

Sustainable Minerals Institute



SMI supports the complex decision making required in a world experiencing the impacts of climate change, transitioning to a low carbon future and the need to create a more equitable society.

Cover Ø Abandoned mine, Western Tasmania Inside front cover Ø *Izok Lake, Canada*

Overview

For more than 20 years The University of Queensland's (UQ) Sustainable Minerals Institute (SMI) has been developing the people, technologies and approaches necessary to address the challenges facing the world on the path to sustainability.

SMI's vision is to provide knowledge leadership for a sustainable world.

To achieve this, SMI adopts a multidisciplinary approach that integrates expertise in geoscience, mining, mineral processing, workplace health, safety and risk, environmental management, social responsibility, and organisational improvement.

Since it was established in 2001, SMI has been the only research institute in the world where this breadth and depth of knowledge can be found in one place.

SMI consists of an International Centre of Excellence in Chile, the Technology Transfer company JKTech and 6 research centres, each nurturing specific disciplinary strengths. The Institute also leads a set of multidisciplinary strategic research programs which focus on priority challenges in, and relating to, the minerals industry. The researchers and specialists in each of these centres and programs work with industry, governments, civil society, local communities, Indigenous Peoples, intergovernmental organisations, research institutions and foundations.

In addition to research, SMI delivers professional development, higher degrees by research and formal teaching programs to train the next generation of industry and community leaders.

Partnering with the Sustainable Minerals Institute is a great first-step for stakeholders who want to contribute to a sustainable future.

How we work

Collaboration and partnership are at the heart of SMI's activities. We work with organisations around the world—integrating research disciplines, generating new ideas, engaging stakeholders and delivering outcomes.

SMI's major partnerships with end-users have resulted in over \$189.8 million in funding for the years 2014-2021.

What we do

Collaboration with SMI can take many forms from consultancy and training through to large scale, long-term, federally funded research such as involvement in Cooperative Research Centres or Trailblazer schemes.

SMI has many direct partnerships with the end-users of research, and researchers have developed a sophisticated approach to engagement, end-user design, and academic independence that is impact-focused and transformative.

Many longstanding relationships are now supported by Umbrella Agreements, which standardise some terms and conditions, so only variations need to be negotiated for individual projects. This has enabled SMI to respond with agility to those organisations engaging with the Institute and Centres on multiple issues.

🛞 Research centres

Centre for Mined Land Rehabilitation Centre for Water in the Minerals Industry Julius Kruttschnitt Mineral Research Centre WH Bryan Mining Geology Research Centre Centre for Social Responsibility in Mining Minerals Industry Safety and Health Centre

्रि Strategic research programs

Unlocking Complex Orebodies Resourcing Decarbonisation Future Autonomous Systems and Technologies Leadership and Organisational Improvement Development Minerals



Professional development

Supporting the training needs for a skilled and future ready workforce is a priority for SMI.

The Institute delivers a range of professional development options designed by leading academics and industry experts to increase specialist knowledge and enable individuals to upskill fast and with flexibility.

SMI short courses and masterclasses connect participants with the latest research and best practice in health, safety and risk, social performance, mine site environmental management, and geology, mining and metallurgy. SMI researchers also work directly with organisations to deliver customised training to support staff in reaching organisational goals and keep pace with change.

The Institute's portfolio of professional activities has grown substantially over recent years and includes a mix of face-to-face and online courses.

Please visit the website for a list of upcoming public courses or contact us to discuss customised training.

education@smi.uq.edu.au smi.uq.edu.au/professional-development

Higher degree by research

As a provider of world class education, SMI supervises students undertaking a Higher Degree by Research (HDR).

Throughout their research studies, SMI HDR candidates are strongly connected to industry and stakeholder groups and the importance of collaboration is reinforced. By graduation, HDR candidates are familiar with the unique challenges associated with conducting research in, and applying research outcomes to, the minerals sector. Industry professionals are a key source of HDR candidates for SMI—a unique reality in the world of postgraduate education that means 55% of SMI's current students are aged over 35.

The Institute is also proud of its multicultural student cohort and significant effort is placed on celebrating diversity and supporting people from non-English-speaking backgrounds.

SMI alumni around the world can be found working in all areas of the minerals sector and in organisations that interact and influence mining.

