# Rio Tinto Sensing Technology Solutions for Environmental Monitoring and Waste Streams Characterisation

## Questions and Answers from the Webinars

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## WEBINAR

### 1. Is the webinar or presentation available to the participants?

The recorded webinars are not available for download, but this Q&A document captures all the questions asked across two webinar sessions, and the team is happy to answer any other questions you may have. The information presented in the webinar is extracted from the documents available on the portal.

## INTELLECTUAL PROPERTY (IP) AND RIGHTS

### 2. Who will be holding the IP and what are Rio Tinto's expectations to operate rights?

The objective of this challenge is for Rio Tinto to support the development of novel technologies that could potentially be used and accelerate the transition to in-situ and remote sensing for environmental monitoring and waste characterisation to improve mine management and develop circular economy opportunities.

Rio Tinto recognises the rights partners have to IP they are bringing to the projects (Background IP) and what is developed during the projects (Project IP) and seek to have access to such IP at terms that are appropriate to the funding provided in each project. As a general principle, ownership of Project IP solely vests in the party that creates it, immediately upon its creation.

Rio Tinto aims to negotiate terms, including IP, directly with each successful submission, and this process is expected to begin following Stage 2 of the project assessment process.

### 3. Is there a Terms & Agreements document associated with the challenge?

Terms & Agreements will be binding at stage 2 and will be provided to the shortlisted candidates from stage 1.

## SOLUTION REQUIREMENTS

### 4. What if our mineral and soil characterisation solution slightly falls outside of the application requirements? Are we still eligible to apply?

Rio Tinto are always on the lookout for good ideas and technologies that may support our goals. If you have a topic that does not fit within the challenge scope and themes, there is an open submission area on the Pioneer Portal (situated below the sections for the active challenges). We encourage anyone to submit an idea there.

If the solution is addressing the essential requirement (sensing) but it is slightly falls out of the specific application requirements, Rio Tinto would encourage the elaboration of a research and development plan to address the required applications and apply.

### 5. We have an idea that is still in the desktop study stage, should we submit it?

This challenge is a pathway to populate a long-term R&D pipeline for the environmental monitoring and waste stream characterisation at Rio Tinto. As such, we are looking for solutions that are in TRL 3 or above (refer to document 'Submission Guidelines' for TRL definitions).

Do not submit a proposal if the experimental proof of concept for the solution has not been achieved (it's still an idea).

### 6. If the product is already commercialised, should we submit it?

Currently available, off-the-shelf in-situ/remote/real-time sensors used in mining environments should not be included in submissions without some form of proposed R&D for improvement. For example, if a sensor system could be taken out of the laboratory environment and adapted to be in-situ, we encourage you to submit it.Off-the-shelf sensors used in other industries but not trialled in mining do require a rigorous testing to verify they meet the application requirements and are encouraged to apply.

### 7. Would an off-the-shelf solution from another sector, adapted to the mining sector, be in scope?

Yes, it is acceptable, and the project should aim to demonstrate any improvement or upgrade required in the mining sector.

### 8. If our technology is an unmanned platform for autonomously deploying water sensors, but we use off-the-shelf sensors on the platform, is this still of interest?

Yes, we encourage you to submit a proposal.

### 9. Are you considering novel satellite sensors and analytics?

Yes, we encourage any novel development in the remote sensing/satellite field.

### 10. Are we allowed to submit multiple projects or apply for more than one Area of Interest (AoI)?

Yes, we encourage you to submit multiple projects and for multiple Areas of Interest.

### 11. If submitting two solutions in two areas of interest will each submission be addressed as a separate contract negotiation or one contract?

This will depend on the entity/group submitting the proposal. If it is the same entity/group, we will consider it one project with two different scopes. However, will be considered separately if, for example, the research groups are different but from the same university/department.

### 12. The submission form only allows selecting the AoI and doesn't allow for selecting specific applications within that AoI. Does this imply that in the submission you must address all applications within the AoI?

A submission under the AoIs can address any of the specific applications, it doesn't have to address all the applications at once.

### 13. It is very unlikely to be able to provide a sensor that would cover all the parameters on the priority list. Is there an interest in sensors for two or three key parameters (for water analysis), or do solutions need to address the whole list?

Yes, the solutions can initially focus on limited parameters and are not required to address all the parameters described in the Challenge Appendix at once. However, there should be a development path for achieving the challenge themes for the specific AoI.

### 14. Are you looking for an instrument that does not exist?

Rio Tinto is aware of a lot of the work that has been done in this space in the past, however, we have not yet found a satisfactory solution to the challenges we face. We are looking for new or improved solutions that fill some of the gaps we have identified.

### 15. Are you talking to DOW, GE and other large environmental companies?

We are working with major/large companies but the solutions we are looking for, to the best of our knowledge, are not available; thus, we opted for this R&D program. The challenge is open to all, and even large companies are encouraged to apply.

