DEEP EXPLORATION TECHNOLOGIES CRC
Uncovering the future

Strategic Plan
2010 — 2013

"We shall not cease from exploration, and the end of all our exploring will be to arrive where we started and know the place for the first time." T. S. Eliot

An Australian Government Initiative

CRC AUSTRALIA

Message from Chair and Chief Executive Officer

The key challenge facing the Australian, and indeed the global mining industry, is meeting the increasing long-term global demand for mineral resources that can only be satisfied by discovering new mineral deposits, and extending known deposits deeper both within basement and under, barren cover rocks. The Deep Exploration Technologies Cooperative Research Centre (DET CRC) will address the technological barriers that must be overcome in order that exploration for mineral deposits through deep, barren cover rocks becomes more successful, more cost-effective, more environmentally-friendly and is undertaken more safely, thereby ensuring the long-term supply of mineral resources and enabling continuing improvement in global standards-of-living.

The DET CRC will impact on the workflow of mineral exploration, specifically on improved technologies for;

- drilling holes;
- obtaining better data more quickly from holes (reducing turnaround time between holes), and ;
- selecting the location of exploration holes.

The measures of success of the DET CRC will not only be the outcomes of its research, but also the utilisation of those outcomes by the mineral exploration industry. Thus the extent of the commercialisation of research outcomes will be a key measure of the success of DET CRC. The CRC has a unique commercialisation model based on engagement with the mineral exploration service sector.

The objective of the Australian Government's Cooperative Research Centres Program is "to deliver significant economic, environmental and social benefits to Australia by supporting end-user driven research partnerships between publicly funded researchers and end-users to address clearly articulated, major challenges that require medium to long-term collaborative efforts." The DET CRC was established in 2010 as the result of a successful funding bid in Round 11 of the Australian Government's CRC Program. The DET CRC is an industry-initiated response to the key major challenge facing the minerals industry, namely the development of new technologies for mineral exploration through deep, barren cover rocks. The DET CRC will administer over $100M of cash and in-kind funding provided by the Australian Government and our participants to this end.

The DET CRC has 12 participants whom include the world's two biggest diversified miners, the world's largest gold producer and the world's largest drilling company. State and Commonwealth Government agencies, CSIRO and three Australian universities are also participants. Numerous smaller companies (both junior miners and mineral exploration service companies) are affiliates of the CRC.

Our strategic plan for 2010 — 2013 presents the purpose and goals of the DET CRC and the high level strategies for achieving our goals. The CRC's broad strategy for research into and development of new technologies for mineral exploration through deep, barren cover rocks was developed in planning workshops held with participants during the preparation of the CRC bid. This strategic plan essentially articulates the strategies developed in that process, upon which the bid documents for the CRC, and the legal documents covering the governance and management of the CRC, are based (i.e. the Commonwealth Agreement, the Participants Agreement and the Company Constitution). This strategic plan is intended to guide the CRC from its inception to its mid-term review in 2013. It will be supported by Project Agreements that define the research that will be undertaken and by an Operational Plan.

Dr Tom Whiting
Chair, DET CRC

Prof. Richard Hillis
CEO, DET CRC

Our Core Purpose. *Uncovering the future*. To develop transformational technologies for successful mineral exploration through deep, barren cover rocks to be utilised and commercialised by the mineral exploration industry in order to replace the world's declining mineral resource inventories and thereby enable continuing improvement in global standards-of-living.

Our Vision. The DET CRC will become the world's leading independent centre for research into and development of new technologies for mineral exploration by bringing together people and organisations, who could not individually achieve our core purpose. Cooperation will be multi-disciplinary (including engineering, geosciences, physics and chemistry), multi-institutional (including universities, government agencies, major mining companies, junior explorers and mineral exploration service companies) and along the research, development, demonstration, deployment and diffusion value chain.

Our Values.

- To pursue research excellence in all we do and encourage innovation, breadth-of-vision and responsibility.
- To recognise that collaboration is the key to success and act with fairness, integrity and responsibility in order to encourage such.
- To consider the needs of all stakeholders in the CRC.
- To recognise that the key to the success of the CRC is its people.

Our Goals. Technologies developed by the CRC will be routinely used in mineral exploration and will enable more successful, more cost-effective, more environmentally-friendly and safer ways to drill, analyse and target both new deep mineral deposits ('greenfields') and deep extensions to known deposits ('brownfields').

