant external research partnerships. The Cooperative Research Centre: Optimising Resource Extraction (CRC ORE), which was born out of SMI, continued to deliver meaningful results to its partners during the year; and the International Mining for Development Centre (IM4DC) – founded as a collaboration between UQ/SMI and The University of Western Australia and funded by a \$31 million Australian Government grant – has also provided the Institute with the opportunity to expand its relationships and impact by delivering knowledge of mineral resources extraction, research and governance into many developing nations.

In 2013 we were pleased to see the instigation of three NextMine™ research projects by SMI. These projects involve researchers from at least four SMI research Centres and collectively have the potential to improve environmental outcomes, develop better management for strategic rare earth minerals and invent new methods for minerals recovery. We see this multi-disciplinary approach to research – both internally and with external collaborators – as increasingly the way of the future in allowing the resources sector to truly transition to sustainability.

I would like to thank all of the SMI Board members for their on-going commitment to SMI, The UQ's Senior Executive team for its continued support, and Professor Chris Moran and his leadership team for successfully driving SMI's efforts during the past year.



SMI DIRECTOR'S REPORT

Many people in the mining industry will attest that 2013 was a challenging year. SMI staff, students and collaborators rose to these challenges by continuing to deliver valuable research and education to the global minerals industry and to those associated with it. This occurred by delivering on projects previously planned and designed, by re-directing some activities towards changed priorities and by diversifying our revenue and engagement to develop new relationships. Also, in a number of cases, long-term project development initiatives came to fruition.

The Centre for Social Responsibility in Mining (CSRM) has developed projects with the World Bank, United Nations University and, most recently, the Ford Foundation. The Minerals Industry Safety and Health Centre has broadened its partnership base and in 2014 will customise the online risk management tool RISKGATE for the North American market. These projects diversify funding and send a clear message that SMI is committed to integrated, practical solutions for resource industry stakeholders.

NextMine™ – the Institute's initiative to draw together our research capabilities – has flourished under the leadership of SMI Deputy Director (Research Integration) Professor David Brereton. We are demonstrating connection across the value chain from ore body to flotation underflow (Designer Tailings), and towards end-user commodities (Rare Earth Industrial Ecology). The regional integration dimension is under development as is an extension of our IM4DC activities towards connecting safety knowledge from large-scale mining into artisanal mining. I am confident the project portfolio will deepen and expand in 2014 and that the results from our initial investment will reap rewards for SMI researchers and external partners alike.

In late 2013 the Chilean Government invited SMI to establish an International Centre of Excellence (SMI-ICE-Chile) following a competitive bid process.

Work is now well underway on enhancing partnerships within the Chilean mining industry and I expect further announcements on this initiative in early 2014. This was developed as part of our NextMine™ initiative in 2014 with the bid led by Deputy Director (Technical), Professor Ben Adair.

October marked two years since IM4DC was established by UQ and The University of Western Australia. IM4DC has been immensely successful in improving mining policy and operations in developing countries, presenting 44 courses, workshops and study tours to more than 1000 participants from 40 countries since its inception. For many at SMI, IM4DC has put them in contact with people from all over the world with common interests in improving the way mining is conducted and governed. This has been a privilege for many of us with impacts at decadal scale.

In 2013 it was a pleasure to celebrate the 20th anniversary of the Centre for Mined Land Rehabilitation (CMLR) and the resulting two decades of science-

based rehabilitation activities on mine sites. CMLR has built many successful partnerships across the last 20 years and the Centre's positive impact will no doubt continue well into the future.

It was also a year of rejuvenation within the Institute. Professor Neil McIntyre began as Director of the Centre for Water in the Minerals Industry (CWIMI) in January and positioned the Centre under four research themes, declaring CWIMI's future research priorities.

Professor Andrew Garnett, the inaugural Director of the Centre for Coal Seam Gas (CCSG), also appointed in January, spearheaded CCSG's project development, stakeholder engagement and education initiatives.

For many years, SMI has been a training ground for those wanting to build their careers in the resources sector. In 2013, 14 SMI Research Higher Degree (RHD) students graduated, the highest number since the Institute began offering RHDs. WH Bryan Mining and Geology Research Centre alumnus Dr Matthew Pearce was also recognised by the International Society for Rock Mechanics for his 2010 thesis.