### 16. Would a sensor that only measures one parameter have less consideration over a sensor that is multiparameter?

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 and its potential to achieve the 'themes' requirements across the short and medium terms for the applicable AoI.

### 17. Has Rio Tinto run similar R&D crowdsourcing campaigns in the past? What was the outcome for Rio Tinto and for the technology companies who participated?

Yes, Rio Tinto has a number of R&D projects across different areas such as automation and robotics in mining, and selective recovery of metals from mining-influenced water (14 projects selected through Rio Tinto last year's challenge). Rio Tinto has also recently collaborated with BHP to develop solutions to improve tailings dewatering and management.

### 18. What scientific level of information is appropriate for the submission?

Please refer to the concept paper requirements in the submission guidelines.

### 19. Can we recommend a solution for a specific Rio Tinto property?

The solution should meet the criteria specified in the AoI and challenge theme requirements regardless of if it could be trialled in a specific Rio Tinto property.

### 20. Is it expected that there will be a requirement to support Rio Tinto integrate the solution to the existing tech architecture/system?

Depending on the maturity of the solution, integration may be required in higher TRLs. Relevant sites and operational access will be provided.

### 21. If a participant only covers the essential requirement (sensor), but not platform / telecom / analytics. Do you prefer submission by a partnership that covers as many fields as possible, or will you combine the sensor technology with other partners for the other fields?

If the solution meets the essential requirement (sensing), we encourage you to apply even without a partner in other fields. During the next stage, Rio Tinto could suggest partnerships between different applicants to develop a more comprehensive end-to-end solution.

### 22. Are the "high priority" challenge themes required to be met for the submission?

The requirements for the concept paper are detailed in the Appendix document in the Pioneer Portal. The focus is on high-priority themes, but we encourage submissions to consider other themes when preparing their submission for this challenge.

## SENSOR REQUIREMENTS

### 23. Does this project focus more on the novel sensing technologies or communication technologies?

The core aim of the challenge is sensing technologies, but we would like to consider how the data is processed. Therefore, we encourage you to submit any ideas that are meeting the AoI and challenge theme requirements.

### 24. For water monitoring, is the focus on produced water ponds, or does it include natural rivers, lakes and wetlands?

Rio Tinto measures water quality at different stages of the process, during the concentration process, in tailings ponds and when it is discharged to the environment, in creeks, seepage, surface water, ponds, lakes, wetlands etc. Detailed information about the target locations is available in the Appendix document on the Pioneer Portal.

### 25. Can you offer any information about where you want to accomplish BOD measurement, concentration ranges of interest, or other constraints?

BOD is a high-priority parameter measured in surface mining-influenced water and groundwater. Refer to the Appendix document on the Pioneer Portal for further details.

### 26. Are there any specific environmental constraints or requirements for water quality sensors?

The specific requirements for each AoI are described in the Appendix document on the Pioneer Portal. Such as the sensor should maintain integrity under variable environmental conditions e.g. resistance to extreme temperature ranged -50 to 90 °C. The wider range is applied due to the geographic diversity of Rio Tinto site locations.

### 27. How versatile should sensors be for metal and metalloid quantification? Should they be able to quantify most or all of the elements listed or would sensors that could successfully quantify a portion of the elements be considered?

Versatile sensing solutions should either measure several parameters in a single sensor or combine multiple sensors in a single system. Not all elements though need to be measured in a single sensor system.

### 28. What specific parameters are Rio Tinto interested in measuring?

A detailed summary of the measured parameters and their priority for all environmental sources (water, air, soil) and mineral & industrial residues is provided in the Appendix document on the Pioneer Portal.

### 29. Does the monitoring system have to include a metals sensor?

The challenge is not just bound to metal detection, but we are interested in other parameters too (e.g., PFAS, turbidity, conductivity, dissolved oxygen etc.)

### 30. What specific information can you provide on the water matrices (e.g. typical interferences) that sensors must cope with?

Sensors ideally need to be resistant to/ maintain integrity under variable environmental conditions (e.g., resistance to extreme pH (2 to 13) and temperature (-50 to 90 °C))

### 31. What are the anticipated (desired) detection limits for metal ions in water?

The detection limit guidelines for each source are described in the Appendix document on the Pioneer Portal. For example, the notional requirement for metals, metalloids and anions/cations is 0.001 g/L in water sources.

### 32. Are there any specific requirements in terms of accuracy and precision?

All the specific requirements are described in the Appendix document on the Pioneer Portal. For instance, direct measurement sensors that maintain accuracy regardless of environmental interference are of interest.

### 33. What type of solutions Rio Tinto is seeking? Are you just focused on the sensors (hardware) or even considering the software?