Our Programs.

- Program 1 Drilling. Reduce the cost and environmental impact, and increase the safety, of drilling exploration holes by delivering incremental and transformational changes in drilling technology facilitated by a unique drilling research and training facility.
- Program 2. Logging and Sensing. Increase the value of holes drilled by real-time down-hole or top-of-hole evaluation of intersected mineralization, detect near-misses and enable immediate follow-up drilling by real-time refinement of exploration and life-of-mine models.
- Program 3. Targetting. Ensure that drill holes are placed to maximise their success and the knowledge they produce by developing new seismic and geochemical methods for exploration and integrating such into new exploration workflows in drilling, logging and sensing.

Impact of DET CRC Research

The impacts of DET CRC research will be:

- significant reduction in the time and cost of drilling;
- significant improvement in drilling safety and environmental impacts;
- quicker and better decision-making in exploration due to higher value data obtained real-time or near real-time from drilling;
- optimised life-of-mine planning through better constraining the extent of deposits earlier in the exploration-development cycle;
- cost-effective discovery by developing tools for deeper targeting — 20% fewer 'barren holes';
- growth of Australia's mineral exploration technology services sector through the commercialisation of DET CRC research, and;
- improved training of drillers (in safety and in new technology) and of graduate-level exploration professionals.

Structure and Governance of the DET CRC

DET CRC Ltd is a not-for-profit company, limited by guarantee, established to run the CRC under the terms of its Commonwealth Agreement, its Participants Agreement and the company's own constitution. The participants in the DET CRC comprise the company members and have rights similar to shareholders (e.g. to elect the Governing Board of DET CRC Ltd.).

The Board of Directors of the DET CRC should have an unconflicted ability to guide the CRC in achieving its goals. Thus the DET CRC has a Board of Directors independent of its participants with individual directors elected on the basis of providing the skill sets required to guide the CRC.

The participants in the CRC must guide the research that it undertakes. Thus the DET CRC has a Science Steering Committee (SSC) on which participants are represented. The SSC is responsible for approving, guiding and monitoring the CRC's research projects including the allocation of CRC funds to research projects, subject to final Board approval. The SSC must be kept informed of progress of research projects in order to effectively guide and monitor them and to fully benefit from them. A key role for DET CRC management is to facilitate direct engagement by participants in the CRC's research projects.

Subcommittees established by the Board, such as the audit committee, risk committee, education and training committee, executive management committee and utilisation committee guide key facets of the CRC. A key role for DET CRC management is to support the Board and its committees in their guidance of the CRC.

Engaging Industry

In order to achieve its goals both in the research and in the development of new exploration technologies and in the utilisation of resultant intellectual property, the DET CRC must profoundly engage a wide cross-section of the exploration industry. A key role for DET CRC management is to maintain the engagement and support of participant companies. Furthermore, DET CRC management will seek new participant companies in order to increase and broaden its industry engagement and to obtain additional funding to support its research.

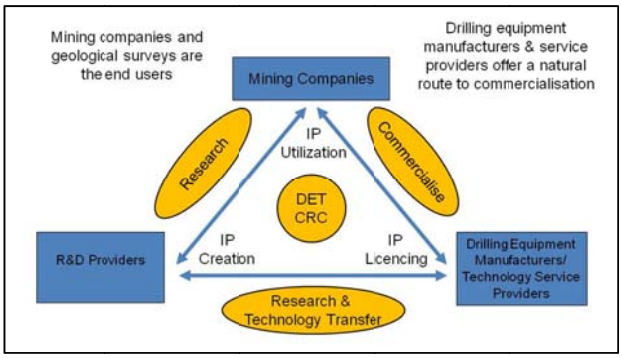
In order to engage small-to-medium sized enterprises and state government agencies in the DET CRC (who are priced out of participant-level involvement), the DET CRC has established three colleges of affiliate members (junior explorer college, service provider college and state government geological survey college). Affiliates are able to join at low cost and each affiliate college has rights similar to a full participant. DET CRC seeks to involve as many affiliate members as possible because they will broaden the experience and expertise base, providing valuable input on project scoping and review and on the commercialisation of IP.

