Digital Technologies in European Nuclear Decommissioning Projects

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DORADO: Digital twins and Ontology for Robot Assisted Decommissioning Operations

Previous steps in PLEIADES

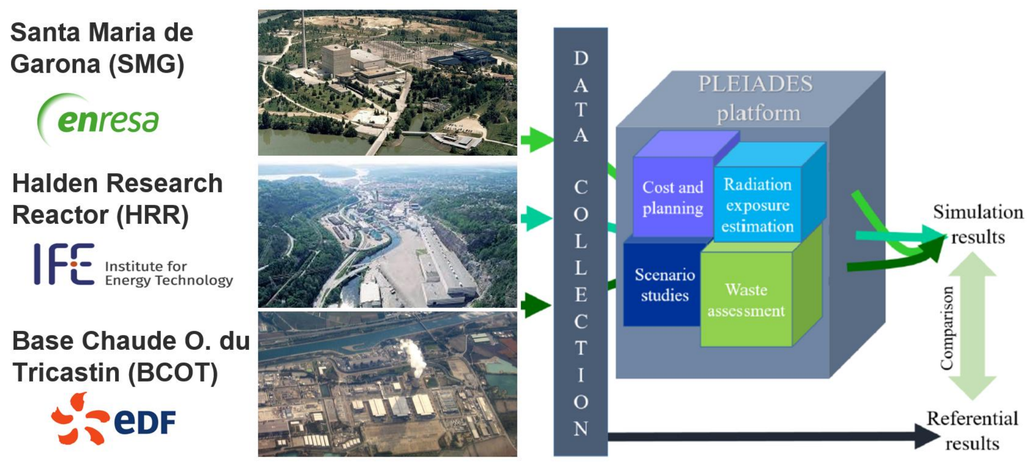

Figure 1. Implementation of PLEIADES on real use cases [6]

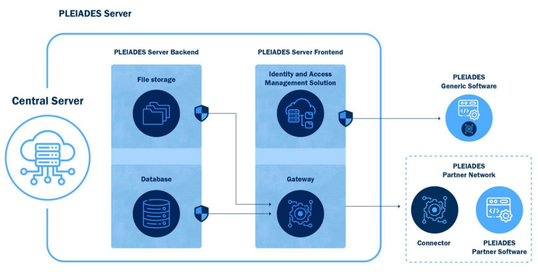

Figure 2. PLEIADES server architecture [6]

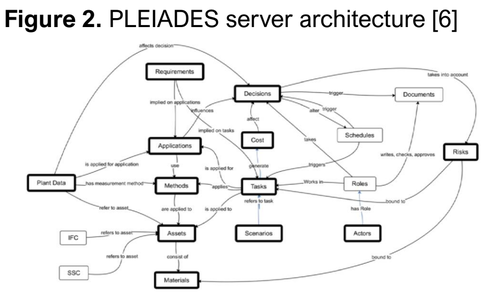

Figure 4. Decommissioning Core Ontology [8]

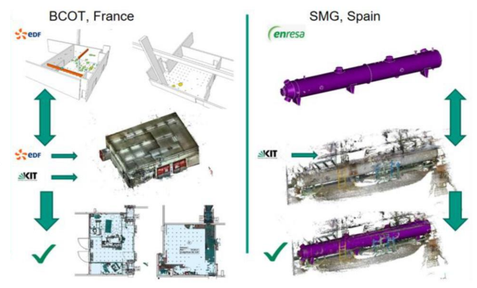

Figure 3. Creation of point cloud data [5]

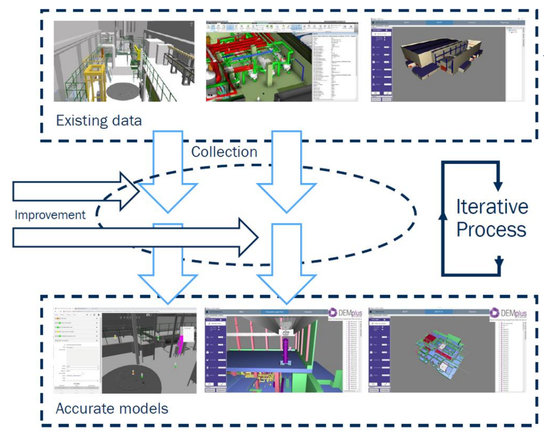

Figure 6. Use cases 3D models in PLEIADES [6]

Further steps for DORADO:

- Extension of the coverage of supported ontology and supported decommissioning planning activities;
- Continuation in the development of the ontology and the API (Application Programming Interface);
- Integration of further technologies such Artificial Intelligence (AI), Robotics and sensor networks;
- Promotion of the concept for wider use.

