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Digital Twins and Ontology for Robot Assisted Decommissioning Operations: DORADO project

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Abstract.

Nuclear decommissioning projects require reliable integration of heterogeneous information, including facility models, radiological data, operational records, sensor measurements, robotic mission data, and regulatory knowledge. Building on the PLEIADES project (PLEIADES website, 2020), DORADO (DORADO website, 2024) investigates how ontology-based digital twins and interoperable data-exchange mechanisms can support safer, more efficient, and better-documented decommissioning operations. This paper reports interim results from the first half of the DORADO project and addresses the following question: how can digital twins, BIM-based data management, ontology, robotics-related data flows, sensor fusion, and supporting digital tools be combined into a coherent platform for nuclear decommissioning applications?

The paper first identifies the main research and implementation gaps inherited from PLEIADES (Jacques et al., 2025), including the need to extend ontology coverage, improve interoperability with standards and knowledge sources, integrate additional technologies such as robotics and sensor networks, and prepare the concept for wider use in realistic decommissioning settings. It then reports the interim DORADO results obtained so far: business value and stakeholder requirements have been analysed; representative use cases have been defined; information-security needs have been assessed using threat modelling; and a central server architecture has been implemented to support data exchange through structured interfaces. The paper further describes ongoing technical integration work related to sensor data mapping, decommissioning ontology, ALARA dose estimation, point-cloud change detection, voice-assisted reporting, and robot mission control. Finally, planned demonstrations using data from representative nuclear facilities are presented to clarify how the platform will be validated in the remaining part of the project.

The contribution of the paper is therefore not a final validation of the complete DORADO platform, but a structured presentation of the project's interim technical results, their relationship to the open needs identified after PLEIADES (Jacques et al., 2025), and the remaining steps required for demonstration and evaluation in real decommissioning use cases.

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1. Introduction

As many nuclear facilities worldwide are reaching the end of their operational lifecycle, Nuclear Decommissioning Projects (NDPs) will increase in the coming decades. But these types of projects were not anticipated during the design and construction of the current nuclear facilities, so research is needed to assess feasibility and optimize processes. Nuclear decommissioning activities include specific challenges associated to nuclear, in addition to the challenges associated to conventional decommissioning.

Data-driven tools like Building Information Modeling (BIM), robotics, and Artificial Intelligence (AI) are developing rapidly and extending to new applications. As the benefits of these technologies have already been proven in other industries, their implementation is being sought in demolition projects. In this context, the project DORADO (Digital twins and Ontology for Robot Assisted Decommissioning Operations) (DORADO website, 2024) was funded through the Euratom (European Atomic Energy Community) Research and Training Programme, to improve safety and efficiency in nuclear decommissioning by applying several modern digital technologies. Human exposure to radiation can significantly be reduced, decision-making processes can be improved, and resource allocation can be optimized throughout the decommissioning lifecycle. By increasing accuracy when working in high-risk controlled areas, safety may also be enhanced by reducing the risk of misunderstandings and confusion. Besides, the use of emergent technologies may be valuable for training purposes; having a BIM model integrating data from various sources with properly defined ontology enables remote planning, training, and inspection activities. After completion, the platform can be used for: characterization and sampling; clearance of surfaces and structures; cost estimation; in situ waste characterization; knowledge management and risk identification. A dedicated decommissioning ontology, which was partially developed in the earlier Euratom project PLEIADES (PLatform based on Emerging and Interoperable Applications for enhanced Decommissioning processES, 2020-2023) (PLEIADES website, 2020), is the core of the process using data transfer protocols (Jacques et al., 2025).

DORADO extends this work by integrating to the platform various technologies, such as point-cloud change detection, voice assistance, sensor data fusion and robotic mission control. The project aims to develop a digital platform that integrates various tools and data sources for nuclear facilities, leveraging BIM models to combine multiple applications, thus enabling flexible data management. The work had started in the previous project PLEIADES, where the basis for the data transfer protocols was defined and the first version of the dedicated decommissioning ontology was created (Jacques et al., 2025). At the end of PLEIADES, some further steps were recommended for DORADO:

- To extend the coverage of the supported ontology and the supported decommissioning planning activities;
- To ensure compatibility with international standards and guidelines;
- To integrate more technologies, such as AI, robotics, or sensor networks;
- To promote the concept for wider use, like decommissioning projects in other industries outside of nuclear field.