AMIRA International ran the project which developed the DET CRC bid to the Commonwealth Government. The CRC aims to maintain a close and mutually beneficial relationship with AMIRA, utilising its industry network and providing to AMIRA opportunities to recruit additional affiliates and participants of the DET CRC.

A key role for DET CRC management is to maintain the engagement and support of participant companies and to recruit new participants and affiliates.

Intellectual Property and Commercialisation

A guiding philosophy of the DET CRC is that commercialisation of DET CRC intellectual property (IP) should be undertaken by the industry sector best equipped to commercialise IP and to provide the resultant service to the exploration industry, namely the mineral exploration service sector. This philosophy of commercialisation through the service companies is critical to successfully impacting on the hardware and workflows of the mineral exploration business. It is not the intention of DET CRC, or its mining company sponsors, to 'hold onto' IP, or to endeavour themselves to commercialise IP. Thus participant service provider companies have the first right to submit commercialisation plans for DET CRC IP to the Board of the CRC and the second right lies with affiliate service provider companies. Legal ownership of DET CRC IP rests with the CRC in order that it can enter into commercialisation arrangements in its own right, however, beneficial ownership of centre IP is shared between the DET CRC and the research providers who have developed the IP. A key role for DET CRC management is to facilitate the commercialisation process and ensure that beneficial ownership of Project IP is clearly assigned. The diagram below summarises the DET CRC's approach to the research, development, demonstration, deployment and diffusion chain.



Education and Training

The DET CRC will have strong emphasis on education and training. It will support the education of university graduates/postgraduates in the new technologies of mineral exploration and in the VET sector it will support the training of drillers in new drilling technologies stemming from the CRC, and with a particular focus on safety. The DET CRC's Drilling Research and Training Facility is critical to these objectives.

Overview of DET CRC Research

The DET CRC is concerned with the technologies of exploration and its results will directly impact on the hardware and workflows of the mineral exploration business. Drilling consumes the majority of mineral exploration expenditure. Hence the CRC is focused on delivering improved drilling technologies such as multilateral holes, lighter drillstrings, automated rod handling and novel drill bits. Drilling safety will be improved by new technologies such as lighter drillstrings that reduce manual handling. The environmental footprint of drilling will be reduced by deviated and multilateral holes exploring the subsurface from a single surface location, thereby reducing the number of cleared drilling pads and access roads.

New drilling technologies will need to be complemented by new drillhole logging technologies. For example, if drilling for resource definition is to follow immediately upon exploration drilling, without expensive demobilising and remobilising of drilling rigs, assay-type information on mineralisation intersected by an exploration hole must be immediately available upon exploration drilling via down-hole logging techniques. Furthermore, there must be real-time refinement of the geological models (e.g. geophysical inversions) guiding drilling using data collected in exploration holes, and these refined models must guide follow-up drilling. Improved knowledge of the extent of mineral deposits earlier in the exploration cycle, particularly their depth extent, will have a critical impact on life-of-mine planning, be that decisions on open-cut versus underground mining or on the location of processing plant and ancillary mine services.

Improving the success of exploration holes and the early definition of discovered deposits requires that drilling and logging results be integrated with surface-based geophysical and geochemical drillhole targeting technologies. Thus research in drilling must be complemented by research in drillhole logging and research in the targeting of drill holes and the DET CRC's research projects are structured into three broad programs:

- Drilling;
- Logging and Sensing, and;
- Targeting.

Program 1: Drilling (Leader, Gary Cavanough, CSIRO)

Objective. Reduce the cost and environmental impact, and increase the safety, of drilling exploration holes by delivering incremental and transformational changes in drilling technology facilitated by a unique drilling research and training facility.

Project 1.1 Next Generation Drilling Systems (Leader, Gary Cavanough, CSIRO)

Objective. To develop and/or adapt breakthrough drilling technology incorporating, for example, flexible drill strings, self propelling down-hole motors and steerable drill bits.

Outputs. An initial one-year project will be undertaken to plan for activities in this project in years two to eight of the CRC. This initial project will:

- document the range of exploration drilling approaches currently undertaken in the minerals industry;
- establish a new exploration drilling scenario (or approach) that will transform the way in which exploration drilling is undertaken, and;
- prepare to develop and/or adapt the transformational drilling technologies.

