



# PERUMIN hub

Comunidad  
de Innovadores

## **Guideline 2023 Scaling Innovations**

## PERUMIN Hub

PERUMIN Hub, the main open innovation program in the mining sector in Peru, seeks solutions to the great challenges of the mining sector through collaborative innovation. This program was born from the alliance between the Institute of Mining Engineers of Peru (IIMP) and the Mining Innovation Hub of Peru (Hub).

PERUMIN Hub has been structured in three stages:

1. **Challenges:** Through a collaborative and reflective process, which begins with the work of management and, combined with an organizational culture of innovation promoted within mining companies, has allowed the identification and characterization of the main challenges, making them available to different innovation groups for the search for solutions in community.
2. **Matchmaking:** in this stage, collaboration is actively promoted through linking spaces between innovators, as well as innovators and mining companies. This process is supported by two complementary spaces to the competition.
  - a. Matchmaking 1 (MM1): Through virtual sessions, we encourage the connection of participants so that they can submit, during the competition stage, more robust proposals as a result of collaborative/alliance work. The purpose of this space is to promote synergies that go beyond the competition stage.

In the evaluation process of the Contest stage, those proposals in collaboration/partnership, because of the MM1 or other process coordinated by the innovators, will be positively valued.

- b. Matchmaking 2 (MM2): Through a platform, potential problem solvers, prior to the competition, can optionally present a profile of their proposals to receive feedback from the internal teams of the mining companies. The goal is to connect them with potential users to adjust their proposals based on the comments received.

In the evaluation process of the competition stage, proposals that have generated greater expectations among the internal teams of the mining companies will be positively valued.

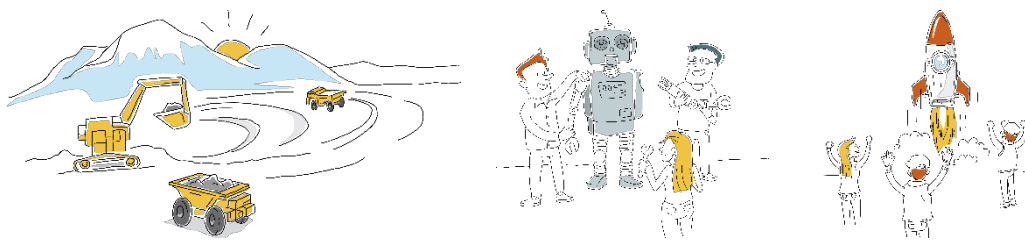
3. **Contest:** At this stage the innovators present their solutions in response to the challenges of mining companies. These guidelines consider the most relevant aspects for the fulfillment of the objective of this stage.

For more information about the PERUMIN Hub program and its stages visit our website <http://www.perumin.com/hub/en>.

## PERUMIN Hub: Contest

### 1. What are the objectives of the contest?

- ✓ Promote the development of innovative solutions that respond to specific challenges of the mining industry.
- ✓ Facilitate the consolidation of innovations through collaboration.
- ✓ Recognize successful innovations and promote their commercial take-off in the sector.



### 2. What are the challenges facing the mining industry?

The main challenges are grouped into 3 thematic areas and 10 challenges:

#### 2.1 Share Value

- How to generate value sharing through the use of data and evidence between mining companies and stakeholders?
- How to generate shared value through active stakeholder participation in territorial development?
- How to incorporate models that generate shared value in mine closure?

#### 2.2 Environment & Sustainability

- How to implement circular practices that allow for the valorization of resources and waste generated in the production process to reduce environmental impact and maximize efficiency and profitability?
- How to implement technologies in operations and in the supply chain that allow for carbon-neutral activity?
- How to facilitate the optimization of water use and reuse in mining operations?

#### 2.3 Mining 4.0

- How to improve productivity and efficiency in operations by taking advantage of 4.0 technologies and facilitating their adoption?
- How to improve the safety and health of workers through automation and digitalization?

- How to incorporate technologies that guarantee cybersecurity in mining companies in the face of the use of 4.0 technologies?
- How to incorporate technological innovations to optimize processes and reduce personnel risks during the exploration stage?

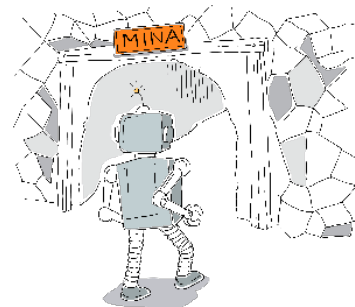
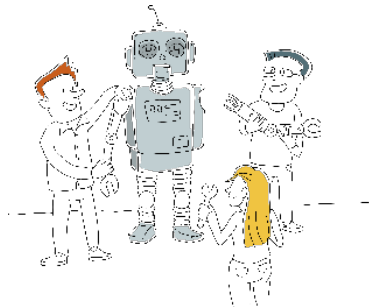
The technical details of each challenge can be found in Annex 1.