The Institute's education programs go from strength-to-strength, in a large part due to the quality of our RHD supervisors. Professor Dee Bradshaw, at the Julius Kruttschnitt Mineral Research Centre (JKMRC), was one of just two UQ researchers to receive the University's Excellence in RHD Supervision Award in 2013, an impressive achievement.

I thank each of the SMI Strategic Advisory Board and Centre Advisory Board members for their on-going contributions and constructive inputs into the Institute, as well as their ambassadorship of SMI within their respective organisations. I am particularly grateful to the SMI Advisory Board Chair, Mr Charlie Sartain, whose wise counsel and active involvement in SMI is having a real impact.

I would like to highlight the depth and quality of involvement over several years of the University's out-going Senior Deputy Vice-Chancellor Professor Debbie Terry – her advice and guidance will be missed. In late 2012, we welcomed a new Vice Chancellor, Professor Peter Høj, who has shown immediate interest in the SMI model and its more general applicability towards meeting his goal of UQ being the most globally connected university in Australia, and also achieving a significant increase in our industry-related research.

Of course, SMI is its people, and I would like to thank all staff, students, alumni, collaborators and adjuncts for your ongoing commitments to SMI, what we stand for, and the potential we possess. I believe that 2014 will be another challenging year for the resources sector and the people with whom we have close relationships. I expect SMI to assess this situation carefully and find ways to be more effective, more relevant, and thereby, a stronger and more resilient Institute into the future 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
(June 2013 – Present)
Sustainable Minerals Institute



Brett Cunningham
Deputy Director — Operations
(January – June 2013)
Sustainable Minerals Institute



Professor Saleem Ali
Director
Centre for Social Responsibility
in Mining



Professor David Cliff
Director
Minerals Industry Safety and
Health 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
Julius Kruttschnitt Mineral
Research Centre



What is the Minerals Industry Safety and 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.

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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.

In August, Professor Robin Burgess-Limerick received \$111,000 industry funding and a further \$150,000 from the Australian Coal Association Research Program (ACARP) to develop and validate an online application that allows simple, inexpensive devices to measure whole body vibration exposure. The 'app' will enable surface coalmines to gather better data and, in turn, prevent exposure related symptoms such as back pain, as well as mine site operator fatigue and discomfort.

The equivalent of more than 400 days of expert opinion were contributed to RISKGATE in 2013, which enabled researchers to build on the program's bow-tie analysis matrix improving mine site safety. RISKGATE will continue to capture operational knowledge and experience from mining experts in 2014 when the program is expanded into the American market. With funding from the Alpha Foundation for the Improvement of Mine Safety and Health, researchers will implement risk management programs that reduce injuries and maximise economic benefits for US mine sites. The program's success was recognised at the World Mining Congress in August when researchers were awarded best paper in the Underground Mining section.

From Mongolia to Mozambique, MISHC has broadened its training programs to improve health and safety education through IM4DC. The courses, which include risk assessments, safety audits and occupational hygiene tests, teach mines inspectors from developing countries how to prioritise their workload to reduce site incidents, demonstrating MISHC's genuine reach around the world.



What is the WH Bryan Mining and Geology Research Centre?

The BRC is about excellence in mining design, planning and operations, underpinned by a comprehensive knowledge of the deposit. Three research themes are focused on decreasing geological and mining risk to offset the effects of resource depletion and improve productivity.

2013 Report

Following the establishment of research themes in 2012, BRC has focused on building capacity and capability in:

- Deep Earth Mining – geoscientific and computational know-how to support more accurate performance predictions for higher capacity deeper mining
- Orebody Driven Decision Science – quantitative modelling of deposits and mining processes to better inform decision-makers
- Geology and Process Optimisation – broadening its scope from mine studies to include regional geoscience for policy and planning

Professor Gideon Chitombo led the Geology and Mass Mining Project to its first milestones in 2013. Supported by industry and a 2011 Smart Futures Research Grant, the research has focused on developing a best practice guide outlining constraints and opportunities to better utilise geoscientific data and emerging technologies in cave mining.

Professor Rodney Wolff leads a collaborative program of work for CRC ORE creating innovative methods and tools for resource evaluation. The research is considering large geometallurgical data sets in the context of multiple capital and operational alternatives.