Project 1.2 Fundamentals of Rock Fragmentation (Leader, Luiz Franca, CSIRO)

Objective. To develop models of the bit-rock interface to improve the selection of bit and drilling parameters and set the framework for transformational changes in drilling technology.

Outputs. The anticipated benefits of the project are an understanding of the processes taking place at the bit-rock interface. The primary outputs will be:

- development of bit-rock interface laws that account for both rock and tool properties;
- improved design of drill bits, and;
- real-time identification the state-of-wear of bits and the ideal operating parameters.

Project 1.3 Drilling Optimisation (Leader, Andrew Olsson, CSIRO)

Objective. To apply existing technologies to significantly reduce drilling cost and increase drilling safety.

Outputs. The project will develop a testing environment for use throughout the life of the DET CRC and will also develop equipment/systems for direct application to exploration drilling. The testing environment outputs are:

- a fully instrumented drill rig;
- characterisation of the rock mass in the vicinity of the drilling research and training facility, and;
- a deep hole drilled at the drilling research and training facility.

Outputs for direct application to exploration drilling are:

- models for prediction of the stability of drill holes;
- composite/hybrid drill sub and rod to provide real-time survey and measurement, and;
- fully automated drill rod handler.

Project 1.4 Drilling Research and Training Facility (Leader, Peter Kanck, Boart Longyear)

Objective. To develop an accessible facility for field testing of new drilling and logging technologies and for vocational training for the drilling industry.

Outputs. The aims of this project are the development of the drilling research and training facility and training modules. The outputs are:

- drill rig commissioned at the drilling research and training facility;
- deep hole drilled and cores logged and stored;
- development of driller training modules, and;
- completion of training modules by participants.

Program 2: Logging & Sensing (Leader, Anton Kepic, Curtin University)

Objective. Increase the value of holes drilled by real-time down-hole or top-of-hole evaluation of intersected mineralization, detect near-misses and enable immediate follow-up drilling by real-time refinement of exploration and life-of-mine models.

Project 2.1 In Front of Bit Imaging (Leader, Binzhong Zhou, CSIRO)

Objective. To enable drillers to look beyond the drill bit in real-time and anticipate what lies ahead of, and around, the drill-bit. Such will permit drillers to respond quickly to changes in the nature of geological targets and monitor geo-hazards.

Outputs. Ability to image in front of and around the borehole, including:

- method for generating seismic images and determining bit location during diamond or percussive drilling;
- downhole tool for imaging more than 10 metres away around the borehole, and;
- software for modelling and image reconstruction used to predict, find opportunities and demonstrate the utility of imaging around the borehole.

Project 2.2 Sensors for Rapid Drill-Hole Characterisation (Leaders, Craig Smith & Stephen Fraser, CSIRO)

Objective. To improve the efficiency and effectiveness of deep exploration programs by developing sensors for rapid down-hole characterisation of hard-rock geology while it is being drilled. The logging data will enable changes in physical, petrophysical and chemical properties to be used near real-time to target regions of interest and provide feedback for ongoing drilling.

Outputs. Ability to acquire and use logging data collected during or immediately after the drilling process, including:

- wireline logging tool that performs elemental analysis of many significant elements in typical hard-rock holes;
- petrophysical logging sonde that collects data either while drilling or during rod retrieval, and;
- interpretation methodologies to assist in determining rock type and alteration using standard petrophysical characteristics or elemental patterns.

Project 2.3 Integration of Geological, Geophysical and Rock Property Data (Leader, Richard Chopping, Geoscience Australia)

Objective. To demonstrate that lithological and petrophysical data from drilling may be used real-time to update pre-drill geological models and inform decisions on immediate follow up drilling, e.g. sidetracks.

Outputs. A methodology that uses borehole data to refine geophysical models in a timely manner, including:

- geophysical inversion algorithms ported to a cloud computing environment;
- method to use magnetic gradients to rapidly refine magnetic target models, and;
- workflows designed to incorporate petrophysical data into large-scale potential field modeling with results guiding immediate follow-up drilling.

Project 2.4 Joint Inversion of 3D Seismic and MT Data (Leader, Graham Heinson, University of Adelaide)

Objective. To investigate the advantages of co-located seismic and MT (magnetotelluric) surveys in terms of mutual constraints and joint inversion that significantly improve geological interpretation over that which can be achieved from a single technique.