The GMIRM risk management training developed by SMI's Minerals Industry Safety and Health Centre is a globally recognised program that equips staff in the resources sector with the knowledge and skills to better identify hazards and make effective decisions about risk.



Research impact

SMI creates impact in the world by driving immediate and long-term change, whether through the application of new processes or technologies, changing behaviour and practices, and/or developing institutions.

Minerals are essential to global sustainability and the impact of SMI's research is centred on advancing technologies and practices that ensure they are adequately supplied while addressing, overcoming and preventing the social and environmental adversities associated with mining.

These impacts are dependent on deep, mutually beneficial partnerships and collaborations which see our researchers grapple with practical challenges at sites across the world.

Selected examples



Exploring new metal-recovery opportunities for old mine waste

As the mining industry seeks to reduce environmental footprints, legacy issues, and satisfy the growing demand for critical metals mine waste is being examined as a potential supplementary secondary resource.

SMI's Mine Waste Transformation through Characterisation (MIWATCH) group apply geometallurgical tools to enable the geoenvironmental characterisation of mine waste across the life-of-mine. They have 3 themes of research—mineralogical and chemical data, evaluation of the geochemical and geotechnical properties of mine waste, and characterisation of existing mine wastes to find future critical metal resources. The group are working with a number of companies and state governments on sites around Australia.



Contributing to the global standard for tailings management

The Global Industry Standard on Tailings Management aims to prevent catastrophic failure and enhance the safety of mine tailings facilities across the globe. It was the result of a review convened by the United Nations Environment Programme (UNEP), the Principles for Responsible Investment (PRI) and the International Council on Mining and Metals (ICMM) following the Brumadhino tailings dam disaster. Professor Deanna Kemp from SMI's Centre for Social Responsibility in Mining was a community and human rights specialist on the multi-disciplinary expert panel that supported the Independent Chair and developed the Standard. She was also in the group of 6 UQ staff to publish chapters in the compendium that accompanied the Standard.





Transforming mine waste back into useful soil

Researchers from SMI's Centre for Mined Land Rehabilitation are developing a technology for rehabilitating 'red mud' mine waste back to useful soil with their partners Rio Tinto and Queensland Alumina Limited (QAL). The technology is now being demonstrated at-scale at 2 sites and is part of QAL' s commitment to minimise its environmental footprint. Planned commercialisation of the technology will bring it to an emerging market for tailings management.



Developing a new international standard for water-related risks in mining

With support from the Minerals Council of Australia and the International Council on Mining and Metals, SMI's Centre for Water in the Minerals Industry developed the Water Accounting Framework, which has become the international standard for identifying and communicating water-related risks associated with mining. The framework led to changes in the Australian Bureau of Statistics' collection of water indicators for their yearly environment indicators survey and underpinned BHP's inaugural water report.



Documenting Indigenous experiences in mining and championing change

SMI's Centre for Social Responsibility in Mining completed landmark research on Indigenous employee retention, economic engagement, business development, involvement in land rehabilitation and women's experiences in the Australian mining industry which led to major Indigenous policy and practice reform across the industry. The Centre also published widely used guides and tools as a result, including Indigenous Employment in the Australian Minerals Industry, Procuring from SME (small-to-medium enterprise) in local communities, and Guide to good practices in Indigenous employment, training and enterprise development.



Optimising from mine to mill

SMI's Julius Kruttschnitt Mineral Research Centre and JKTech's Mine-to-Mill optimising methodology has significantly reduced costs, increased production, reduced emissions, made tailings and waste safer, and decreased noise and dust generated for a wide range of mining company partners. Analysis found that production increases at constant costs of between 9% and 46%, with a cumulative financial benefit across all case studies of A\$1.85 billion per annum.



Reducing energy use through industryacademia collaboration

Researchers from the Julius Kruttschnitt Mineral Research Centre established and lead the Collaborative Consortium for Coarse Particle Processing Research (CPR) aimed at developing improved energy efficiency for mineral processing operations. The Consortium includes representatives from Rio Tinto, Glencore, Anglo American, Hudbay Minerals, Newcrest Mining, Aeris Resources, Baker Hughes, Eriez Flotation and Newmont. The Consortium has a number of projects underway and has successfully created a Forum where companies can come together to discuss and share learnings on their own processing challenges in a collaborative way.