### 3. What kind of solutions does the competition seek?

We are looking for innovations with a certain degree of development/maturity according to the following categories:

#### 3.1 Category 1: Innovations to be validated

This category is aimed at preliminary innovative solutions that have already passed the conceptual validation phase and have a **prototype to be validated**<sup>1</sup>, as well as a validation plan that can be implemented for the first time in a mining company. The solutions presented in this category must respond in a timely manner to one or more of the challenges prioritized in this third edition.

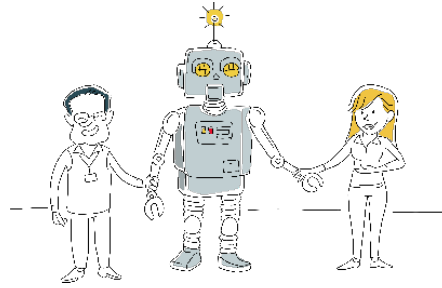


#### 3.2 Category 2: Successful innovations

This category is aimed at **innovative solutions** that have already been **tested and validated**<sup>2</sup> in the field (mining companies or centers that simulate real conditions), peruvian or from another country, with satisfactory results obtained **in recent years (2020-2023)**. Innovations submitted in this category should only be framed within one of the thematic areas presented above: i) Environment and Sustainability, ii) Share Value, y iii) Mining 4.0.

<sup>1</sup> As a reference this category is aligned to TRL4 and TRL5, proposals in idea stage (TRL1 to TRL3) will not be accepted. For more details: <http://vinculate.concytec.gob.pe/niveles-demadurez/>

<sup>2</sup> As a reference this category is aligned to TRL6 and TRL9. For more details: <http://vinculate.concytec.gob.pe/niveles-demadurez/>.



### 3.3 Category 3: Innovative collaborative model

This category is aimed at innovative solutions where, regardless of the technological tools that can be used (it is not a requirement), the work model and the potential impact beyond the mine through the generation of shared value are the focus. The model may be in a phase to be validated or validated in the mining sector or other sectors or industries.



## 4. Who can apply?

### 4.1 Category 1: Innovations to be validated

Participation in category 1 is divided into 3 subcategories:

- a) **Domestic companies:** companies headquartered in Peru<sup>3</sup>.
- b) **International companies:** companies headquartered outside Peru.
- c) **R&D Entities<sup>4</sup>:** universities, research centers or institutes based in Peru, represented by a recognized unit in their organizational structure such as Schools, Faculty, Laboratory, Research Office, Research Group, Incubators, among others.

In the three subcategories, the application can be made individually or in collaboration with companies and/or R&D entities<sup>4</sup> national or international.

### 4.2 Category 2: Successful innovations

Participation in category 1 is divided into 2 subcategories:

<sup>3</sup> It includes the companies provided for in Decree Law No. 21621, Law of the Individual Limited Liability Company (E.I.R.L.); the corporate forms provided for in Law No. 26887, General Law of Corporations, such as S.A., S.A.A.A., S.A.C., S.R.L., Sociedad Civil, Sociedad Civil Ordinaria, S. Civil de R.L. as well as branches in Peru of a foreign company in accordance with article 403 of the General Law of Corporations.

<sup>4</sup> Universities, research centers or institutes.

- a) **Domestic companies:** companies headquartered in Peru<sup>3</sup>.
- b) **International companies:** companies headquartered outside Peru.

In both subcategories, applications can be made individually or in collaboration with national or international companies and/or R&D entities<sup>4</sup>.

### 4.3 Category 3: Innovative collaborative models

Companies, R&D entities<sup>4</sup>, and associations or NGOs may participate. However, in the case of international entities (without headquarters in Peru), they must have a Peruvian partner who will be in charge of leading the application.

## 5. How to apply for the contest?



To apply, the proposal must be submitted through the following link <http://bit.ly/peruminhub-concurso> completing all the items of the proposed form, according to the schedule detailed in section 8.

## 6. What are the contest requirements?

- 6.1 Letter of Presentation (Annex 2):** Must be signed by an authority of the applicant entity. Applies to all 3 categories.
- 6.2 Letter of alliance (Annex 3):** Must be signed by an authority of the allied entity(ies). Applies to all 3 categories for proposals that involve more than one organization.
- 6.3 Field validation document (Free format):** Must be signed by an authority of the organization or company where the field validation has been performed. Applies to Category 2, successful innovations; and Category 3 in case the model has been validated.

The required document is free format and should only contain explicitly the following information:

- Name of the organization or company where the field validation was performed.
- Name of the entity/company applying.
- Name of the project and/or technology to be validated.
- Favorable validation results.
- Validation end date (month and year).

