From Sky to Underground: High-Precision Data for the Digital Twin

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Italy is moving towards a digital transformation of its territory through the creation of the **digital twin of the soil**, a high-resolution three-dimensional model that promises to revolutionize the knowledge and management of the environment. The project, promoted by the **Department of Sustainable Development (DiSS)** of the **Ministry of Environment and Energy Security (MASE)**, is an integral part of the investment **PNRR M2C4 I.1.1**, within the framework of the advanced system of territorial monitoring and forecasting.

Leading the initiative is **e-GEOS**, a company controlled by Leonardo and participated by the Italian Space Agency (20%) and Telespazio (80%), in collaboration with a consortium of industrial, academic, and scientific excellence. The goal is to create a dynamic and precise digital map of the national territory, based on laser (LiDAR) and aerogravimetric data, which will serve as a basis for intelligent management of environmental, infrastructural, and geological resources.

According to **Massimo Claudio Comparini**, General Manager of Leonardo's Space Division, this is a strategic initiative where **innovation, public-private collaboration, and technological vision** converge. The project combines advanced technologies such as **supercomputing, artificial intelligence, and cloud computing** to create a digital infrastructure capable of supporting the country's resilience and sustainability.

The Digital Twin of the Soil: Technologies and Applications

At the core of the project is a cutting-edge scientific and technological approach. The digital map will be created through **aerial surveys with LiDAR (Light Detection and Ranging) technology**, capable of capturing the morphology of the terrain, infrastructures, and surfaces with millimetric precision. Added to this are the **aerogravimetric data**, essential for building a **new Italian geoid model**, which allows for the return of terrain altitudes in **orthometric heights**, i.e., referenced to the mean sea level.

These data represent an extraordinary scientific basis not only for describing the surface but also for analyzing the **subsoil**, assessing the **stability of slopes**, conducting **hydraulic modeling** to identify flood risk areas, and improving the **accuracy of positioning systems**. In perspective, they will also be fundamental tools for mining explorations and identifying **raw material deposits**.

As highlighted by **Milena Lerario**, CEO of e-GEOS, the digital twin will offer **a dynamic and scientifically robust representation** of the Italian territory. A concrete support to **environmental and territorial policies**, capable of guiding decisions in crucial areas such as hydrogeological risk prevention, urban planning, water resource management, and landscape protection.

Once completed, the model will be accessible in a **free and interoperable** mode, integrating with existing databases and promoting reuse by **public administrations, universities, research centers, and companies**. A true open infrastructure of territorial knowledge.

An Ecosystem of Excellence and a Step Forward for Digital Italy

The project is made possible by the collaboration between e-GEOS and a **highly qualified consortium**, which includes specialized companies such as **CGR S.p.A. (Compagnia Generale Ripreseaeree)** and **IRS s.r.l. (Italian Remote Sensing)**, along with internationally renowned universities and scientific institutions: **University of Pavia, Politecnico di Milano, Sapienza University of Rome**, and the **Technical University of Denmark**. They are joined by innovative companies like **GReD s.r.l.** and **Mermec Engineering S.r.l.**

This multidisciplinary network ensures the **maximum reliability and scientific rigor** in data acquisition and processing. It is a concrete example of a **strategic partnership between public and private sectors**, demonstrating the country's ability to systematize high-tech projects with a strong impact on the future.

The creation of the digital twin of the soil is part of the **Integrated Monitoring System Program (SIM)** of the PNRR, designed to provide concrete tools in the **fight against climate change**, **natural risk prevention**, and **sustainable land management**. An important piece also for the construction of a **structured digitalization of the Public Administration**, in line with European strategies for digital and ecological transition.

Thanks to the technological leadership of the Leonardo group and the support of the involved institutions, Italy positions itself at the forefront in creating digital infrastructures for the knowledge and protection of the territory. The digital twin will not just be a map: it will be **a decision-making tool**, **a dynamic archive**, **a simulation platform** to face future challenges with awareness and responsibility.

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