Figure 5. Project partners [4]

DORADO key facts: Started in Sept 2024 / 36 Months / 12 Partners / 8 Countries / 5 WPs

DORADO partners

Technical Research Centre of Finland Ltd. – VTT	Finland
Karlsruher Institut für Technologie – KIT	Germany
Institute of Energy Technology – IFE	Norway
WAI	Slovakia
SPIX industry	France
Centre d'Etude de l'Energie Nucléaire – SCK CEN	Belgium
Autorité de Sûreté Nucléaire et de Radioprotection – ASNR	France
Institut für Umwelttechnologien und Strahlenschutz GmbH – iUS	Germany
CATENDA	Norway
Université de Strasbourg – Unistra	France
Amphos 21	Spain
Electric Power Research Institute – EPRI	Irland

DORADO project organization

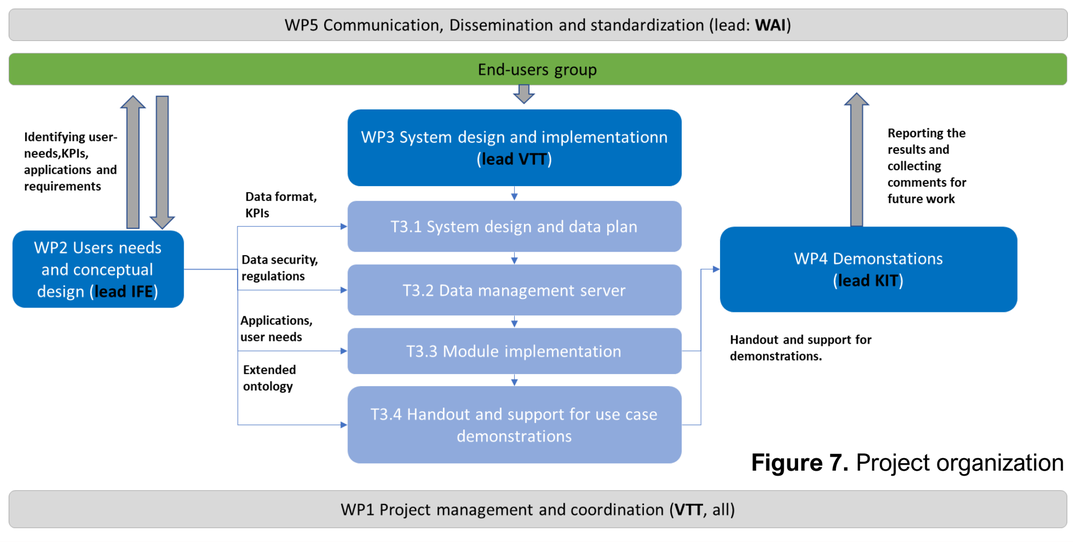

Figure 7. Project organization

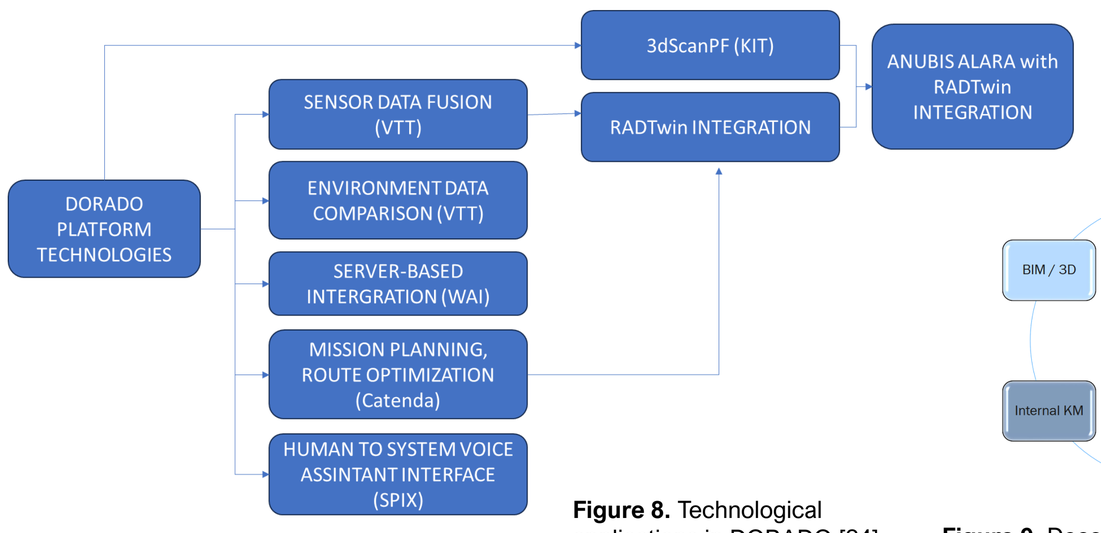