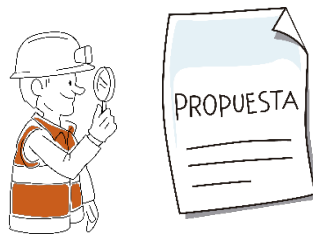
### 6.4 Considerations/Restrictions

- In all three categories, finalist/winner companies from the PERUMIN

Hub 2021 or 2022 edition cannot participate with the same solution they were selected for. However, they can participate with another solution or the same one only if they have changed categories from "to be validated" to "successful/validated innovations."

- If the proposal is developed by more than one entity, the one that developed the technology must lead the application.
- For the selection of the best solution per category, in addition to the technical evaluation, it will be considered that the solution is not a winner of another PERUMIN 36 program such as Foro TIS or PERUMIN Inspira. In this case, one of the awards will be prioritized.

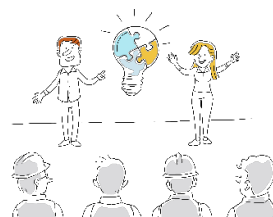
## 7. How will the evaluation and selection be carried out?



The evaluation process will be carried out in three stages:

**7.1 Technical evaluation:** at this stage all solutions will be evaluated by experts in the technologies or subject matter to be qualified, through PERUMIN Hub allies. This evaluation will pre-select the innovations that will go to a second stage of evaluation at the user level.

**7.2 User-level evaluation:** the innovative solutions must respond to the specific needs of the mining companies, which, through their representatives, will be responsible for selecting the finalists. For this purpose, the solvers that have passed the technical evaluation will have to present their solutions clearly, precisely and dynamically at the scheduled Demo Days.



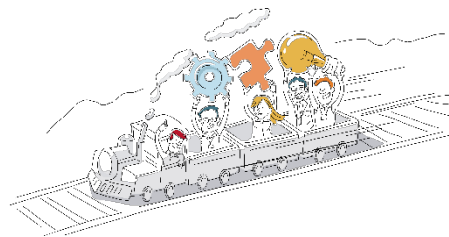
At these Demo Days, mining companies will know at first-hand the solutions that the community of innovators has developed, selecting 15 finalists who will be able to present their proposals at the PERUMIN

36 Mining Convention. The selection of finalists will be subject to the passing grade by the evaluators, but the following distribution will be used as a guideline:

	Environment & Sustainability	Share Value	Mining 4.0	Total
Category 1: Innovations to be validated	3 finalists per subcategory: national companies, international companies, and R&D entities.			9
Category 2: Successful innovations	2 finalists per subcategory: national companies and international companies			4
Category 3: Innovative collaborative models	2 finalists.			2
<b>Total</b>				<b>15</b>

**7.3** The exhibition, final evaluation and announcement of best solutions will take place during the week of September 25-29 at the PERUMIN 36 Mining Convention.

**7.4** PERUMIN Hub will cover round-trip tickets within Peruvian territory with the final destination being the city of Arequipa, as well as the accommodation for 1 representative per finalist entity according to **presentation dates**<sup>5</sup>. Additionally, the entry fee to the PERUMIN 36 Mining Convention will be financed for 2 representatives per finalist entity.<sup>6</sup>



All evaluation stages will consider the following criteria, according to category:

Category 1: Innovations to be validated

Criteria	Description	Weight
Importance	The solution is relevant, pertinent and of clear benefits in response to the challenge.	25%

<sup>5</sup> Flight schedules and lodging locations will be determined by PERUMIN Hub, any modification or change will be at the expense of the participants. Likewise, the distribution of accommodation could be in double rooms.

<sup>6</sup> In the case of the second representative, flight and accommodation expenses are not included.



Criteria	Description	Weight
Innovation	The solution is novel and innovative with respect to the local and/or international market, in relation to the challenge. It will be considered positive to have registered intellectual property.	25%
Feasibility	The proposed implementation plan is feasible and consistent with the expected results.	30%
Sustainable Development	The solution has social and/or developmental impact linked to the Sustainable Development Goals (SDGs)	10%
Collaboration	The solution is the result of a collaborative strategy between two or more entities.	5%
Expectation	The solution has generated interest among potential users. The number of "The solution is innovative" will be taken as a reference, because of the feedback from the mining companies in "Matchmaking 2"	5%

### Category 2: Successful innovations

Criteria	Description	Weight
Importance	The innovation presented is relevant and of clear benefits in relation to the subject area and the Peruvian mining industry.	30%
Innovation	The solution is novel and innovative with respect to the local and/or international market. It will be considered positive to have registered intellectual property.	20%
Scalability	Innovation has a high potential for adaptation and expansion in the market.	35%
Sustainable Development	The solution has social and/or developmental impact linked to the Sustainable Development Goals (SDGs).	10%
Expectation	The solution has generated interest among potential users. The number of "The solution is innovative" will be taken as a reference, as a result of the feedback from the mining companies in "Matchmaking 2"	5%