Separately, Professor Chitombo was named Chair of the Innovative Technologies and Concepts for the Intelligent Deep Mine of the Future (I2Mine) Project Advisory Board. The Project concentrates on the development of technologies suitable for future deep mining activities and will involve a series of activities designed to realise the concept of an invisible, zero-impact mine.

In April, Dr Dion Weatherley confirmed the link between seismic activity and the precipitation of gold and other trace elements in earthquake fault zones. Dr Weatherley developed a mathematical model that suggested seismic activity could be one of the primary mechanisms for the formation of economical and mineable ore deposits. The research, published in *Nature Geoscience*, was the result of collaboration with the Australian National University.



What is the Julius Kruttschnitt Mineral Research Centre?

JKMRC, part of UQ for the past 50 years, is a unique mining and minerals research organisation that, to date, has graduated some 230 RHD students who typically go on to become technology leaders in the industry. JKMRC has a number of large one-on-one research programs such as Anglo American's Centre for Sustainable Comminution and the Rio Tinto Centre for Advanced Mineral Sorting. Additionally, a portfolio of large, industry-wide collaborative projects, including flagship projects such as P9, have significantly advanced industry characterisation, modelling and simulation in mineral processing circuits for many years, and P843 has pioneered the discipline of geo-metallurgy.

2013 Report

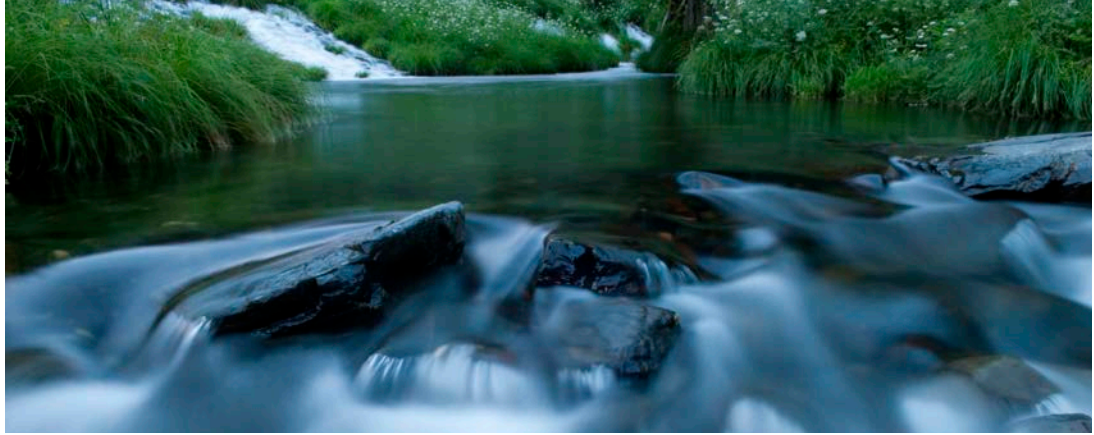
In 2013, JKMRC further built on its reputation as the world's pre-eminent mineral processing and geometallurgy research centre through the development and delivery of leading research projects.

The Global Comminution Centre, led by JKMRC's Professor Malcolm Powell, welcomed its sixth research group in October. The Technische Universität Braunschweig, Germany, brings expertise in ultra-fine grinding and modelling, and completing the Centre's collective expertise across the discipline.

JKMRC has also strengthened research partnerships within SMI. Dr Nenad Djordjevic is leading a NextMine™ grant to investigate the viability of in-situ mineral extraction given the recent maturing of key enabling technologies such as fracking and bio-leaching. The project has the potential to significantly reduce the environmental and social impacts of future mining operations.

In its 50th year the AMIRA P9 project, founded and led by JKMRC, continues to deliver innovative solutions. The current program is substantially improving the platform for mineral-processing modeling and simulation by developing integrated simulation techniques that more effectively support sponsors' needs. This is achieved through the development of the Integrated Extraction Simulator (IES), a platform developed by CRC ORE and JKMRC. Opportunities to use the IES as an enabler for integrated, multi-disciplinary work at SMI have been identified.

JKMRC and CRC ORE are developing a more strategic relationship in the area of Grade Engineering™ through the application of a deep understanding of ore-deposit variation to the way mines and concentrators are designed, developed and operated. Successful large-scale case studies have validated this approach and are proving a promising way to deal with severe industry challenges.



What is the Centre for Water in the Minerals Industry?