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:

1. Sensor (detection device)
2. Sensing platform

3. Telecommunications
4. Analytical software

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.

### 34. Would Rio Tinto be interested in monitoring snow in order to calculate how much water is "stored" in the mountains?

This would be considered in the 'yellow' parameters to be measured (See Appendix document in Pioneer Portal), i.e. low priority, nice to have.

### 35. Do the requirements for step-change improvements of sensors apply to satellite data? Are data processing enhancements considered in-lieu of hardware improvements?

Yes. However, if the technology solution is already developed and commercially applied, it is out of the scope of this challenge. Data processing enhancement should be a step change compared to the existing capabilities.

### 36. Can you elaborate on why you need 10x detection limits for water testing compared to standard tests? Is it technologically/economically feasible?

This is the first target as a leading indicator of whether the technology could have an improvement trajectory (shows promise) towards the detection limits used for regulatory reporting purposes (with the aim to replace these in the future).

### 37. What are the size constraints and what level of permanence of installation is being imaged for the finished solution?

No specific size is considered. The solutions should meet the challenge themes in the appendix (e.g. versatile).

### 38. Are data-driven weather models (like Bom's BARRA model) sufficient for rain, temp, and wind measurements or is on-site sampling required?

Currently, available technologies are out of the scope of this challenge unless a step changes to meet the AoI's criteria as per the challenge appendix document on the Pioneer Portal.

### 39. On large bodies of water is static measurement required, or measurements in multiple locations? What depths and parameters are measured?

Refer to the Appendix challenge document in the Pioneer Portal (e.g. for ponds, dams, natural and pit lakes). Typically, measurements are required in different locations of the water body, with measurements taken at multiple depths in each location. The use of manned or unmanned floating devices could be explored.

### 40. The challenge states that currently available, off the shelf monitoring will not be considered e.g., pH, conductivity etc, yet these have high priority in the Appendix document. What about completely novel measurements e.g., bio toxicity?

To be considered for this challenge, sensing solutions need to meet the criteria indicated in the challenge themes. To the best of our knowledge, off-the-shelf sensors for pH, conductivity do not necessarily meet such criteria. However, if there are, the applicant could propose an integrated mix of off-the-shelf sensing capabilities with emerging ones to meet the criteria (e.g. versatile).

### 41. For the water AoI, you have specific parameters that you are trying to measure. Do they need to be currently accepted regulatory measurements or require regulatory approval? Are any for internal process control?

The parameters that are to be measured in-situ and remotely for the specific applications are detailed in the Appendix document on the Pioneer Portal.

Given the importance placed on regulatory-driven monitoring, it is crucial that Rio Tinto identifies and uses sensors that provide the relevant regulatory authorities with confidence that the data provided is accurate. It could be expected that a regulator may require periodic sampling to be undertaken to confirm the sensor technology results in a verification step.

## TECHNOLOGY READINESS LEVEL (TRL)

### 42. Can you please elaborate further on the TRL levels desired?

We are looking for technologies that fit TRL levels from TRL 3 through to TRL 9 (refer to document 'Submission Guidelines' for TRL definitions).

The project should not include more than two stages of development. The stages are:

- 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.

## CURRENT SENSING METHODOLOGY

### 43. Can you describe current methodologies and technologies used for these measurements across Rio Tinto sites?

Most of Rio Tinto's 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.

### 44. Do you have a vision for the end goal in terms of an operational concept?

After the R&D phase, the solution will be presented to the Rio Tinto operations globally. The ultimate aim is to embed these sensors into the operations and closed sites.

## CURRENT CHALLENGES

### 45. What are the current challenges of using these methods and technologies?

Ensuring a safe and healthy work environment for our people is a top priority and through this project, we hope to eliminate some of the health and safety risks. Many of the risks (e.g., thermal stress, musculoskeletal disorders etc) can be effectively mitigated by eliminating the need to travel remotely to take samples and maintain or calibrate sampling equipment, and are, therefore, a key driver behind reducing the amount of manual sampling.

### 46. What's the major challenge/hurdle Rio Tinto is aimed to solve by this R&D project?

The R&D project aims to reduce the cost of long-term monitoring and risks for remote workers collecting samples. Gathering more data will also allow us to be proactive in the way we manage our environment and minimise any risk.

### 47. Is the challenge more inclined towards legacy assets or closed assets?

Most of Rio Tinto's assets, whether operational or legacy/closed sites, will have some form of environmental monitoring of mine-influenced water (MIW), air, soil and sediment. Thus, the challenge will be applicable for all type of assets.

### 48. Will Rio Tinto provide relevant data?

Yes, we will provide relevant data wherever required or necessary.