### Category 3: Innovative collaborative models

Criteria	Description	Weight
Importance	The innovative collaborative model presented is relevant and of clear benefits in relation to the challenge and the main actors involved.	30%
Innovation	The model is new and innovative in the sector.	15%
Feasibility	The proposed implementation plan is feasible and consistent with the expected results.	30%
Sustainable Development	The solution has social and/or developmental impact linked to the Sustainable Development Goals (SDGs).	20%
Expectation	The solution has generated interest among potential users. The number of "The solution is innovative" will be taken as a reference, as a result of the feedback from the mining companies in "Matchmaking 2".	5%

## 8. Schedule

Activity	Date
Matchmaking 1	March 14 to 30, 2023
Matchmaking 2	April 5 to 24, 2023
Start of applications - Contest	Thursday, May 11, 2023
Closing date for applications - Contest	Monday, June 12, 2023, at 23:59 hours (UTC-5)
Announcement of pre-selected and schedule of presentations	July 10 to 14, 2023
Demo Days	August 10 to 14, 2023
Publication of finalists	August 14 to 18, 2023
PERUMIN 36th Mining Convention	September 25 to 29, 2023

## 9. Consultations

If you have additional questions, please do not hesitate to contact us by email at [peruminhub@iimp.org.pe](mailto:peruminhub@iimp.org.pe) or visit our website <http://www.perumin.com/hub/en>.

## 10. General Provisions

- 10.1** PERUMIN Hub reserves the right to disqualify participants if it detects proposals with false information, that violate intellectual property or that fail to comply with the requirements and/or provisions at any stage of the program.
- 10.2** PERUMIN Hub has exclusive authority to interpret the scope of the provisions contained in these Guideline.
- 10.3** PERUMIN Hub is committed to non-disclosure or share sensitive information regarding the project without the prior knowledge and consent of the participant. In the case of evaluators, confidentiality agreements will be used.
- 10.4** PERUMIN Hub will not participate in or be responsible for the agreements made by the participating entities in the processes of collaboration, alliances or others. The actions taken, in a potential implementation of the proposed solutions, will be in agreement with the parties involved, escaping the scope of this Contest.

## Annex 1. Characterization of thematic areas and challenges

The challenges are grouped into 3 thematic areas and 10 key challenges<sup>7</sup>:

### 1.1 Share Value



The mining sector is committed to improving its levels of competitiveness through increasingly efficient, sustainable, and respectful operations in the territories where they operate. Likewise, mining companies recognize that this improvement requires the active participation and incorporation of all actors involved in the value chain, including the surrounding communities.

In this sense, the development and well-being of the actors involved in the mining value chain have an impact on the development and competitiveness of the sector. To achieve this, elements and strategies are required that generate favorable conditions and capacities, thus achieving a virtuous circle.

#### **Challenge 1: How to generate value sharing through the use of data and evidence between mining companies and stakeholders?**

The generation of accurate information is one of the pillars for proper evidence-based decision-making, making it possible to develop alternatives to traditional solutions and/or visualize the results achieved. Therefore, this decision-making process involves the development of solutions focused on: (1) Implementing initiatives that generate value sharing; and (2) Visualizing results for proper decision-making in the future.

#### **Elements of value:**

Mining companies are looking for technologies that consider one or more elements of value in their proposal:

- Incorporation of real-time information collection practices.
- Communicational solutions and/or strategies or others that share the collected results to be disseminated within and outside the mining company.
- Innovations in the field of communication or others that stimulate close and permanent interaction between stakeholders and the mining company.

<sup>7</sup> The prioritization and characterization of the challenges were made possible thanks to Alpayana, Anglo American Quellaveco, Compañía De Minas Buenaventura, Compañía Minera Antamina, Compañía Minera Antapaccay, Compañía Minera Apumayo, Compañía Minera Poderosa, Compañía Minera San Ignacio de Morococha, Gold Fields La Cima, Minera Bateas, Minera Chinalco Perú, MINSUR, Nexa Resources Perú, Sierra Metals, Sociedad Minera Cerro Verde y Southern Peaks Mining.

- Solutions that allow for the permanent reaffirmation and feeding of trust between stakeholders (local suppliers, community, state) and the mining company.
- Innovations that facilitate the involvement of stakeholders (communal companies/local actors) in land use planning as well as in the generation of business models.
- Innovations that contribute to the clarity and understanding of the roles of actors (government and company). The attribute of data transparency to facilitate decision-making is valued.
- Solutions that promote greater learning and interest about the mining sector.