CWiMI conducts research on the measurement, monitoring and modelling of water in the context of mine operations, 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.

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Professor Neil McIntyre began as the CWiMI Director in January, the first of three senior appointments designed to build capacity around the four new research themes. 2013 also saw the formation of a new Advisory Board to ensure continuing alignment with industry research needs.

Working with the Minerals Council of Australia (MCA), CWiMI continued to cement its Water Accounting Framework as the Australian standard and the framework's water quality component was endorsed by the MCA for national use.

Researchers Dr Alan Woodley and Dr Greg Keir completed an ACARP project providing insights into the interaction between water and energy efficiency on mine sites. Their new hierarchical simulation model tool enables insight into achieving more efficient water and energy use and improves understanding of risks associated with poor management at sub-site, site and regional scales.

As part of CWiMI's increasing international activity, Associate Professor Sue Vink provided advice and training to scientists from the Peruvian Autoridad Nacional del Agua. The project, in collaboration with the International Water Centre, was funded by the Australian Government's Public Sector Linkages Program.

In addition to collaborating with other leading water organisations, CWiMI has furthered its SMI partnerships. For example, CWiMI, CMLR and CSRM researchers are together measuring the ecological and social impacts of mining in Mongolia.

In 2013, CWiMI successfully co-hosted the Water in Mining Conference with the Australasian Institute of Mining and Metallurgy with 230 people from 16 countries attended, giving CWiMI the opportunity to shine on the international stage. Coupled with the conference, CWiMI led an IM4DC training event, hosting 16 delegates from Peru, Ghana, Zambia, Mongolia, Philippines and Indonesia.



What is the Centre for Social Responsibility in Mining?

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

2013 Report

2013 has seen the continuation of CSR M's 2012 diversification strategy. The Centre has reaped significant rewards from this strategy, not least broadening knowledge of the Institute with a number of philanthropic and not-for-profit organisations.

For the first time in the Institute's history, the World Bank provided \$250,000 direct funding to SMI for a CSR M regional economic development study of mining in Madagascar. The Ford Foundation announced its first UQ project when it approved \$US254,000 for social inclusion research in Colombia. Separately, a two-year project into the role and effectiveness of certification schemes in the promotion of responsible mineral development has been made possible with a \$US250,000 grant from the Tiffany & Co Foundation.

In 2013, CSR M completed a number of significant research projects. A six-month study identified resource companies wanting to retain good workers in remote locations needed to provide employees with personal space to communicate with family and friends.

A two-year \$621,000 Australian Development Research Award Scheme grant enabled CSR M and CMLR researchers to capture, for the first time, the dramatic expansion of Mongolian mine sites from initial diggings to their present size using satellite imagery. The videos, which show the impact of urbanisation, new roads and illegal 'ninja' mines, represent the first project in CSR M's Mongolia Research Hub.

While CSR M broadened its scope in 2013, it also continued to work across its core disciplines. The Community Relations Research Unit (ComRel) was established in 2013 to improve understanding of community relations and development practices. This knowledge, in turn, builds the mining industry's knowledge and capability in social performance, demonstrating both breadth and depth to the CSR M research and education strategy.



What is the 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 the 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.

2013 Report

2013 has been a challenging but rewarding year for CMLR. While the tightening fiscal situation and moving regulatory environments have impacted the willingness of some industry partners to commit funding for long-term research initiatives, the Centre has marked the achievements of its 20th year.

The anniversary celebrations gave researchers the opportunity to reflect on their impact to date. High-impact research findings have continued in 2013, including the identification of 24 native nickel hyperaccumulator plant species as a part of a PhD program in Sabah, Malaysia. This discovery will potentially enable such species to contribute to the rehabilitation of nickel-contaminated sites.

2013 also presented the opportunity to revitalise existing equipment and projects. CMLR's herbarium was renovated and upgraded with state-of-the-art photographic and database facilities to enable the digitisation of reference specimens. The Centre's remote sensing and spatial ecology capacities were expanded through the completion of a new rugged and reliable Unmanned Aerial Vehicle platform, developed in collaboration with Skycam NZ.