Outputs. Algorithms or processes designed to integrate surface seismic data with deep penetrating EM data, including:

- joint inversion algorithm able to extract features from both data sets towards a petrophysical model;
- cooperative inversion work flow and algorithms that keep seismic resolving power and add rock unit petrophysics from other geophysical data, and;
- case study of use of both MT and seismic data

Program 3: Targeting (Leader, David Giles, University of Adelaide)
Objective. Ensure that drill holes are placed to maximise their success and the knowledge they produce by developing new seismic and geochemical methods for exploration and integrating such into new exploration workflows in drilling, logging and sensing.

Project 3.1 3D Seismic Exploration for Hard Rock Environments (Leader, Milovan Urosevic, Curtin University)
Objective. To transfer seismic exploration technologies from their application in petroleum settings to widespread use in mineral exploration via advances in processing and acquisition tested in case studies tailored to specific mineral deposits.
Outputs. Optimised instrumentation and methodology for hard rock seismic acquisition evaluated by case study, including:

- seismic multi-attributes for geological interpretation;
- multi-component seismology for rock characterisation, and;
- correlation of seismic and geochemical parameters.

Optimised combined surface and borehole seismic techniques evaluated by case study, including correlation of 3D seismic data to underground lithology through utilisation of full waveform logging, vertical seismic profiling and core sample measurements and images.

Project 3.2 Hypogene Alteration (Leader, James Cleverley, CSIRO)
Objective. To determine the geochemical and mineralogical signature of hypogene mineral systems and develop sampling and analytical workflows that allow the rapid assessment of mineral system footprints in deeply buried environments during drilling.
Outputs.

- Synthesis of knowledge on hypogene alteration in iron oxide copper gold (IOCG) and orogenic gold systems.
- Criteria for recognition of hypogene alteration halos associated with selected mineral deposits and incorporation into drilling, sampling and analytical workflows.
- Case study databases and reports for Gawler Craton IOCG and Yilgarn Craton Gold (St Ives).

Project 3.3 Geochemical Sampling Deep Cover (Leader, Steven Hill, University of Adelaide)
Objective. To develop geochemical methods for exploration within deep cover materials and integrate such into exploration workflows in drilling, logging and sensing.
Outputs.

- Definition and characterisation of sampling media within deep cover and incorporation into drilling, sampling and analytical workflows.
- Case study databases and reports for Gawler Craton IOCG and Yilgarn Craton Gold (St Ives).
- 3D geological and hydrological atlas and explanatory notes for deeply buried terranes of the Gawler Craton.

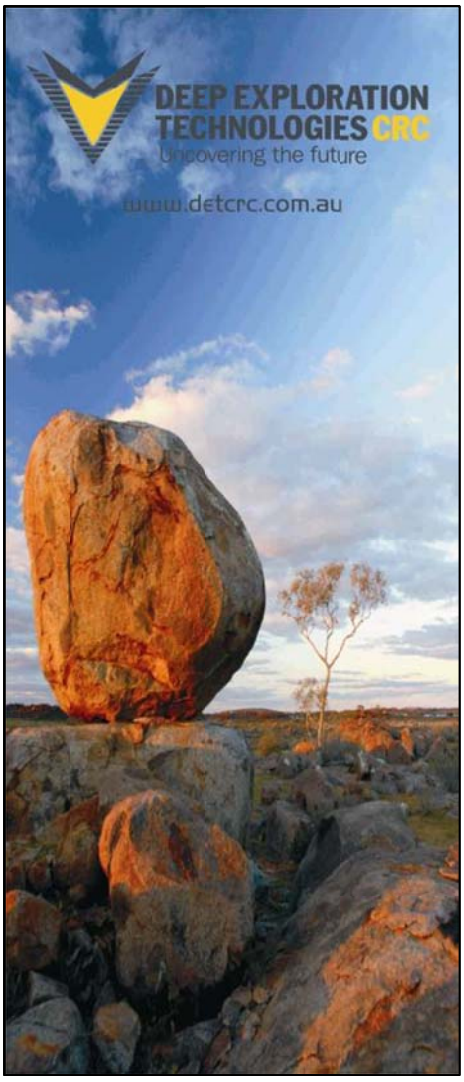
Project 3.4 South Australian Data Integration (Leader, Martin Fairclough, PIRSA)
Objective. To collect and integrate regional-scale data, producing mineral potential maps of the highly prospective mineral provinces of South Australia and use these data to refine drilling, sampling and analytical methods in the deep exploration search space.
Outputs.

