Table 3.1b2: Work package description – WP2

Work package number	2		**Lead beneficiary**	XX		
Work package title	Networking					
Participant number	X					
Short name of participant	XX					
Person months per participant	18 (EU) 9 (APC)					
Start month	1		**End month**	36		

Objectives. The main objective of WP2 is to ensure the integration of the Astroparticle, Geoscience and Industrial communities into a coherently-acting, multidisciplinary consortium. To achieve this goal we will focus on the following specific aims:.

1) Define and support enabling technologies and infrastructures for the instruments pertinent to all communities.
2) Support the interoperability of and access to scientific data and the use of new methodologies of data analysis
3) Support the exchange and common interpretation of experimental results.
4) Stimulate collaborations, combined skills and performances among the communities.
5) Prepare the communities for the successful exploitation of the large infrastructures of the next decade.

Description of work. WP2 will foster and coordinate exchanges among the Astroparticle, Geoscience communities, the Industry and the different infrastructures. It will also disseminate the conclusions and outcomes of these exchanges. Networking will be encouraged by providing sponsorship of meetings and workshops, and creating a website to coordinate and communicate the networking activities, scientific discussions, and their outcomes. WP2 will provide, as well, training for young scientists on the usefulness of interdisciplinary research. Because of its crucial role to establish connections and communication among APOGEIA partners, WP2 will be closely and transversally articulated with all the other WPs.

The workshops and meeting objectives themes and goals will be to :

1. Promote
   a. the R&D for advanced sensors serving the increase of sensitivity of instrumentation
   b. the organization of large networks of sensors, data interoperability, and the low latency alert aspects, as key aspects of climate change research and resilience to natural and/or anthropogenic catastrophes
   c. the multi-modal characterization and monitoring of key geoscience (magmas, volcanoes, ocean, deep sea, desert, underground sites), astroparticle (underground laboratories, gravitational Wave antennas, large cosmic ray observatories deployed in large areas, undersea observatories) and civil infrastructure sites (cities, archaeology, building resilience) in preparation of the next generation of infrastructures.
   d. information exchange on transversal issues as safety, energy autonomy, links for data transmission
2. Define
   a. interoperability, exchange of data and sharing in a multi-messenger/multi-modal types of analysis and a common policy on the issues of low latency alerts,

b. a common approach to large-scale computing issues and access to computing infrastructures,

3. Support
   a. the industrialization of the above sensors, networks and AI learning techniques, that already are at a quite advanced technological level in coordination with the participating industries
   b. the creation of startup companies that will emerge from the interdisciplinary environment that will accompany the consortium
   c. the interdisciplinary links between the relevant communities at the European level.
   d. the development of the main technical design elements of the next generation of relevant large infrastructures

Task 2.1 The APOGEIA Meetings and Workshops (XXX, *coordinatorXXX*)

This task will support the organization of larger topic-oriented meetings relevant to the objectives, namely to foster the links between the consortium communities, promote the interdisciplinary goals mentioned above, increase the communication ane engagement aspcets towards the civil society. We plan to organize 2 large meetings per Sensor and AI analysis workpackage (WP3,WP4,WP5,WP6) Examples of proposed workshops and meetings are shown below:

1. Workshops on best practices concerning large sensor networks, with emphasis on fiber networks and mobile robots, for locating multiple sources of signal noise. This is a clear example of a single topic of research benefiting all consortium communities. On the scientific part, we aim, at one hand, at better understanding the Earth System and on the other hand, characterizing sea,seismic and atmospheric s sources will be crucial for the next generation of Astroparticle Physics Infrastructures. Also, R&D towards better sensitivity, with better timing techniques, including a proper integration of clock network service (https://www.clonets.eu/)
2. Workshops on the technology of European Underground Laboratories, promoting the dialogue within the European underground laboratories, international infrastructures and Industry with the scope to develop a roadmap towards a full alignment of standards, opportunities for economies of scale, radioactivity free enviromnents for science and society, hyper-sensitivity quantum sensors.
3. Workshops on Best Practice in Muon Tomography to maximize scientific return for Geoscience and Astrophysics communities. Best practices will be defined in terms of 1) numerical codes used for flux computation; 2) instrument calibration and metadata recorded during experiment; 3) Data processing and storage. Main deliverables: An established common procedure and standard data formats useful to both communities and the society at large.
4. Workshops on the use of machine and deep learning techniques to all the above technology fronts.
5. One or two more workshops may emerge from the interdisciplinary dialogue, as an example: a workshop on exploring habitability using astroparticles. Water radiolysis occurring in rocks containing radioactive compounds is responsible for a significant portion of natural molecular hydrogen (H_2) production on Earth (several 10^{11} moles of H_2 per year). H_2 is the key driver for the development and sustenance of the deep biosphere, the rock-powered life, living under severe energy limitations, far away from photosynthetically derived organic matter and oxygen. This rock-hosted deep biosphere harbours the majority of bacteria and archaea on Earth and constitutes an appealing model for the emergence of life on our planet. Defining and assessing (astro)particles-related proxies to track down radiolysis-derived H_2 production at depth may help refining remotely our understanding of planet habitability, natural H_2 fluxes and the associated biomass reliant on the geosphere for energy supply these fluxes can sustain. This is still an exploratory field where networking is crucial to foster new interdisciplinary collaborations.

The possibilities will be discussed within the ASTAC and the AEC and reported to ACB.

Budget WP2 For a topic-oriented meeting of 50-100 participants, we estimate an average total cost of 25 k€. This includes organizational support, local services and travel/subsistence costs for researchers (specially Early Carreer Scientists) to attend the aforementioned meetings. Projecting 8 workshops in total for 3 years of operation, we obtain a workshop budget of 8x25 k€=**200 k€.**

The workshops will be managed by a person at 50% 1,5 FTE years (126 k€)

Total Budget for WP 2: 326 k€

Deliverables

D2.1 A specific website for the WP2 meetings (M3)

D2.2 First year meetings report (M12)

D2.2 Second year meetings report (M24)

D2.3 Third year meeting report (M36)

Critical risks for implementation. The main risk of this program can be the continuation of the virus crisis. Nonetheless, this risk in mitigated by the fact that remote participation to APOGEIA meetings will always be guaranteed.