CMLR researchers have also collaborated with SMI colleagues on cross-disciplinary NextMine™ initiatives. The Centre is leading the Designer Tailings project, which is connecting research across ore characterisation, minerals processing and tailings rehabilitation sciences. Data gathered in the biogeochemical processes in tailing storage facilities and receiving environments is used to inform the design and operation of processing plants. In addition, the approach of upstream ore characterisation and segregation in order to produce integrated value chain models. By proactively identifying opportunities to alter the physical, mineralogical and geochemical properties of tailings, the rehabilitation of these waste streams will be more effective and their potential for creating negative environmental and social legacies into the future very much reduced.



What is the Centre for Coal Seam Gas?

CCSG draws together the research capabilities of UQ, which has been conducting research into coal seam gas (CSG) for almost two decades. CCSG has four key research areas: water; geoscience; petroleum engineering; and social impact, as well as a focus on education programs.

The Centre supports leading practice policy development and will enable Australia to become the primary source of new knowledge, technology and skilled graduates for the industry as it develops worldwide. CCSG aims to be the world leader in coal seam and unconventional gas research within a decade.

2013 Report

With the appointment of Professor Andrew Garnett as Centre Director, and Professors Steve Tyson and Jim Underschultz in Subsurface Modelling and Petroleum Hydrodynamics respectively, 2013 was a year of maturation for CCSG. The Centre has moved from the start-up phase into delivery mode and is positioning itself for the future. This resulted in a focus on identifying research projects that were well planned and would deliver results for community, industry and regulators.

CCSG initiated a process to identify and assess industry and regulator research needs and also funded major scoping papers in the areas of environmental and public health, Indigenous land use agreements and impacts of CSG extraction on biodiversity to identify potential research questions not currently being addressed by the Centre or broader research. This resulted in the commencement of 15 research projects across the four research themes with a combined value of \$8 million. Projects with a further value of over \$2.5 million are at various stages of development and approval.

The Centre also engaged 16 UQ Schools and Centres in its research, as well as research institutes internationally recognised in oil and gas. This engagement resulted in a number of collaborative projects, including investigations into the impacts of US coal bed methane gas developments and lessons for Queensland. Further, CCSG has underwritten the establishment of a new UQ Masters Degree in Petroleum Engineering, which is operated in conjunction with the Heriot Watt University, in Scotland.

2013 culminated in a Researchers' Day in December, in which researchers, and PhD and Masters students presented more than 25 posters to government and industry representatives outlining progress on CCSG related research projects.



SMI NextMine™
Innovation Through Connection

SMI NextWorkforce™
Professional development
for a sustainable future

What are NextMine™ and NextWorkforce™?

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.

2013 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.

Current projects are:

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

The focus of NextWorkforce™ activities in 2013 has been on planning for new postgraduate coursework programs and short courses that will directly align with the NextMine™ agenda. This work will continue in 2014.

ACCESSING SMI'S INTELLECTUAL PROPERTY



JKTech Pty Ltd offers the global resources industry a range of cutting edge technologies aimed at increasing productivity and metal recovery, and reducing operating costs, while improving the long-term sustainability of an operation. It delivers world-class solutions to the minerals industry by providing products and services in ore characterisation and process improvement within all areas of the life-of-mine cycle including geology, mining, mineral processing and sustainability. JKTech is wholly owned by UQ as the technology transfer company for SMI.

JKTech's collaborative working relationship with SMI is integral to its success and, in the past year, this has been demonstrated by the collaboration in two International Centres of Excellence opportunities. SMI and JKTech have been invited to host SMI-ICE-Chile furthering the commitment to a strong regional focus in this market, and achieving value to the local industry through the offering of a 'one-stop-shop' with JKTech and SMI to deliver coordinated research, and technology transfer. Further collaboration was demonstrated with JKTech and SMI participating in a joint trip to India to evaluate whether there is sufficient demand in that country for an International Centre of Excellence. This opportunity continues to be explored.

JKTech has been meeting the worldwide demand for intellectual property for the minerals industry, with its success demonstrated in 2013 including the following achievements:

- 497 professionals were trained in intellectual property developed at UQ with participants from around the world
- Demand in Chile has resulted in JKTech establishing a subsidiary office, located in Santiago which was officially opened by UQ President and Vice-Chancellor Professor Peter Høj in May
- JKTech's South African office had its first full year of operations and delivered major transformational change in delivering risk management program, G-MIRM, to major mining companies in that region
- JKTech received the Queensland Premier's Export Award in the Minerals and Energy category for 2013 and was a finalist in the 2013 Australian Export Awards
- SUSOP Pty Ltd, JKTech's management technique for sustainable development, received the Sustainable Technology Award from the UK Institution of Chemical Engineers
- With the past year being challenging for the mining industry, JKTech's innovations and expertise have enabled many operations to increase outcomes and profitability through mine-to-mill optimisation programs



Dr Glen Corder (right) receives the Sustainable Technology Award from the UK Institution of Chemical Engineers on behalf of SUSOP.

