

Article about the Project (interview subjects part 1)

Call:	HORIZON-CL4-2022-RESILIENCE-01 (A DIGITISED, RESOURCE-EFFICIENT AND RESILIENT INDUSTRY 2022)
Topic:	HORIZON-CL4-2022-RESILIENCE-01-06
Type of Action:	HORIZON-IA
Proposal number:	101091885
Proposal acronym:	Mine.io
Type of Model Grant Agreement:	HORIZON Action Grant Budget-Based
Project title:	A Holistic Digital Mine 4.0 Ecosystem

The project is focused on proposing and developing a new Holistic Digitized Ecosystem of Mining Industry 4.0. Its aim is to propose a new organization of the extraction, processing and use of mineral resources.

This approach was forced by the changes brought about by the Fourth Industrial Revolution (Industry 4.0) and the introduction of Internet of Things (IoT), Artificial Intelligence (AI), Big Data, Machine-to-Machine communication (M2M) and cloud computing.

These technologies are forcing significant changes to the mining and mineral processing industries, as well as their significant digitalization to improve productivity, financial ratios and reduce the industry's negative environmental impact.

Important objectives of the project are:

- **Build an open, digital and sophisticated digital infrastructure and the foundation of the “hyperconnected business” in the Mining I4.0 production**
- **Develop advanced, low-impact, smart integrated solutions to boost the sustainable discovery of strategic raw materials in Europe.**
- **Advance Mobility, Logistics and Supply Chain Operations**
- **Digitalization of Assets and Process Equipment**
- **Advance Sustainable Mining**
- **Demonstrate, evaluate and all Mine.io concepts & solution in real-scale regional-scope pilots (Implemented in WP6)-Demonstrate the feasibility (evidence-supported) of innovative technological solution supporting the I4.0 transition in the mining sector**
- **Organize and facilitate the uptake, replication and upscaling of the technological solutions developed by Mine.io**
- **Disseminate the project's scientific and technical results - Outreach to other R&D initiatives, end-users' communities and the global mining environment 'for knowledge transfer and Market development through liaison and training activities**
- Systematization of basic processes of the mining industry, optimization of equipment, use of built-in predictive analysis
- optimization of industrial procedures based on data-driven processes, cyber-virtual and cyber-physical systems,
- automation and robotization of mine exploration processes and management of sustainable extraction and processing of raw materials.

The project will involve 25 industrial and scientific partners from 11 countries: Poland, Italy, Germany, Finland, Sweden, Spain, Greece, Cyprus, Portugal, Hungary and Norway.

Partners bring to the project such technologies, competences and facilities as:

- innovative exploration technologies – imaging and monitoring of mining resources by means of cosmic radiation (muons),

- drone technologies and sensors integrated with underwater drones to monitor flooded excavations and mining processes,
- technologies of underwater mobility and electrification of vehicles using wireless;
- technologies of applications of electromagnetic and magnetic sensors in waste monitoring process;
- optimization of well drilling processes along with innovative techniques of analysis of well cores using X-ray technology;
- technologies in the field of mineral processing:
 - Dual-Energy XRT,
 - Artificial Intelligence Technology for the control of the metal ore processing;
- waste management technologies:
 - fusion of data from multiple sources and their interpretation for waste monitoring,
 - blockchain-based waste tracking system;
- mining technologies.
- mineral processing technologies.

Innovative applications of the above technologies are analysed in 4 thematic groups in so-called use-cases and validated as part of pilot actions in 6 locations: mines, smelter and mineral processing plants.

The four thematic groups comprise:

- **Sustainable Underground Mining**
 - **Use Case: Advanced Mobility (Autonomous and Electrified Vehicles – wireless charging)**
 - **Pilot Site 5: Germany**
- **Digitalization of Assets and Processing Equipment**
 - **Use Case 1: Mine.io I4.0 Asset Digitalization**
 - **Pilot Site 1: Germany**
 - **Use Case 2: Digital Smelter - Demonstrating an array of digitalization techniques at pilot scale with regard to smelting processes**
 - **Pilot Site 1: Germany**
 - **Use Case 3: Digital Flotation System - Artificial Intelligence technology for monitoring and control of metal ore processing**
 - **Pilot Site 2: Poland**
- **Digital Solutions for In-Situ Mining Exploration**
 - **Use Case: In-Situ Underwater Exploration Technology Validation for Water-Filled Mines**
 - **Pilot Site 6: Portugal**
- **Digital Solutions for Waste Exploitation and Post Mining Environmental Management**
 - **Use Case 1: Geochemical Mapping of Soils and Mining Wastes in Lavrion Historic Mine Site – Post Mining Environmental Management**
 - **Pilot Site 3: Greece**
 - **Use Case 2: Multi-Source Data Fusion and Interpretation for Surveillance of tailings embankments**
 - **Pilot Site 4: Finland**

Poland is represented by: Ł-ITR, Ł-EMAG, AGH, KGHM S.A.