- Definition of key geochemical and spectral parameters distinguishing mineralised IOCG systems and regional alteration in the basement and cover sequences of the Gawler Craton.
- Mineral potential maps and commentary for IOCG's in the Gawler Craton, integrating spectral, geochemical and geophysical data from Projects 3.1, P3.2 and P3.3 with PIRSA regional database.

Public domain project summaries are available for each project. The details of each project are contained in commercial-in-confidence Project Agreements.

Management of DET CRC Research

Each program has a program leader employed by one of the participating research providers who is responsible for the overall strategy and progress of their program and for linkages with the other programs. Each project has a project leader employed by one of the parties to the research project who is responsible for the strategy and progress of the project.



Given the linkages between the programs and given that outcomes in Programs 2 & 3 are required to complement new drilling technologies developed in Program 1, the DET CRC will need to ensure that project goals and outcomes are integrated, that key dependencies of one project upon others are recognised and managed and that the projects in their entirety, if successful, achieve the CRC's overall vision. Given that the aim of the DET is to directly impact on the hardware and workflows of the mineral exploration business, it is expected that research funds will flow not only to universities and CSIRO, but also to service providers able to deliver new technologies required for mineral exploration through deep, barren cover rocks.

It is critical that individual projects are appropriately guided and monitored. The Science Steering Committee has a key role in both guiding and supporting projects and in terminating unsuccessful projects. A key role for DET CRC management is to ensure that the Science Steering Committee is facilitated in, and has appropriate processes for, guiding and supporting projects and for terminating unsuccessful projects and that projects have specific, measurable and assessable milestones.

The DET CRC's initial funds are allocated to the projects scoped out in the bid development process and summarised herein. The DET CRC will seek additional funding from new participants to build an 'Opportunity Fund' to support successful and/or new projects. The Science Steering Committee will guide the allocation of Opportunity Fund monies.

"*Twenty years from now you will be more disappointed by the things that you didn't do than by the ones you did do. So throw off the bowlines. Sail away from the safe harbor. Catch the trade winds in your sails. Explore. Dream. Discover*." Mark Twain

Our People

Board of Directors

Our Board is skills-based and independent of participants. The Board comprises the Chairperson, the CEO and directors with strong backgrounds in the following areas:

- corporate governance, audit and risk management, and finance;
- research or education;
- drilling;
- mining and/or mineral exploration;
- commercialisation of science and research, and;
- government agencies.

Chief Executive Officer

The Chief Executive Officer (CEO) is appointed by and reports to the Board. The CEO is responsible for the strategic leadership of the CRC and for the management of the CRC including its research activities and finances.

Executive Management Team

Our executive management team comprises the Chief Executive Officer, Business Manager and Program Leaders and administers the policies and delegated authorities of the Board.

DET CRC Staff

The DET CRC staff comprise the CEO, Business Manager, Administration Officer and Project Manager for the Drilling Research and Training Facility and undertake the day-to-day running of the CRC including managing its research activities and finances.

Program and Project Leaders

Our three program leaders are appointed as in-kind staff from our participant organisations and hold substantive positions within their host organisations. Each program leader is a recognised international expert in their respective field. Program leaders are responsible for the overall strategy and progress of their program and for linkages with other programs. Each project has a project leader employed by one of the parties to the research project who is responsible for the strategy and progress of the project. Program and project leaders work in partnership with researchers to develop and deliver research activity that addresses the contracted milestones in our Commonwealth Agreement and as agreed by our Science Steering Committee.

Science Steering Committee

The Science Steering Committee is responsible for providing scientific leadership to the Centre. It is responsible for approving and monitoring projects and for planning new projects to attain the goals of the CRC. It also facilitates ongoing linkages between industry needs, research capabilities and service providers. The voting members of the SSC are the CEO, one representative from each participant and one representative from each of the three affiliate colleges. The program leaders, AMIRA International, one of the Directors and independent experts are also non-voting members the SSC.

CRC Program

Participants

Other Participants

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