

Sensing Technology Solutions for Environmental Monitoring and Waste Streams Characterisation



Introduction

At Rio Tinto, we're finding better ways to provide the materials the world needs.

Although mining and processing activities extend over decades, we recognise that we are only temporary stewards of the land, and other activities and uses will follow. To mitigate the potential impact of this transition in land use, we look for opportunities to innovate and implement best practices in progressive mine site closure, remediation, and repurposing, and where appropriate, long-term monitoring and maintenance. We aspire to leave a positive legacy for future generations.

Most of our mines or processing facilities, whether operational or closed, include some form of environmental monitoring for water, air, soil, and sediment quality, using manual (or semi-automated) sampling in remote locations followed typically by chemical analysis in the laboratory. These monitoring activities may change during operation and may continue for many decades once the mine or processing facility is closed, as part of a post-closure monitoring plan.

Opportunities exist to improve the current environmental monitoring and laboratory analysis practices with online, connected in-situ and remote sensor technology. The substantial data gathering may assist in building and validating better models for predicting any potential long-term impacts on the environment.

Our mining operations can generate large volumes of mineral waste throughout their operating life. Comprehensive characterisation of mineral wastes is at the core of our environmental management. It assists in segregating reactive from non-reactive wastes, in designing repositories and blending strategies and monitoring to minimise potential environmental impacts. Furthermore, these wastes represent a significant opportunity to unlock new sources of critical minerals.

Opportunities exist for sensing technologies to reduce the cost of waste characterisation throughout the life of the mine, unlocking opportunities for upcycling mineral waste and proactively managing environmental impacts. This may significantly help Rio Tinto reduce closure costs and provide greater accuracy of closure cost estimation.

Business Challenge

Do you have an idea that could add value to our environmental monitoring and management of mineral and industrial waste streams characterisation across the mining lifecycle, from exploration, through operations, closure and post-closure care and maintenance? If so, we are looking to partner with experts to identify, develop, and validate leading-edge in-situ and remote sensing solutions for various environmental monitoring and waste stream characterisation applications.

What we are looking for:

- Monitoring for environmental , revegetation, and wastewater treatment optimisation applications:
 - o Regular (or continuous) monitoring for:
 - Groundwater at multiple depths (e.g. wells, bores, aquifers etc.)
 - Surface water flow and at multiple depths (e.g. ponds, dams, pit lakes, creeks, rivers, channels, trenches, etc.) or wastewater treatment plants input and outputs
 - Air (e.g. personal monitors, ambient, source emissions etc)
 - o Rapid and intermittent contamination detection for soil/growing media
 - o Regular and continuous soil/growing media characterisation to improve revegetation outcomes.
- Monitoring waste streams characterisation for valorisation, remediation, or contamination avoidance applications:
 - o Rapid and intermittent rare earth elements (REEs) and critical minerals detection in water, mineral and industrial wastes
 - o Regular (or continuous) characterisation of tailings storage facilities, waste rock dumps and industrial landfills
 - o Rapid and intermittent in-situ testing for generation prediction of acid and metalliferous drainage generation in waste rock (alternative to lab-based humidity cells)

What we are NOT looking for:

- Currently available, off the shelf in-situ/remote/real time sensors (e.g. pH, temperature, etc)
- Sensors that do not meet the requirements outlined in the Appendix.

The goal of this challenge is to identify and implement sensing technology solutions that address some or all the following challenge themes:

- **Reliable** solutions that maintain accuracy over long periods regardless of environmental factors, such as pH and temperature, with detection limits comparable to laboratory analysis.
- **Versatile** sensing solutions that measure multiple parameters in a single sensor or combine multiple sensors in a single system.
- **Adaptable** solution platforms that allow sensors to be incorporated into equipment already being used throughout the life of mine or strategically placed in a variety of matrices such as water, sludge, soil or waste rock piles, with easy and fast deployment.

- **Independent** sensing solutions that are easy to install, have self-calibrating or no calibration requirements and can operate in isolated environments with little or no maintenance to ensure minimal operator interactions.
- **Intelligent** solutions that have automated data processing and advanced analytics to identify trends and anomalies, alerting when there are risks to the environment, as well as enabling optimisation of process performance.

A number of target Areas of Interest (Aols) are presented in the **Appendix**, which should be used to guide submissions.