KGHM S. A. will make accessible the other partners the technological line of copper ore flotation, on which the metal is leached from the ore and is accumulates in the so-called flotation froth, by means of mechanical and chemical processes.

The other Polish partners will develop a measuring system, using artificial intelligence technology, enabling continuous monitoring of the metal content in the flotation foam. It will lead to algorithms for optimization and control of the copper ore flotation process.

Ł-ITR will develop an optical-electronic-informatic measurement system enabling the recording the images of flotation froth, their processing and analysis. Based on these images, an artificial intelligence algorithm for monitoring the copper content of flotation froth will be created.

Ł-ITR and Ł-EMAG will develop machine learning algorithms that enable the construction of froth image classification algorithms. On this basis, Ł-EMAG will develop an artificial intelligence algorithm for monitoring the flotation process.

AGH will provide technological support for the measurement process, which will enable us the installation of the measurement system at the most appropriate measuring points and ensure the correct interpretation of the obtained results. It will also measure, using XRF techniques, the metal content of flotation froth samples collected during the froth image recording process. It will be necessary to build machine learning algorithms and artificial intelligence.

Additional measurements of the flotation froth content, by chemical methods, will be done by KGHM S. A. for calibration of the XRF technique

The technology developed by Polish partners can be implemented at KGHM S. A. and will in the future lead to the optimization of flotation technology at this plant.

Editorial article - Summary of the first workshop with potential future project stakeholders (interview subjects part 2)

The first workshop of the Mine.io project marks the beginning of an exciting journey towards sustainable mining practices. With over 60 participants, including end users, representatives from the mining industry, technology service providers, scientific research units, and business managers, the workshop was a resounding success. It provided a platform for fruitful discussions on various topics related to mining and paved the way for future advancements in the field.

Editorial article - The Transformative Potential of Mine.io: A Recap of Our First Workshop

The forthcoming of the fourth industrial revolution has brought significant changes to traditional supply chain management. With the integration of Industry 4.0 (I4.0) technologies, such as the Internet of Things (IoT), Artificial Intelligence (AI), Big Data, Machine-to-Machine communication (M2M), and cloud computing, companies have been able to improve their performance and productivity.

One sector experiencing significant transformation is the mining industry. The concept of **Mining 4.0** introduces new possibilities for increased productivity. It also promises to create stimulating workplaces in a good work environment by advancing automation, autonomous processes, and remote control in mining and processing value chains. Industrial digitalization in this context offers the potential for significant improvements by enhancing the quality and availability of data and information in mining operations.

Introducing Mine.io

In response to these emerging trends, we've developed Mine.io, a novel mining digital ecosystem that aims to build a systemic structure for the implementation of 4.0 technologies in mining industrial environments. Our solution embraces the whole mining value chain - from resources' exploration, extraction, and processing to waste management and post-mining activity.

Our goal with Mine.io is to establish a unified data infrastructure and collaborative platform ecosystem. This will promote openness and sharing of data, improve cooperation between mining enterprises, and enhance the systematization of the basic processes of the mining industry.

Insights from our First Workshop

Recently, we hosted our first workshop, which provided the opportunity to present our seven pilot projects. The success of the Mine.io workshop is a testament to the commitment and collaboration of industry professionals, researchers, and stakeholders in driving sustainable mining practices.

Participants of the workshop were introduced to the transformative potential of Industry 4.0 technologies in revolutionizing the mining industry. However, they also highlighted several challenges that Mine.io could face in the future. These include data models for mining data and processes, the incorporation of different data from different sources, and human resources development.

The quality of data, interface standardization, efficiency indicators for proactive improvements, and standards of communication protocols and data formats were identified as some of the most pressing digitization challenges faced by the mining industry today. Participants also noted the potential of automation and AI as emerging technologies that could significantly improve mining operations and increase efficiency.

Looking Ahead

The productive discussions and insights gathered during the workshop have reaffirmed our belief in the transformative potential of Mine.io. We're excited to continue working on the development of our solution and look forward to our next workshop in October 2024, which will be more technical and reveal the evolution of our seven pilot projects.

As we move forward, we remain committed to fostering collaboration among mining industry stakeholders. Together, we can drive the digital transformation of the mining sector and unlock new potentials for increased productivity, efficiency, and sustainability.

To learn more about our project and keep up to date with it, please visit our website:

<https://mineio-horizon.eu/>

and social media:

https://twitter.com/mineio_horizon

<https://www.linkedin.com/company/mineio-horizon>