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## Making exploration of underground flooded mines a reality - the UNEXUP solution

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The UNEXUP project, funded under EIT Raw Materials, is a direct continuation of the Horizon 2020 UNEXMIN project. While in UNEXMIN efforts were made towards the design, development and testing of an innovative exploration technology for underground flooded mines, in UNEXUP the main goal is to push the UNEXMIN technology into the market, while further improving the system's hardware, software and capabilities. In parallel, the aim is to make a strong business case for the improved UNEXUP technology, as a result of tests and data collection from previous testing. Improvements to the UX-1 research prototypes will raise technology readiness levels from TRL 6, as verified at the end of the UNEXMIN project, to TRL 7/8 by 2022. A "real service-to-real client" approach will be demonstrated, supporting mineral exploration and mine surveying efforts in Europe with unique data from flooded environments that cannot be obtained without high costs, or risks to human lives, in any other ways.

The specific purpose of UNEXUP is to commercially deploy a new raw materials exploration / mine mapping service based on a new class of mine explorer robots, for non-invasive resurveying of flooded mines. The inaccessibility of the environment makes autonomy a critical and primary objective of the project, which will present a substantial effort in resurveying mineral deposits in Europe where the major challenges are the geological uncertainty, and technological / economic feasibility of mine development. The robot's ability to gather high-quality and high-resolution information from currently inaccessible mine sites will increase the knowledge of mineral deposits in Europe, whilst decreasing exploration costs – such as the number of deep exploration drillholes needed. This can potentially become a game changing technology in the mining panorama, where the struggle for resources is ever increasing.

On the technical side, a fourth robot, modular in nature, will be added to the current multi-robot platform, providing additional functionalities to the exploration system, including better range and

depth performance. Hardware and software upgrades, as well as new capabilities delivered by the platform will greatly extend the usefulness of the platform in different environments and applications. Among these: rock sampling, better data acquisition and management, further downsizing, extended range, improved self-awareness and decision making, mature post-processing (such as the deployment of 3D virtual reality models), ability to rescue other robots, and interaction with the data will be targeted during the next years. Upgrading the overall technology with these tools, and possibly additional ones, will allow the system to operate with more reliability and security, with reduced costs.

These added functions arise from different stakeholders' feedbacks from the UNEXMIN project. UNEXUP targets parties from the mining, robotics and mineral exploration sectors, as well as all other sectors that have any kind of underwater structure that needs to be surveyed - caves, underground reservoirs, water pipelines and fisheries are among them. For the purpose of exploitation of the technology, a joint company was founded, "UNEXMIN GeoRobotics Ltd", which is part of the UNEXUP consortium, and is responsible for selling the service to the market.