### **Challenge 2: How to generate shared value through active stakeholder participation in territorial development?**

There is a consensus among mining companies, communities, and state actors in the search for territorial development and well-being of communities. To achieve this, mechanisms are sought that allow for solid relationships of trust and transparency to share needs and expectations among the involved actors.

#### **Elements of value:**

Mining companies are looking for technologies that consider one or more elements of value in their proposal:

- Innovations that contribute to the generation of consensus in areas of potential and improvement for territorial development.
- Solutions that help identify economic-productive potential in the territory for implementation (tourism, agribusiness, among others).
- Models that bring the community and the company closer to the development of new businesses, beyond the traditional ones. Consider current and future capacities in local actors.
- Innovations that contribute to managing expectations with communities and commitments assumed between actors.
- Sustainable solutions (environmental and social) that allow for better coexistence in the territory.
- Strategies and/or technologies that promote the well-being of actors and the shared use of facilities; through improvements in road communication and the use of energy, among others.
- Innovations that contribute to the progressive incorporation of women in the mining value chain.
- Nature-based solutions, as well as the revaluation of ancestral solutions to be incorporated into joint territorial development plans.
- Opportunity to adopt experiences from other countries considering the ecosystem's own context.

### **Challenge 3: How to incorporate models that generate shared value in mine closure?**

Mining operations, upon completion, must restore the environment almost

as it was before. The recovery of vegetation and/or geochemical stabilization in tailings deposit areas is slow, and there is a high dependence on communities around the mine for closure success. In addition to the environmental and area recovery focus, today it is unthinkable not to include adding value to the community in the closure strategy. Prior to the removal of facilities, it is verified whether the community will need any of them. One must think of the best uses for these facilities to generate new activities. It is no longer possible to think of closure at the end of the operation's life cycle, but rather closure plans must be associated with the mine's life (LOM - life of mine) and be progressive so that the data generation instruments implemented can project the influence of mine closure on the environment and consider the long term.

### **Elements of value:**

Mining companies are looking for technologies that consider one or more elements of value in their proposal:

- Community involvement (communal companies/local actors) in land use planning, as well as in the generation of competitive business models and economic activity development. The approach of providing post-closure/sustainable closure/social closure value to communities is valued.
- Solutions that consider the visual impact.
- Solutions for temporary/progressive/final/post-closure.
- Solutions that consider the impacts that closed mines are having.
- Opportunity to adopt experiences from other countries considering the ecosystem's own context (climate: abundant rain, paramos, etc.).
- Water digitization: information technologies that put open data in value in a transparent way with a focus on generating trust.
- Nature-based solutions, as well as the revaluation of ancestral solutions such as wetlands, among others.
- Solutions that consider the possibility of carbon compensation in closure components and opportunities for carbon absorption in closure components.
- Solutions that allow defining and delimiting parameters with authorities that certify successful closure.
- Innovative post-closure solutions regarding land transfer, return with the same or higher economic value. Different aspects such as areas, stability, risks, limitations, among others, must be considered.
- Solutions that consider the safety of tailings dams according to current standards.
- Opportunities for the use of land/surface for energy generation (photovoltaic, wind turbines, others).

## 1.2 Environment & Sustainability



The main challenge of the expansion of mining activity lies in the level of sustainability that can be achieved. This is essentially based on the efficient use of natural resources, as well as its environmental footprint.

ESG criteria, which refer to environmental, social, and corporate governance factors, are positioning themselves in 2023 as the greatest risk and opportunity facing the mining industry.

Topics such as water management, closures and rehabilitation, remain a significant challenge for the sector.

### **Challenge 1: How to implement circular practices that allow for the valorization of resources and waste generated in the production process to reduce environmental impact and maximize efficiency and profitability?**

The circular economy has become an increasingly popular trend to address the environmental and economic challenges of today's world. Instead of following a linear model of production and consumption, circularity proposes closing the life cycle of materials and resources, keeping them in use for as long as possible and minimizing waste and pollution. The implementation of circular practices can bring significant environmental, social, and economic benefits, and in this sense, the challenge arises of how to valorize resources and waste generated in the production process to reduce environmental impact and maximize efficiency and profitability. This challenge is particularly relevant in the context of mining in Peru, where extractive activity is an important part of the economy but also has a significant impact on the environment and local communities.

#### **Elements of value:**

Mining companies are looking for technologies that consider one or more elements of value in their proposal:

- Solutions focused on the valorization of effluent water in the influence zone.
- Solutions that decrease or partially or totally replace the use of lime in metallurgical and water treatment processes.
- Technologies that extend the life use of critical inputs: mill steel balls, tires, equipment oil, etc.
- Use of non-contact water (which has not been touched by the metallurgical mining process, for example, rainwater).
- Alternatives for injecting water into the aquifer in times of excess rainfall.
- Revalorization of rejection water (water that contains salts, filtered from the treatment plant), without causing pipe scaling.
- Solutions focused on the recovery of remaining mineral grades.