Equipping explorers with a next-generation toolkit

Researchers from the WH Bryan Mining Geology Research Centre developed a 3D model of Queensland that places an unmatched amount of data at the fingertips of explorations geologists. Funded by the Geological Survey of Queensland and supported by Euclideon, the project populates an interactable 'Digital Twin' of Queensland with visualisations of drill core data, surface geochemistry data, multiple different types of geophysics data, geological maps, cross sections, photogrammetry scans and much more.





Rethinking feasibility through multi-disciplinary analysis

SMI researchers, along with partners from the University of British Columbia, worked with MMG to rethink the feasibility of 2 high-grade mineral deposits in north-west Canada. As part of this 'Izok Lake' project, the team provided MMG with practical solutions and recommendations for the project after employing a multi-disciplinary approach to addressing challenges with energy supply, remoteness, climate change, infrastructure, difficulty accessing the deposit, a complicated mix of ores, local community impacts, water management and wildlife.



Resourcing a sustainable future for the Pacific

The Development Minerals program is working with a wide range of partners to introduce low carbon cement to the Pacific. The Program, which was supported by Fiji's Ambassador and Permanent Representative to the United Nations, aims to build resilience in regional supply chains, create a reliable and affordable source concrete for infrastructure, and ensure that key concrete inputs such as aggregate, limestone, clay and gypsum are sourced sustainably and match the values of the Blue Pacific initiative.



Ensuring automation translates into improved health and safety outcomes

Researchers from SMI's Minerals Industry Safety and Health Centre, with funding from BHP Mitsubishi Alliance and Whitehaven Coal, launched a multi-year collaborative research consortium initially focussed on 4 priority human aspects of automation topics: risk analysis; human-centred design; training; and health.



Understanding the full picture of mine dust lung diseases

Minerals Industry Safety and Health Centre researchers received significant funding from the Queensland Government to improve safety, health, and treatment outcomes for mine workers with, and at risk of, dust lung diseases. The multiproject effort involves identifying occupational and individual risk factors associated with developing respiratory diseases as well as identifying the factors critical to the development, severity, and progression of coal workers pneumoconiosis and silicosis.



Providing industry with smart water supply solutions

Researchers from SMI's International Centre of Excellence in Chile and the Centre for Water in the Minerals Industry worked with partners (including Mitsubishi) to develop water-supply planning software to connect 16 desalination plants in the arid Atacama region of Chile. This 'smart water supply system' is enabling planners to use desalinated seawater for the reliable supply of water to industry and communities with minimal environmental impact.

Centres

SMI's research centres nurture deep disciplinary expertise and are committed to delivering sustainable development and training the next generation of industry and community leaders.





Centre for Mined Land Rehabilitation

CMLR addresses the environmental challenges of the minerals industry by translating scientific research into practices that improve mine rehabilitation and closure outcomes. The Centre has a reputation for providing the science necessary to inform decision making that can help minimise risk and maximise opportunities resulting from resource exploration, extraction and processing.



Centre for Water in the Minerals Industry

CWiMI is committed to developing sustainable management of water in the minerals and energy industries by solving environmental, social and engineering challenges of water management. It seeks to promote practices that enable efficient management of water quantity and quality within the minerals sector and to underpin healthy regional water systems in catchments that contain mining activities. Technical areas of excellence are hydrology, hydrogeology, soil hydrology, geochemistry, water resource engineering, spatial science, data science, climate science and aquatic ecology.



Centre for Social Responsibility in Mining

CSRM is committed to improving the social performance of the global resource industry. Through independent research, teaching and multi-stakeholder dialogue processes, the Centre is helping to resolve some of the industry's most pressing social and political challenges, including land use competition, business and human rights, mining-related conflict, resettlement and displacement, cultural heritage, governance and geopolitics.



Julius Kruttschnitt Mineral Research Centre

JKMRC creates industry impact through applied research and knowledge transfer in mineral processing technologies. The Centre has strong partnerships with industry—collaborating with stakeholders worldwide and has an outstanding reputation as an innovator in mineral processing techniques, evidenced by the widespread use of it research outcomes. JKMRC hosts a node of the Australian Research Council Centre of Excellence for Enabling Eco-Efficient Beneficiation of Minerals and leads several collaborative research consortiums.