Figure 8. Technological applications in DORADO [24]

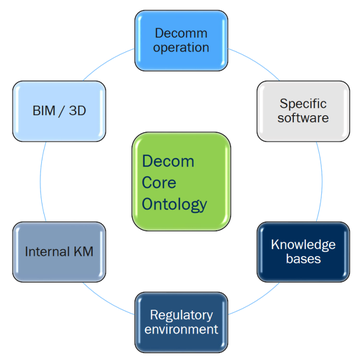

Figure 9. Decommissioning Core Ontology [7]

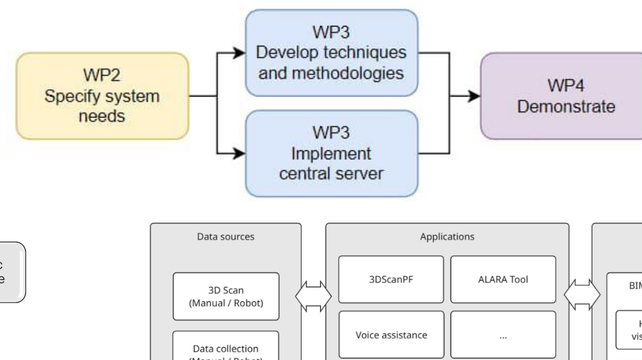

Figure 10. Linking techniques to demonstrations [12]

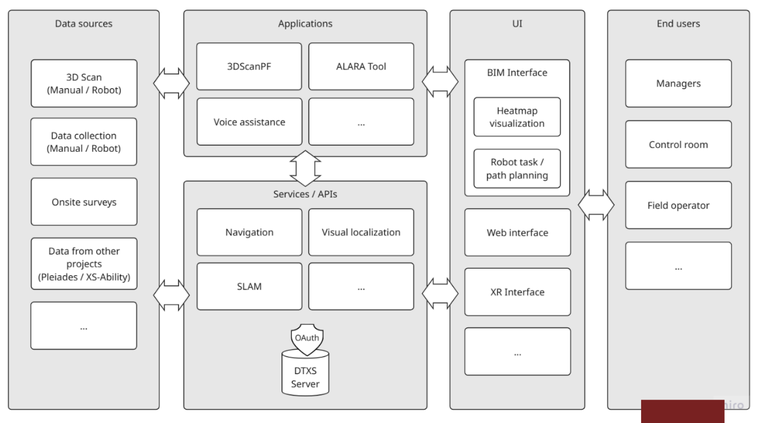

Figure 11. DORADO system architecture [1]

- Next technologies are being incorporated:

  Sensor data fusion with temporal dimension; Environment data comparison against BIM; Point-cloud and 3D model change detection; Digital twins based ALARA dose estimation; Server-based integration with IFC file format and extended data queries; Mission control, robot route optimization; Human to System smart voice assistant interface; Standardization using the common ontology.