- Solutions focused on the revalorization of tailings with non-metallic mineral concentration (pyrite, carbonates, silicates, etc.).
- Revalorization of organic waste for energy generation or contribution to agriculture or other activities.
- Revalorization of sludge by acid water treatment.

### **Challenge 2: How to implement technologies in operations and in the supply chain that allow for carbon-neutral activity?**

Mining is a key sector in the global agenda for sustainable development and climate change, not only through its role as a supplier of minerals and metals, essential inputs for the generation of clean technologies, but also as a change agent capable of incorporating new technologies that reduce carbon footprint and/or generate positive footprint, allowing for carbon-neutral activity.

Some energy alternatives that are being developed include wind, solar, and biodiesel energy, while green hydrogen is also being considered as one of the pillars in the energy transition. However, viable economic/technical alternatives for reducing carbon footprint are still needed.

#### **Elements of value:**

Mining companies are looking for technologies that consider one or more elements of value in their proposal:

- Technologies that not only reduce carbon footprint but are cost-efficient (considering energy storage, access to the mining area, as well as environmental conditions).
- Long-term focus including alternatives for the use of rehabilitated areas and considering a reduction in energy costs in post-closure activities.
- Consider improvement processes in the proper management of energy and the reduction of carbon footprint, such as those related to ISO 50001, in the solution.
- Consider efficient measurement or quantification of carbon footprint as a key element for measuring improvement and generating a positive impact on the sector's reputation.
- Synergy with other sectors or projects (e.g. reforestation, reduction of the impact of illegal mining), as well as solutions that consider the value chain (focus on suppliers).
- Solutions that prioritize the use of alternative energies.
- Solutions that include financial aspects as a value proposition (carbon credits, green bonds, others).

### **Challenge 3: How to facilitate the optimization of water use and reuse in mining operations?**

Sustainable Development Goal 6 (Ensure availability and sustainable management of water and sanitation for all) has as one of its targets to

substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.

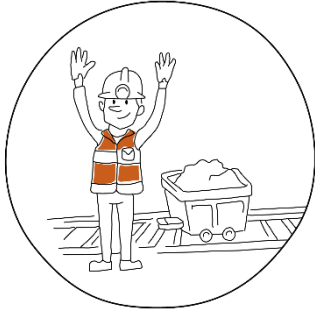
### **Elements of value:**

Mining companies are looking for technologies that consider one or more elements of value in their proposal:

- Solutions focused on reducing consumption and losses (such as water evaporation). New technologies that do not require replenishing water or new hydrometallurgical processes that avoid water losses (losses due to evaporation/filtration) are valued.
- Technologies that allow for measuring: i) water use, ii) water losses due to evaporation, filtration, and/or retention in tailings, iii) variables of quantity and quality based on the supply watersheds.
- Circular economy-focused solutions that maximize the number of times water remains in the circuit, reusing it and admitting other types of water, such as groundwater.
- Incorporating a water balance diagnostic approach with a watershed focus and climate change projection.
- Aligned with Peruvian regulations that facilitate/enabling joint work with ANA.
- Ensuring water quality during discharge and post-operations in a sustainable manner.
- Taking advantage of different water sources, being efficient in water collection, and/or making use of undervalued sources.
- Having a multisectoral vision, including, for example, the energy and/or agricultural and/or territorial sectors (not only the mine but also the water sources and direct and indirect influence areas).
- Solutions that incorporate the diagnosis/measurement of the natural source (natural excesses in water quality) that validate initial conditions and facilitate exception parameter permits.
- Solutions that facilitate the use of treated water before returning to the watershed and are self-sustainable.
- Solutions focused on avoiding perpetual treatment.
- Technologies related to better tailings management to reduce water footprint.
- Solutions focused on the energy efficiency of pumping equipment.
- Solutions for treating sulfate and acidic water.



### 1.3 Mining 4.0



The fourth industrial revolution is already an unavoidable challenge in the mining sector, and the current situation makes it even more urgent. Technologies such as the Internet of Things, Artificial Intelligence, virtual reality, robotics, Cloud, Big Data, cybersecurity, 3D printing, among others; are applicable to each stage of the mining business, from exploration to mine closure. Their applicability not only increases productivity, but also contributes to better environmental and social performance.

#### **Challenge 1: How to improve productivity and efficiency in operations by taking advantage of 4.0 technologies and facilitating their adoption?**

Increased productivity, reduced times and costs in operations, and increased recovery in plant processes are expected results that enable an opportunity for process automation, sensor development, use of AI, among other 4.0 technologies. To achieve this, critical processes or elements for implementation must be identified. Furthermore, to maximize the benefit, it is essential to manage the process of adaptation, adoption, and utilization by employees.