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1.1 Research Questions and Contribution

Based on the open needs identified after PLEIADES, this paper addresses three practical research questions. First, how can the ontology-based data-exchange concept developed in PLEIADES be extended to support additional decommissioning technologies, including sensor fusion, point-cloud processing, ALARA dose estimation, voice assistance, and robot mission control? Second, what technical and organizational requirements must be addressed to make such a platform usable in regulated nuclear decommissioning environments, particularly with regard to stakeholder needs, cybersecurity, interoperability, and traceability? Third, which parts of the DORADO platform have already been implemented or specified during the first part of the project, and which elements remain to be demonstrated in real use cases? The contribution of this paper is to report the interim answers to these questions by presenting the user requirements and business value analysis, the security and data-management concept, the initial platform implementation, and the planned demonstration cases.

Ultimately, DORADO aims to continue this technical development work by integrating new technologies into the server. Eight technologies are being developed and integrated into the platform, which will enable several new practical applications like project planning, worksite monitoring and reporting, as well as long-term knowledge management. Next figure shows the system architecture of the platform:

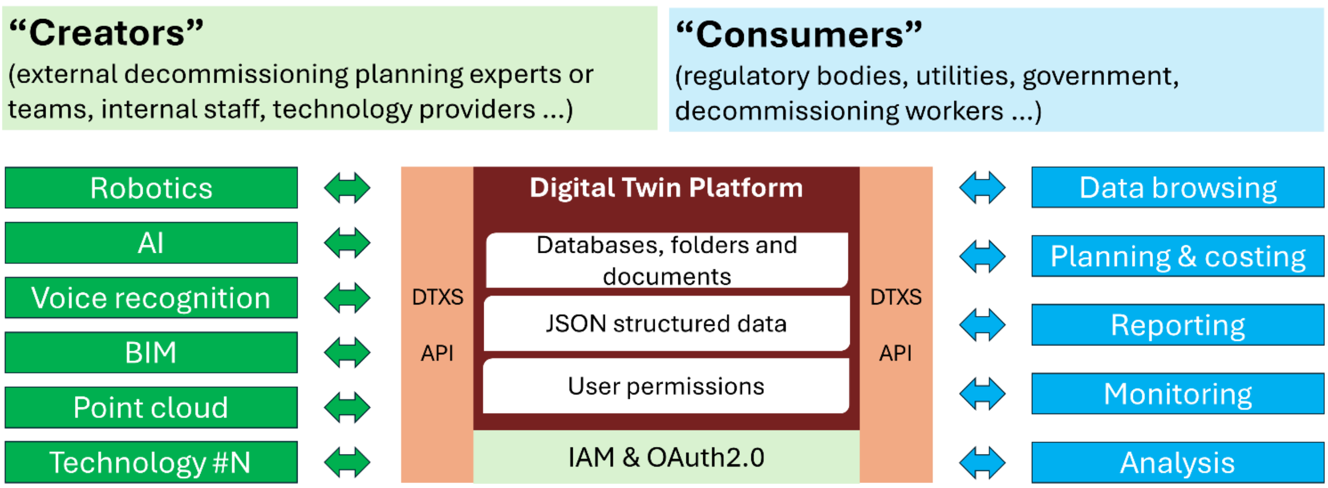

Figure 1: Illustration of the proposed DORADO architecture (Räty et al., May 2026)

2. Interim Results: Requirements, Use Cases and Platform Design

2.1 Business Value Analysis

The nuclear sector is characterized by a highly regulated operating environment and a traditionally conservative approach to technological change. The transition from operation to decommissioning represents a major organizational and technical challenge for facility owners, requiring new competencies, workflows, and decision-making frameworks. Achieving safe,

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efficient, and cost-effective decommissioning therefore necessitates close engagement with stakeholders and domain experts, as well as the adoption of digital solutions that are compatible with regulatory expectations and established safety principles. Advanced digital technologies — including robotics, digital twins, Building Information Modeling (BIM), voice assistance, and ontology-based data management — offer significant potential to address these challenges. Their impact is both tangible and intangible. Quantifiable benefits include reduced radiation exposure and labor costs through remote and automated operations, accelerated project schedules, and improved planning accuracy. Robotics-supported inspection and dismantling enhance precision and reduce the need for human access to hazardous areas, while BIM, point clouds, and digital twins improve visualization, site characterization, and work sequencing. In parallel, these technologies support improved waste characterization, material tracking, and identification of components suitable for reuse or recycling, contributing to cost reduction and sustainability objectives. Less tangible benefits include improved data quality, enhanced decision support, stronger collaboration between stakeholders, improved regulatory documentation, and long-term knowledge preservation, all of which support a robust safety culture and public confidence.

