

I2DT

Interoperability for complex, large-scale digital twins

To take the next step in digital twin (DT) technology, the ITEA project I2DT (Intelligent Interoperable Digital Twins) will create a framework and tools for the interoperation of DTs of complex, large-scale systems and processes with a special emphasis on safety and security.

Addressing the challenge

Interoperability between large-scale DTs, such as production facilities or smart cities, could optimise processes, reduce resource consumption, predict threats, improve product quality and enable accurate predictions and adaptations. However, most DTs are built for isolated purposes. Obstacles to interoperability include the heterogeneous representation of geo-spatial and time-dependent data, the segregation of information in data silos and the lack of clarity on how to integrate machine learning components into simulations. There are thus few options for constructing intelligent, interoperable DTs of large-scale (cyber-) physical systems and processes.

Proposed solutions

I2DT will develop a framework for the specification, implementation and deployment of customised DTs that reflect complex processes and systems. This will consist of a reference architecture with security in mind, a methodology and tool support for DT construction based on an efficient model and pipeline-based development paradigm, as well as advanced DT lifecycle and operations management support. Schemes will also be created for machine learning integration into online simulation – including aspects of data acquisition, preparation, training and validation – and a unified reference architecture and standards will be developed for data exchange between interoperating DTs. A plug-and-play-like mechanism for interoperability will be achieved by building on the Functional Mock-up

Interface (FMI) standard for coupling simulation models and associated tools. The project will also demonstrate its technology in diverse use-cases: wildfire protection, smart parking, data centre optimisation and electric vehicle battery management.

service for wildfire suppression, insurance underwriting and asset protection. Smart parking, meanwhile, will develop a software framework that connects heterogeneous parking systems with DTs and recommends optimal parking spaces. Across the use-cases, the project aims for a 50% reduction in the effort to create DTs and an 8% reduction in resource usage via these DTs. Such optimisation will increase the sustainability of companies and industries that take up the results, but I2DT will further boost



^ I2DT concept and vision

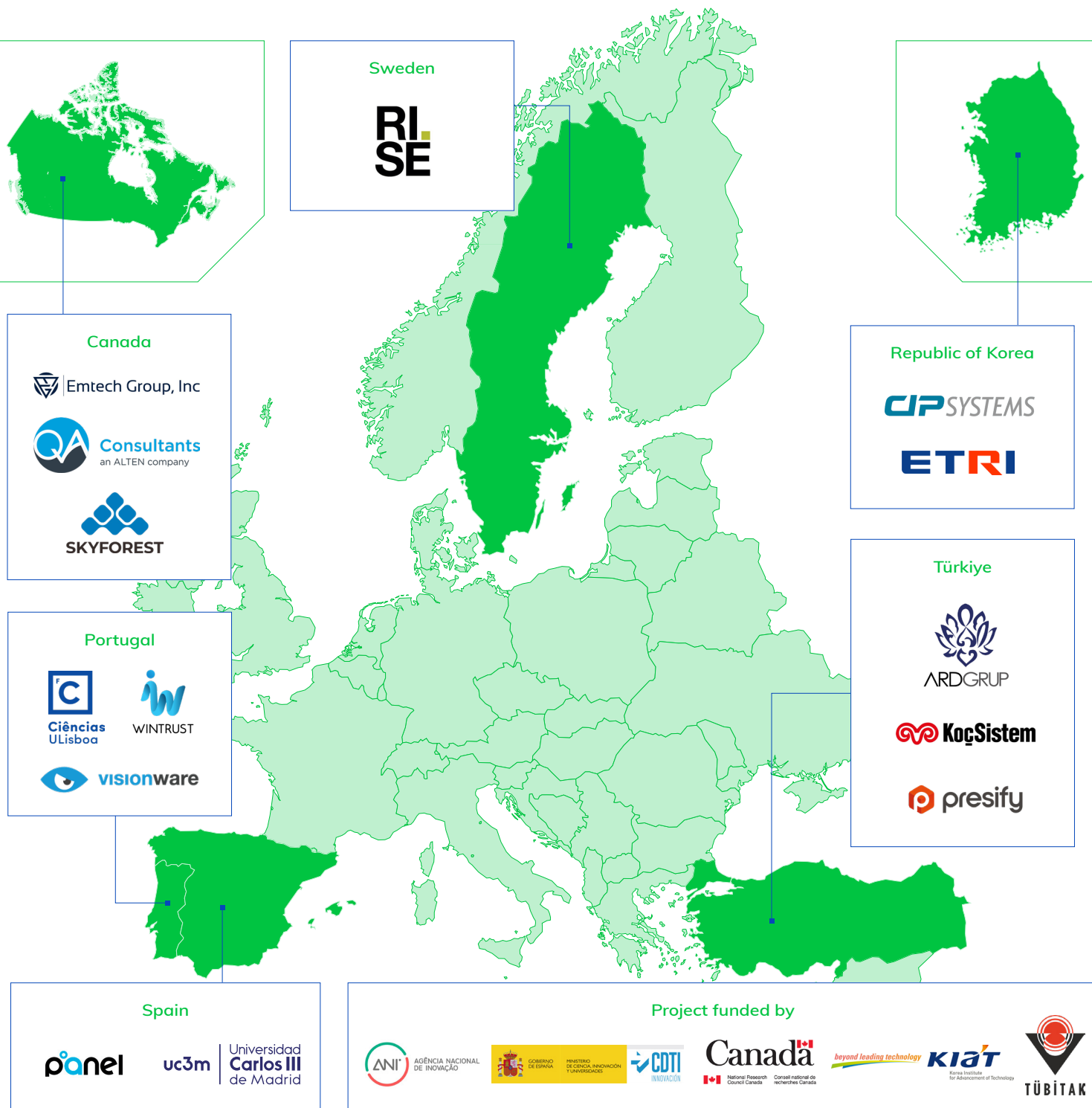
Projected results and impact

I2DT's methodological results will consist of the reference architecture, a development method and toolkit (including tools for DT composition, integration, code generation and deployment) and a lifecycle and operations management support kit. The partner-specific use-case results will then demonstrate I2DT's broad applicability. For instance, the wildlife protection use-case will produce a global twin of 10m grid cells, which will be marketed as a

sustainable digitisation by promoting 60% re-use of its artifacts within and outside of the project. In the process, the consortium will expand their offerings in a global DT market expected to grow from USD 12.7 billion in 2021 to USD 45 billion by 2026. As almost all domains can benefit from DTs, the project ultimately provides the first step towards a metaverse of integrated virtual, extended and physical realities for a more sustainable future.

Project partners

I2DT
2025



Project start
November 2024

Project leader
Mehrdad Saadatmand, RISE

Project website
<https://itea4.org/project/i2dt.html>

Project end
October 2027

Project email
mehrdad.saadatmand@ri.se



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