In 2013, JKTech's Social Responsibility Manager headed a team, including CSR experts, in carrying out a socioeconomic diagnosis for Vale Malaysia. Vale is currently constructing an iron ore distribution centre comprising a deep-water jetty and an onshore stockyard on the West Coast of the Malay Peninsula. With construction due for completion in mid-2014, Vale's distribution centre is one of the largest foreign direct investment projects to date in Malaysia.

JKTech is proud to play a part in enabling a successful long-term commitment by Vale to the region and the local communities of which its client is now part.

JKTech has, and always will be, committed to promoting diversity with its team comprising a cross-section of international experts from South Africa, India, China, Malaysia, Peru, Zimbabwe, Ghana, Argentina and Vietnam, among others. This year JKTech was pleased to welcome its first female board member, Leeanne Bond, bringing broad expertise in general management, engineering projects and professional services across a broad range of industrial sectors, including 10 years with Worley Parsons.

One of the organisation's well-known SMI Knowledge Transfer team leaders, Diana Drinkwater, was elected Chair of the Education Commission of the International Mineral Processing Congress (IMPC) in a decision ratified by the Council at its meeting in Santiago, Chile. Chairs of IMPC Commissions are automatically ex-officio members of the Council, which means that Diana also becomes the first female member of the IMPC Council in its 60-year history. This is a testament to her standing within the global resources training sector.

In 2014, JKTech will continue to deliver solutions that assist minerals resources operations to operate efficiently and profitably in the face of unprecedented worldwide financial challenges, combined with declining ore grades, and harder and more complex ore deposits. The world-class research delivered by SMI is core to JKTech's success in achieving this.



STUDENTS

Research Higher Degree Graduates

Education programs offered through SMI are recognised internationally for their rigorousness and relevance for mining professionals. In 2013, 14 SMI Research Higher Degree students graduated.

Dr Eiman Amini – Julius Kruttschnitt Mineral Research Centre

Influence of Flotation Cell Hydrodynamics on the Flotation Kinetics and Scale up of Flotation Recovery

Dr Brigitte Comley – Julius Kruttschnitt Mineral Research Centre

The Trials of Frother Evaluation for Industrial Scale Use

Dr Marcos de Paiva Bueno – Julius Kruttschnitt Mineral Research Centre

Development of a Multi-Component Model Structure for Autogenous and Semi-Autogenous Mills

Dr Artem Golev – Centre for Social Responsibility in Mining

Application of Industrial Ecology Principles for Enhanced Resource Efficiency in Heavy Industrial Areas

Dr Nadja Kunz – Centre for Water in the Minerals Industry

Sustainable Water Management by Coupling Human and Engineered Systems

Dr Michael Larson – Julius Kruttschnitt Mineral Research Centre

Experimental study of Isa Mill performance leading to a preliminary model

Dr Carmen Letton – Julius Kruttschnitt Mineral Research Centre

Integrated Schedule Optimisation

Dr Wenying Liu – Centre for Water in the Minerals Industry

A Quantitative Risk-Based Approach for Improving Water Quality Management in the Minerals Industry: Flotation as an Example

Dr Ana Maria Rojo Contreras – Julius Kruttschnitt Mineral Research Centre

Effect of ore blends on flotation of copper and molybdenum in porphyry ores

Dr Jason Scally – WH Bryan Mining and Geology Research Centre
*Non-Gaussian type Gram-Charlier Asymptotic Expansions: the Modelling of
Commodity Related Series*

Dr Gerson Sandoval – Julius Kruttschnitt Mineral Research Centre
*Development of a Novel Strategy To Estimate Flotation Recovery As A Function
Of Particle Size And Mineral Liberation*

Dr Anne Schneider – Centre for Mined Land Rehabilitation
Soil-plant relationships in constructed covers of mine waste material

Dr Apete Soro – Centre for Mined Land Rehabilitation
Rehabilitation strategies for post-mined land in Fiji

Dr Jiajia Zheng – Centre for Mined Land Rehabilitation
*Lead from Mining and Mineral Processing Activities to the Community via the
Air-dust Pathway: An Example from Mount Isa City Using Human Health Risk
Assessment Approach*

STUDENT AWARDS



Image Courtesy: ISRM

Rock On! BRC alumnus awarded international prize

BRC alumnus Dr Matthew Pierce has been awarded the 2013 Manuel Rocha Medal by the International Society for Rock Mechanics for his 2010 doctoral thesis entitled *A Model for Gravity Flow of Fragmented Rock in Block Caving Mines*.