#### **Elements of value:**

Mining companies are looking for technologies that consider one or more elements of value in their proposal:

- Solutions that consider not only the implementation of technology but its integration with others for the maximization of value. Integration and optimization in the use of hardware are also valued, reducing infrastructure and maintenance costs, among others.
- Solutions that consolidate automation processes, 3.0 technology as the basis for the jump to 4.0.
- Utilization of data (existence of extensive data with differences in formats) such as observations of sensor failures, bearing failures, etc. It would be valuable to have models that help in data processing and observation, reducing time in information analysis for decision-making.
- Cost-efficient solutions that consider data capture, transmission, and use for interoperability.
- Technologies that take up the basic principles of the mining cycle and its unit operations.
- Solutions that facilitate autonomy in the plant.
- Adaptation to operational conditions in mines in Peru (geography, climate, value chain, etc.), which consider the limitations of connectivity infrastructure in the mine and enabling instrumentation; instruments, tools,

sensors that resist corrosive environments, high temperatures, spaces that make connection and real-time transmission difficult.

- Solutions that include virtual instrumentation (without physical equipment). There is a trend in the development of virtual sensors that reduce costs, allow for faster massification, as well as predictive control developments.
- Simplicity in the use of technologies that facilitate change management considering the digital gap of potential operators, employees, and/or decision-makers.
- Solutions that incorporate the cultural aspect: i) training and ii) mindset and that include management models that articulate enabling instruments and culture, for worker empowerment, socialization, and technology adoption, even involving suppliers.
- Solutions that include measures that ensure cybersecurity.
- Solutions that adapt to company cybersecurity policies.
- Solutions that incorporate measurements that allow for clear benefits; with adequate report and indicator management.
- Technologies accessible to small and medium-sized companies with a focus on integrating with local suppliers. Self-financing in the implementation of solutions.
- Solutions that integrate 4.0 technologies throughout the value chain: mining production, plant, ports, among others; generating efficiency in processes. Likewise, those that involve suppliers in the value chain are valued.
- Solutions that include literacy components in use and concepts related to 4.0 technologies. Solutions that reduce digital knowledge gaps are valued.

## **Challenge 2: How to improve the safety and health of workers through automation and digitalization?**

Mining activities require a continuous effort to protect workers in order to minimize the risk of accidents and enable them to perform their work safely and in optimal health conditions. Occupational safety and health is a cross-cutting concern that begins with shift changes.

### **Elements of value:**

Mining companies are looking for technologies that consider one or more elements of value in their proposal:

- Solutions that introduce a paradigm shift for workers regarding the benefits of using technological solutions for their safety, as well as the simplicity of use.
- Solutions that maximize the impact of personnel training.
- Solutions that combine analysis of worker behavior, predicting fatigue and detecting anomalous situations, in order to facilitate pattern identification for accident prediction and achieve more effective prevention.
- Solutions that not only include prevention but also prediction, through the identification of patterns in worker behavior, such as habits, sleep, health, among others, for the prediction of occupational accidents.

- Technologies that reduce exposure to high-risk jobs, as well as those with a higher incidence of accidents. Potential for automating/digitalizing/remotizing procedures.
- Solutions that facilitate the identification of patterns for accident prediction. Analysis of worker behavior, such as habits, sleep, health, among others.
- Solutions that include monitoring of worker health.
- Solutions that not only consider the implementation of technology but also its integration with others for value maximization.
- Opportunities in the application of advanced analytics models (extensive data but with different formats). Utilization of national and international data for analysis and decision-making is valued.
- Technologies accessible to small and medium-sized companies with a focus on integrating with local suppliers.
- Adaptation to operational conditions in mines in Peru (geography, climate, value chain, etc.).
- Technologies that involve suppliers in the value chain.
- Technologies that rapidly and efficiently report occupational incidents.
- Solutions that provide real-time information are valued.
- Technologies for rapid alert and prevention of potential incidents.
- Technologies that reduce contact between vehicles.
- Solutions that predict fatigue in operators and personnel.
- Solutions that detect and alert to anomalous situations.
- Solutions that consider the effects of using new technologies and include actions to counteract effects such as employment impact.

### **Challenge 3: How to incorporate technologies that guarantee cybersecurity in mining companies in the face of the use of 4.0 technologies?**

Traditionally, security has focused on protecting people, a key actor in mining operations. However, due to digital transformation and the inclusion of Industry 4.0-based technologies, security requires a new approach that includes systems, data validation, and protection.