BRC

WH Bryan Mining Geology Research Centre

BRC maximises the value and availability of geoscientific data across the mining value chain for sustainable and responsible mineral production. The Centre's capabilities combine economic geology, geophysics, environmental geochemistry, geotechnical, underground mass mining, mineral chemistry, structural geology and tectonics, geometallurgy, mineral processing and data analytics.



Minerals Industry Safety and Health Centre

MISHC develops and delivers solutions to ensure the resources industry is safe, healthy, and rewarding for workers. For 25 years the Centre has collaborated with industry and regulators to improve the management of risk, safety, and occupational health.

Its multidisciplinary team provides applied research and world-class education and professional training to advance practice in the areas of risk and critical control management, process and systems safety, the human aspects of automation, emergency responses, the application of advanced technologies, and worker psychology, fatigue and stress.

SMI-ICE-Chile

SMI International Centre of Excellence in Chile

SMI-ICE-Chile seeks to address the priority sustainability challenges of industry and society in Chile and Latin America, developing researchbased technological and knowledge solutions and creating capabilities and value in impacted territories that benefit all inhabitants.

SMI-ICE-Chile has 4 research and development lines:

- Processing: energy, water and emissions
- Environmental Rehabilitation and Ecosystem Dynamics
- Social Performance and Resource Governance
- Integrated Safety and People Health

JKTech

JKTech Pty Ltd

JKTech is the technology transfer company for SMI. It delivers consultancy, laboratory services, specialist software and equipment, and professional development to support mining and mining equipment, technology and services (METS) companies achieve positive and sustainable outcomes. JKTech's products and services are used in over 600 METS companies and 200 plus mining operations, across 47 commodities in 100 countries.

Strategic research programs

SMI's strategic research programs ensure the Institute applies a multidisciplinary and systems-based approach to addressing global sustainability challenges.

Unlocking Complex Orebodies

The Complex Orebodies Strategic Program aims to address the projected shortage of metals by unlocking deposits that are currently unviable due to technical, environmental, social and political barriers. The quest to overcome these barriers through economies of scale is reaching the limit of effectiveness and sustainable pathways are necessary. In collaboration with industry, the Program is developing the innovative technologies and methodologies required for cost effective, sustainable access to these complex orebodies.

Resourcing Decarbonisation

As society transitions to a low carbon future the mining of certain critical minerals will rise exponentially to underpin new energy technologies. Mining companies must produce quantities never experienced before, and supply of these minerals is driving resource extraction into new geographic areas and potentially vulnerable ecosystems and communities. The University of Queensland is investing seed funding to catalyse impact-driven research in this area. Researchers are tackling the sources and supply risks around mineral supply, mitigating the carbon impacts of the resources sector, examining market incentives and policy protections and understanding the complex risk interactions associated with decarbonising society.

Future Autonomous Systems and Technologies (FAST)

FAST is a collaboration between UQ's School of Mechanical and Mining Engineering and SMI. The Program focuses on developing trusted autonomous systems and technologies for people to work effectively in the mining business process, supporting the industry's transition from mechanised to autonomous and digitised operations. The focus of this program is on designing, developing and deploying autonomous systems and technologies that are trusted and bring tangible economic and social benefits.

Leadership and Organisational Improvement

Leadership and Organisational Improvement draws on expertise from across the University to design research and consulting projects aimed at delivering real world improvements in leader and organisational effectiveness. The Program co-ordinates and undertakes research on High Reliability Organisational thinking, and the adaptation of this approach to the resources sector. Development and deployment of tools to diagnose organisational issues, devise robust improvement processes, and measure progress are a focus of the program. High Reliability Organisational thinking is used to improve outcomes across the spectrum of resource sector activities. The Program also works with industry to design, and monitor the impact of, evidencebased bespoke leadership development courses.

Development Minerals

The Development Minerals Strategic Program undertakes research, education, technical assistance and capacity building on the materials most important for local development. These materials are crucial for infrastructure, housing, road building, manufacturing and agriculture, and support the livelihoods of millions of people working in domestic artisanal, small and medium sized businesses. The Program works with a range of international partners to improve sustainability and human development outcomes and help realise the United Nation's Sustainable Development Goals.





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