His research identified a number of techniques and methods to better predict rock flow in caving mines. By tracking locations and flow in 3D space of materials within caved rock columns, industry can now optimise production strategies. The findings have been incorporated into a software package used at cave mining operations and projects globally.

“UQ was a great place to do my PhD for a number of reasons including its connection to the mining industry. Regular interaction with the Mass Mining Technology sponsors ensured my research outcomes were both practical and innovative,” Dr Pierce said.

Dr Pierce currently works at Itasca Consulting Group and has previously served on the company’s Board of Directors.

SMI Students ‘Map the Future’

Two CSRM students have been recognised for their unique insights into mining ethics at the 23rd World Mining Congress and Expo (WMC) in Montreal, Canada.

RHD students Julia Keenan and Rebekah Ramsay, together with CSRM Deputy Director – Industry Engagement and Community Relations Dr Deanna Kemp, were awarded best paper in the Mining Ethics and Sustainability conference stream for *Company-Community Agreements, Gender and Development*.

Separately, MISHC researchers won best paper in the Underground Mining stream for *Industry Scale Knowledge Management – Introducing the RISKGATE Underground Strata and Explosions Body of Knowledge*.

The WMC theme, *Mapping the Future: Advances in Mining Engineering*, enabled more than a dozen SMI researchers to share their knowledge with 1500 delegates from across the mining industry.

RHD Candidate awarded UQ Research Scholarship

BRC RHD candidate Niromi Naranpanawa has been awarded a UQ Research Scholarship.

The full-time scholarship, which began in June, enables Niromi to complete her thesis entitled: *Quantitative modelling (spatio-temporal) of regional economic, social and environmental impacts of mineral extraction*.



AWARDS

Professor Dee Bradshaw

Minerals processing researcher Professor Dee Bradshaw has proven she can find gold in more than just rocks, after she was named one of two 2013 winners in the UQ Excellence in RHD Supervision Awards in September.

JKMRC's Professor Dee Bradshaw, who is better known for her flotation and mineralogy research, was recognised for her ability to mentor postgraduate students at every stage of their studies. Described as a leader who nurtures and develops students, and brings out the best in them, many of Professor Bradshaw's students have entered highly sought after roles within industry and academia globally.

"There are many aspects of Dee's supervision approach that I try hard to emulate when I work with my own students and she will always be a role model for me as a scientist, teacher, manager and connector of people," former student and CSIRO research scientist Dr Liza Forbes said.

Professor Bradshaw has been responsible for initiating and developing postgraduate courses in flotation chemistry, process mineralogy and geometallurgy at JKMRC, and has also helped inform many other professional development courses for industry.

She has directly supervised more than 30 research higher degree candidates to graduation both at UQ and in her former role at the University of Cape Town, and currently supervises 18 students.

"Just as each ore requires a tailored approach to extract the value in it, so each student has a unique combination of abilities, gifts and talents each requiring different resources to succeed and excel. I call this process and transformation 'Living Gold'," Professor Bradshaw said.

SMI Director Professor Moran said: "Dee encourages independent thinking, while enforcing strong technical expertise, fostering fundamental truths and always encouraging her students to challenge assumptions. It is no surprise that she has a global reputation for easily attracting high quality RHD candidates."





Charlie Sartain

Leading Australian mining executive and SMI Advisory Board Chair Charlie Sartain has been recognised for his services to the industry and his support for education and training.

Queensland Premier Campbell Newman presented the 2013 Queensland Resources Council Medal (QRC) to Mr Sartain at the Council's Annual Luncheon in mid-November.