#### **Elements of value:**

Mining companies are looking for technologies that consider one or more elements of value in their proposal:

- Solutions that promote a culture of prevention in the handling and protection of data against cyber attacks, including data capture (phishing), through internal communication and a paradigm shift in workers towards the use of technological solutions.
- Solutions that consider not only attacks with a direct impact on operations but also attacks on the capture of sensitive organization data.
- Solutions must take into account the differences in variables, risks, and management between IT and OT convergence, as this generates new opportunities.

- More data is being collected, and this architecture is becoming more exposed. Solutions that incorporate preventive cybersecurity policies are required without hindering user management.
- Solutions that incorporate traceability of data and access.
- Cloud data management is seen as a trend. However, the exposure of systems in operations with continuous connection failures must be considered.
- Solutions that meet the security requirements established by ISO 27110 in conjunction with the Personal Data Protection Law that adapt in terms of outputs, network, and information transmission.
- Solutions that adapt to the security standards and policies of each mining company (outputs, network, information transmission).
- Consider remote work in information management.
- Solutions that incorporate analysis of gaps and/or weaknesses (for example, ethical hacking).
- Solutions that consider not only the implementation of technology but also its integration with others for value maximization.
- Technologies accessible to small and medium-sized enterprises with a focus on integration with local suppliers.
- Adaptation to operational conditions in mines in Peru (geography, climate, value chain, connectivity, etc.).
- Solutions that consider regulations such as the Personal Data Protection Law.

#### **Challenge 4: How to incorporate technological innovations to optimize processes and reduce personnel risks during the exploration stage?**

According to the Ministry of Energy and Mines in Peru, only 1 out of 100 mining exploration projects turn into a mine. The exploration stage involves a series of expenses that will only be compensated by the discovery of a mineral deposit that justifies the technical and economic development and operation of a mine. Additionally, it is considered a high-risk activity in terms of personnel safety.

#### **Elements of value:**

Mining companies are looking for technologies that consider one or more elements of value in their proposal:

- Solutions focused on the field sampling process during the prospecting stage. Consider the opportunity to sophisticate sampling equipment to reduce risk and complexity in its use.
- Solutions that reduce personnel contact with equipment during the drilling stage, considering the cost-benefit of an exploratory stage (small platforms).
- Solutions that reduce the risk of pipeline manipulation during the drilling stage.
- Monitoring of data, obtaining geotechnical information during drilling.

- Use of sensors on platforms to reduce personnel exposure in high altitude areas.
- Optimization of water resources during the exploration stage. Improve the estimated requirement, solutions that facilitate the reuse of the resource.
- Solutions that minimize the requirement for personnel, and therefore the security risk, in mechanisms such as induced geophysics.
- Utilization of data that facilitate pattern identification, through mechanisms such as machine learning, among others.
- Solutions that optimize regulatory processes, streamlining and simplifying them (potential for platforms that facilitate multi-actor analysis and work).

## Annex 2. Cover Letter

### Cover Letter<sup>8</sup>

Gentlemen  
PERUMIN Hub  
Present.

I, *(indicate first and last names)*  
.....  
*....., as (position within the institution I represent: legal representative,  
director or others as applicable)*  
..... of the  
*(indicate the name of the company/entity/department or whichever is  
applicable)* .....,  
am pleased to communicate my intention to participate in the PERUMIN Hub  
2023 open innovation program competition.

I declare that I am aware of the provisions of these terms and conditions and  
that all the information presented in the proposal of the institution/entity I  
represent is strictly in accordance with the truth.

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Name and Surname  
ID / Passport  
E-mail address  
Cell Phone

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<sup>8</sup> The letter may be signed digitally or physically. In the case of companies/NGOs/associations it must be signed by the legal representative and in the case of R&D entities by the highest authority of the instance/area/department being submitted.

## Annex 3. Letter of Collaboration

### Collaboration Commitment Letter<sup>9</sup>

Gentlemen  
PERUMIN Hub  
Present.

I, *(indicate first and last names)*  
.....  
*....., as (position within the institution you represent: legal representative,  
director or others as applicable)*  
..... of the  
*(indicate the name of the company/entity/department or the corresponding  
one)* ....., am  
pleased to communicate my commitment to collaborate, as a strategic partner,  
in the proposal *(indicate the name of the project submitted to the competition)*  
*....., submitted by (indicate name of the company/institution  
applying)* ..... in the framework of the PERUMIN Hub 2023  
open innovation program competition.

I declare that I am aware of the provisions of these terms and conditions as  
that all the information presented in the proposal, of which I am a part, is  
strictly in accordance with the truth.

---

Name and Surname  
ID / Passport  
E-mail address  
Cell Phone

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<sup>9</sup> The letter may be signed digitally or physically. In the case of companies/NGOs/associations it must be signed by the legal representative and in the case of R&D entities by the highest authority of the instance/area/department being submitted.