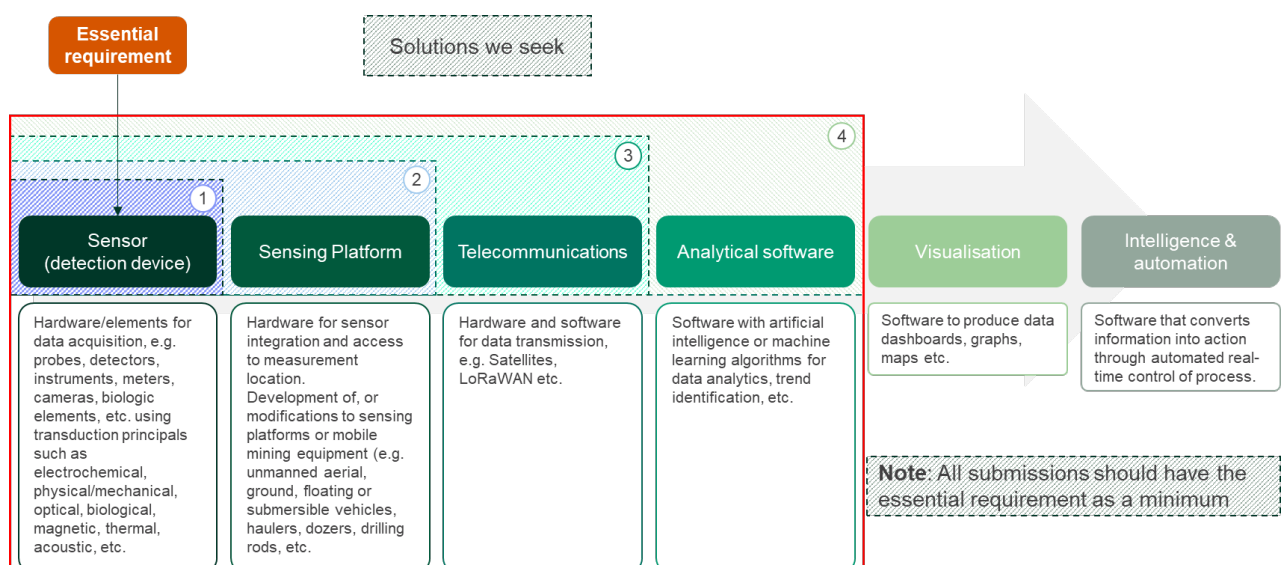
Solutions we seek

We are reaching out to the global research, technology, and innovation industry to catalyse the development of new R&D projects to achieve our goals for this business challenge, which are to:

- Identify and support the development and validation of emerging in-situ and remote sensing technology solutions that are at a technology readiness level (TRL) between 3 to 8
- Stimulate the market to transfer applicable solutions from adjacent industries
- Deliver against the specific in-situ and remote sensing AOIs in the Appendix
- Encourage collaboration between:
 - o players across a technology solution value chain (e.g. between research organisations, engineering services and manufacturing/fabrication services)
 - o different technology providers to bring integrated solutions that can deliver multiple benefits (i.e., multiple probes/sensors from different providers in a single sensing platform)
- Capture key lessons and opportunities for future mine challenges.

We aim to develop projects with leading-edge solution providers discovered in this campaign that will play an integral part in our R&D pipeline of opportunities for the next three years and beyond.

The complete solution space may be considered with the focus of the challenge items 1 through 4 as follows:



Solutions do not necessarily need to be fully integrated sensing systems (i.e. incorporating items 2 to 4) provided they include the essential 'sensor (detection device)' component. We will also consider arrays of semi-integrated components, e.g.:

- Development of or modifications to robotic systems (autonomous or semi-autonomous) to incorporate the sensor(s), e.g., unmanned aerial vehicles (UAVs) – drones, balloons, etc., unmanned ground vehicles (UGVs) and unmanned underwater vehicles (UUVs)
- Development of or modifications to mobile devices and equipment used in mines, e.g., smartphones, material handling equipment (e.g. trucks, dozers, etc.), drilling, etc.