Mr Sartain began his career with MIM Holdings Ltd as a mining engineer in the mid-1980s. He rose through the ranks and was appointed Chief Executive of Xstrata Copper in 2004. Mr Sartain left Xstrata following its merger with Glencore earlier this year, but he has maintained his interest in promoting education and nurturing the next generation of Queensland engineers.

In addition to serving as Chair of the SMI Advisory Board since 2011, he has been an active member of The University of Queensland Senate since 2010.

“Charlie has made a valuable contribution to both the Sustainable Minerals Institute and the University more broadly. I congratulate him on this well deserved accolade from the QRC,” SMI Director Professor Chris Moran said.

Mr Sartain is the second associate of the SMI in as many years to win the QRC Medal, after Bob Bryan AM won the award in 2012. SMI founding Director Professor Don McKee was awarded the inaugural QRC Medal in 2007.



PROFESSIONAL SERVICE

Dr Patrick Audet

Agriculture, Ecosystems and Environment, *Editorial Board*

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*

Dr Thomas Baumgartl

Applied Clay Science, *Editorial Board*

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

Soil and Tillage Research, *Editorial Advisory Board*

Professor David Brereton

Australian Council of Learned Academies, *Member*

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

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*

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*

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*

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*

Dr Natasha Danoucaras

Minerals Council of Australia Water Working Group, *Member*

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*

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*

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*

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*

Dr Matthew Krosch

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

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*

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*

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*

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*

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*

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*

Corinne Unger

AusIMM Community and Environment Society, *Committee Chair*

Antony van der Ent

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

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*

Dr Tony Webster

AusIMM Heritage Committee, *Corresponding Member*

Professor Rodney Wolff

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

Dr Alan Woodley

Minerals Council of Australia Water Working Group, *Member*

PUBLICATIONS



Morris S. (2013) Publishing short-cuts and their potential career impact. *Springer Science Reviews*.

SMI BRC

WH Bryan Mining &
Geology Research Centre

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SMI CCSG

Centre for Coal Seam Gas

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Professor Debbie Terry, The University of Queensland
Professor Max Lu, The University of Queensland
Jeremy Mann, Anglo American
Mike Oswell, Anglo American Australia
Brandon Craig, BHP Billiton Mitsubishi Alliance
Vacant, Ensham Resources
Geoff Day, Newcrest Mining
Ken Ramsey, Newmont Mining Asia Pacific
Paul Dowd, Resources and Engineering Skills Alliance
Brett Heyward, QLD Dept of Natural Resources and Mines
John McGagh, Rio Tinto Coal Australia
Michael Wright, Thiess



Chair: Don McKee

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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



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
Jeff Jurinak, QGC
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Bernadette Ditchfield, 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
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SMI CMLR

Centre for Mined Land
Rehabilitation

Chair: Peter Roe, BHP Billiton Mitsubishi Alliance

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 Peter Smith, Environment Action
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 Gerald Miles, The Nature Conservancy
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 Professor Ove Hoegh-Guldberg, The University of Queensland
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 Ramanie Kunanayagam, BG Group
 Ron Brew, Newcrest Mining
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Maryann Wipaki, Glencore Copper

Gavin Lind, Minerals Council of Australia

Mark Thompson, Newcrest Mining

Paul Harrison, QLD Dept of Natural Resources and Mines

Paul Dewar, Rio Tinto Bauxite and Alumina

Jason Economidis

FINANCIAL STATEMENT

Income and Expenditure Statement

January 2013 to December 2013

Revenue	End of Year Actuals \$
University	11,627,561
Research and Consulting	27,864,141
Other	3,624,991
Total Revenue	43,116,693
Expenditure	
Salaries	26,095,776
Non Salary	13,210,865
University Corporate Overheads	6,723,768
Total Expenditure	46,030,409
Operating Surplus/(Deficit)*	(2,913,716)
SMI Funding	%
Industry	52%
Research Funding Bodies (eg CRC ORE, CSIRO, AMIRA) and Industry Bodies (eg ACARP, MCA, QRC)	19%
Government	17%
Non-Government Organisations	6%
Other Industry	6%
SMI Top 10 Company Contributors 2013	% of Total Revenue
Rio Tinto	14%
Centennial Coal	8%
QGC	8%
Xstrata	6%
Santos	3%
Arrow Energy	3%
Anglo American	2%
Metso Minerals (Australia)	2%
Newcrest Mining	2%
Sibelco Australia	2%

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.