## SUBMISSION TEMPLATE

### 49. Where to find a template for the application or other relevant documents?

The concept paper template can be found in the submissions guidelines document provided on the Pioneer Portal. The documentation on the portal contains the following information:

- Submission guidelines: concept paper template, submission guidelines and TRL definitions
- Appendix: specific in-situ and remote sensing AoIs, parameters measures, the limit of detections etc.
- Brief: explaining what Rio Tinto is looking and not looking in a solution and other solutions requirements, and campaign timeline

## COLLABORATION, FUNDING, PUBLICATION

### 50. Do we need to collaborate with an academic partner?

This is not a requirement, but we encourage consortiums from research and industry, and if needed, we can help link organisations that we think are a good match.

### 51. We have a research centre with the customer platform to commercialize the technology but the IP is owned by the research centre. Should the research centre submit the paper on its own?

The research centre should submit a proposal, but as part of their parent organisation and not a separate entity.

**52. Is the funding provided for the demonstration or directly into R&D?**

The funding will depend on the type of solution proposed. It could be a development that includes a prototype or field demonstration, or it is fully developed but used in different industries therefore requires an upgrade to be used in the mining sector. Typically, the R&D will be focused on trialling with some development or improvements.

**53. We have a data/sensor platform with embedded analytics, AI and visualisation. It is in use in the water sector where we use it with 3rd party sensors to identify pollutants and predict harmful bacteria. Therefore we are sensor agnostic. Can we submit or will we need to partner with an innovative sensor provider?**

Yes, the analytical platform could be submitted without partnering with the sensor provider if meeting the challenge requirements mentioned in the Brief document on the Pioneer Portal. If there is integration development we will investigate it, this is a part of the challenge. If it is only providing visualisations, then it will not be considered.

**54. Given the timeline, can we propose collaborators in the first stage that are not yet secured?**

The collaborators need to be identified when submitting the proposal in stage 1.

**55. How do we identify potential collaboration partners who are applying to this programme and for whom we have an enabling technology?**

After Stage 1 submissions, if we see synergies between technologies in meeting the challenges, we'd be happy to make the connection. We would do this on a case-by-case basis and of course, the decision to pursue any collaboration would be up to each of the parties involved.

**56. If a company holds all the knowledge and has a solution to analyse and communicate. Do they still have to collaborate?**

We encourage collaboration between 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). If the company brings an integrated end-to-end solution, then collaborating with others could make less sense.

**57. Does Rio Tinto already collaborate with big firms or research organisations e.g. CSIRO?**

Rio Tinto hasn't collaborated with any organisation at this stage on this challenge. The challenge is open to all, and we are considering applications from all organisations/companies/researchers etc.

### 58. The challenge brief states that "Large private organisations or teams composed of multiple organisations are encouraged to contribute at least 20% of the total project cost", is this mandatory? If we do not have such a contribution will our application be considered?

Any contribution from the applicant will be regarded positively during the evaluation when identifying the cost contributions required from Rio Tinto. A 20% threshold is not mandatory. If there is a suitable solution that meets the criteria, we encourage you to apply.

### 59. What percentage of stage 2 full proposals would Rio Tinto expect to fund?

Rio Tinto doesn't have a specific percentage of proposals that will be successful at this stage as it depends on the amount of funding required by each proposal. We look to fund as many relevant solutions as possible.

### 60. Will there be opportunities for the research generated to be shared publicly?

Publishing rights are reviewed on a case-by-case basis. Usually, relevant publications of the project funded by Rio Tinto will be reviewed by Rio Tinto before publishing to ensure no confidential information is disclosed or prevents the patentability of any subject invention derived from the research.

## SUBMISSION ASSESSMENT

### 61. Who will review my submission and how long will it take?

The applications will be reviewed by an expert panel consisting of subject matter experts across the organisation and within Isle Utilities. Isle supports us with the review process and facilitates the enhanced development and adoption of the new solutions. However, the final decision will be made by Rio Tinto.

### 62. What are the assessment scoring criteria for submissions and are they available?

The assessment of the submissions will be based on the goals and challenge theme priorities established for each AoI in the Appendix document, together with how the solution compares to qualified sensors or analytical methods.

Refer to the Challenge Brief document on the Pioneer Portal for further details on specific assessment criteria.

### 63. Can you give insight into the expected statistics? How many applications do you expect? How many do you expect to be selected for Stage 2?

We don't have specific statistics at this point. Last year, during the mine water treatment challenge, we received over 75 concept papers, from which we encouraged 25 applicants to submit a full proposal. We selected 14 projects for further negotiations, with each project requiring US$250k to US$2M cash contribution from Rio Tinto.

## IMPLEMENTATION

### 64. Where will the solution/sensor be implemented?

The project location will be identified at a later stage. The location for a pilot project will depend on the technology you have and the AoI you are targeting, and that could be implemented at several sites.