The assessment of the submissions will be based on the goals and challenge theme priorities established for each AOI in the Appendix, together with how the solution compares to qualified sensors or analytical methods. Submitters should consider the following when comparing presented solutions against current and emerging state-of-the-art technologies:

- Cost per measurement – Including capital and operating (consumables) cost.
- Power consumption – Current consumption during operation (μ A) and current consumption during sleep (μ A)
- Power input – Mains or battery powered, options for batteries and lifetime/replacement period and renewable power options (e.g., solar, wind or turbine)
- Frequency of sampling – Data resolution (e.g., seconds, minutes, hours)
- Process time – Time taken to complete each sampling
- Ease of installation, operations, and maintenance
- Parameters sampled – which may be application dependent (e.g. pH, electrical conductivity, metals and metalloids, anions and cations, flow, TSS, etc.)
- Communication capabilities and protocols – data transmission type, e.g., SCADA, Internet of Things (IoT), satellite, etc.
- Health and safety considerations – how does the solution impact or enhance Health, Safety & Environment and training requirements.

Timeline

The crowdsourcing campaign is a two-stage process.

This initial phase (Concept Paper) will close for submissions on **28 Jun 2023**. An initial shortlist of selected submissions will be requested to submit a Full Proposal for an R&D project (Stage 2).

Critical dates are as follows:

Webinar: 07 Jun 2023

Stage 1 (concept paper) submission deadline: 28 Jun 2023

Stage 1 successful submissions announcement : 26 Jul 2023

Stage 2 (full proposal submission) deadline: 04 Sep 2023

Informing selected submission for contracts discussion: 09 Oct 2023

Submissions lodged after the closing date and time or lodged using an alternative to the Pioneer Portal may be disqualified from the evaluation process and ineligible for consideration.

About your submission

We encourage submissions to include comprehensive and reference evidence to support the claims made in the submission. This will provide us with confidence in the feasibility and effectiveness of your solution or concept.

We may elect to proceed with any number of submissions (including all or none) at our sole discretion. If there are aspects of your solution that could work with other solutions, we encourage you to consider whether you would be willing to partner with other parties. Partnerships will be discussed on a case-by-case basis.

Your submission should include an assessment of the Technology Readiness Level (see Appendix for definition of TRLs). We are willing to fund and or cost-share projects from **US\$50,000** up to **US\$1 million**. This funding may be made available as cash and in-kind (e.g., site access for prototyping or testing, subject matter expertise, wastewater samples). Large private organisations or teams composed of multiple organisations are encouraged to contribute at least 20% of the total project cost. We may consider the amount of proposed cost share when selecting applications for further discussions.

Proposals linked to grant applications seeking co-funding will also be considered. This should be disclosed as part of your submission and will be discussed on an individual basis upon successful progression.

Our contribution could be provided through:

- R&D collaboration agreements (e.g., Joint Development Agreements, Technology Trial Agreements) or
- equity arrangements.

An R&D project should not include more than two stages of development, with each stage being one of the following:

- Prototype/Pilot: Advancing a technology currently in **TRL3** or **TRL4 to TRL6**
- Demonstration: Advancing a technology currently in **TRL6 to TRL7** or **TRL8** (also from TRL7 to TRL8)
- New to mining deployment: validating a technology currently in TRL8 for its future upscaling in mining environments.

Note: We will not consider requests at **TRL 1 or 2**.

We are open to a range of project delivery timelines, from less than one year to multi-year projects of up to four years.

We will consider a mix of quantitative and qualitative criteria in determining whether to invite the submission to provide a Full Proposal and whether to select a Full Proposal for award negotiations. These criteria include:

- Impact and benefits of the proposed technology. This criterion involves consideration of the following:
 - o The extent to which the proposed concept will have a positive contribution to the business challenge and the applicable Aol

- The extent to which the proposed concept improves environmental monitoring and avoidance of contamination, reduces safety risks and operational burden, and/or identifies valorisation potential
 - Demonstrated awareness of competing commercial and emerging technologies
- Project implementation and solution development, which includes consideration of the following:
 - Identification of techno-economic challenges that must be overcome for the proposed technology to be commercially viable
 - Clear identification of how the concept will be built, deployed, in what matrix/environment, and what auxiliary components/technologies are needed for the solution to deliver value to the applicable target AOI(s)
 - Additional research needed, prototype cost and facilities needed are clearly stated
 - Team/consortium in place with competencies to drive development to higher TRLs

How to lodge your submission

Please submit via the form on the [Rio Tinto Pioneer Portal](#). You must agree to the Terms and Conditions.

Requirements for the concept paper are provided in the Appendix.

For further clarification email pioneerportal@riotinto.com.