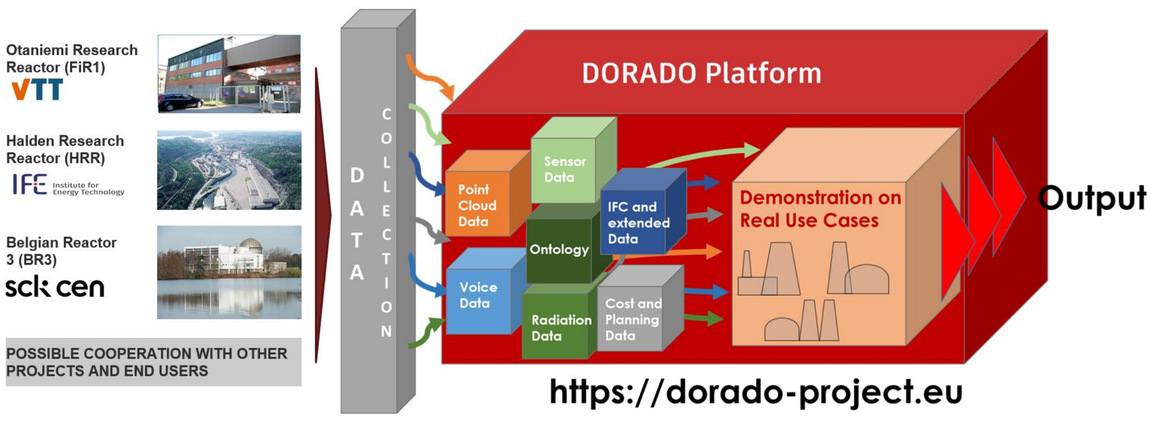

Figure 12. Demonstrations on real use cases [11]

End-users group interaction

End-users are invited to follow DORADO via webinars, newsletters and other publications. Join us if you are:

- **Technical/ Technological Expert;**
- **User of any of the DORADO tools;**
- **Business manager;**
- **Other related professional.**

End-users have the opportunity to increase their understanding of each technology, strengthen their own understanding of the benefits of using each technology and hence, gain a better understanding of how the technologies can be utilized in their own business.

JOIN US!

https://www.dorado-project.eu/join-us

Summary and results

- DORADO continues the work of PLEAIDES by integrating more technologies and extending the ontology for new applications;
- Eight new technologies are handled, emphasizing the use of BIM (Building Information Modeling) and AI (Artificial Intelligence)
- Developed technologies will be demonstrated with data from real facilities. Holistic approach and data compatibility is the key!
- 3 webinars presenting digital technologies have been organized, they are available here: **https://www.dorado-project.eu/events**
- Results of the project and publications are available in the website: **https://www.dorado-project.eu/results-and-publications**

REFERENCES:

[1] [11] [12] www.dorado-project.eu [4] M.-B. Jacques (2021). PLEIADES, the Smarter Plant Decommissioning. DEM 2021 –International Conference on Decommissioning Challenges (France, Avignon) [5] M.-B. Jacques, J.-E. Hulsund, I. Szoke (2022). PLEIADES project overview. DigiDecom 2022- Halden
[6] Marie-Benedicte Jacques, Antti Räty, Joseph A. Ridao Cabrerizo, Dusan Daniska. European Collaborations for Safe and Efficient Dismantling: Digital twins, Ontology and Data Exchange, EPJ Nuclear Sci. Technol. 11, 19 (2025). https://doi.org/10.1051/epjn/2025022
[7] F. Borrmann, F. Becker, V. Hein, I. Szöke, M.-B. Jacques, J.A. Ridao, D. Daniska, F. Patrice. An international approach to nuclear decommissioning ontology, in DEM 2021 – International Conference on Decommissioning Challenges. France, Avignon, 2021 September 13-15 (2021)
[8] I. Szöke, M.-B. Jacques, F. Borrmann. PLEIADES, the Smarter Plant Decommissioning, in DEM 2021 – International Conference on Decommissioning Challenges. France, Avignon, 2021, September 13-15 (2021)
[24] Antti Räty et al., DORADO-projekti tuottaa digitaalisia malleja käytöstäpoistoon, ATS Ydintekniikka, 4|2024 Vol. 53 https://bin.yhdistysavain.fi/1608821/Hk8OJiHcEk5Ouc8t9VUO0bO3jz/ATS%20Ydintekniikka_4-2024.pdf

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