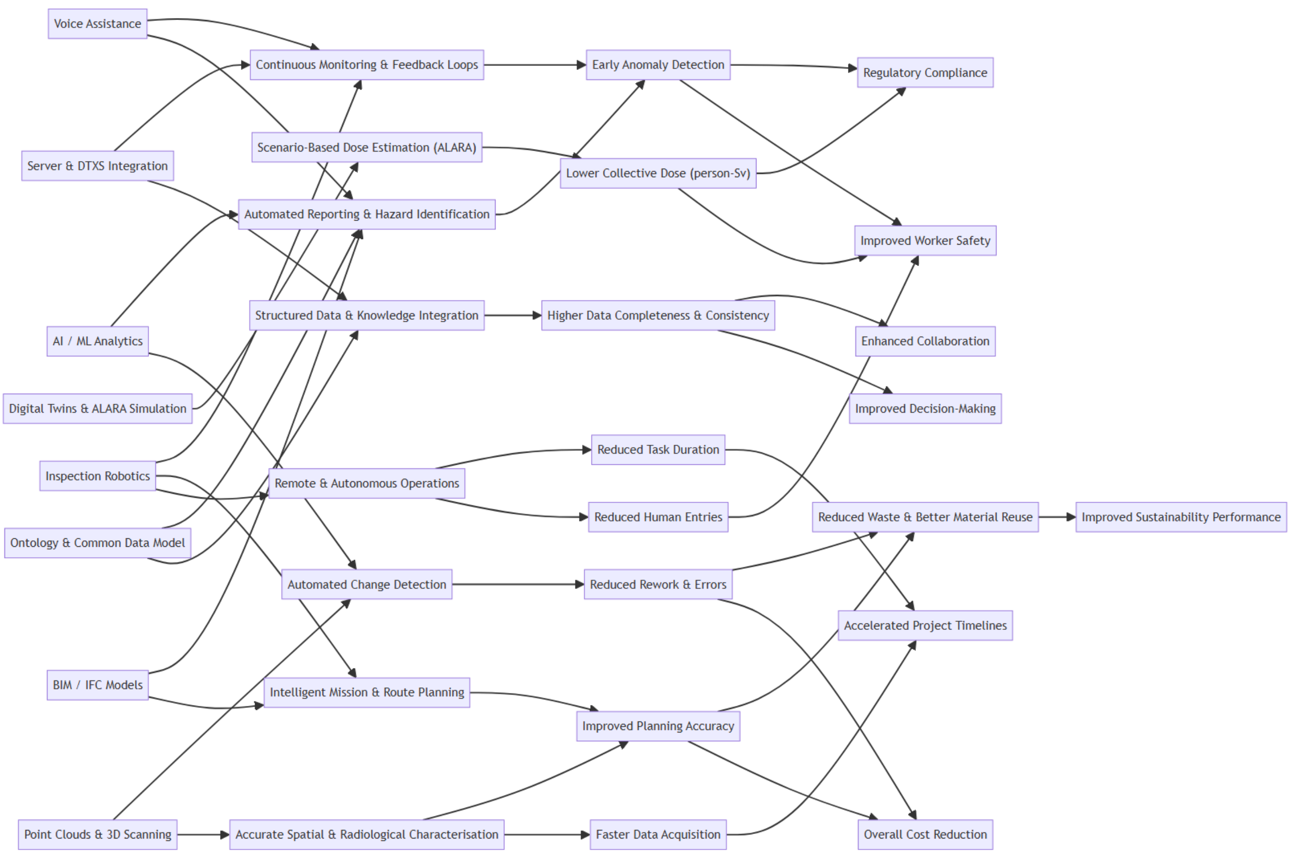

Figure 2: Identified business value indicators (AI generated)

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Within the DORADO project, these benefits are systematically addressed through five impact dimensions: safety, efficiency, cost, data and knowledge management, and sustainability. Safety is the primary driver, with an emphasis on minimizing collective radiation doses and limiting personnel access to high-risk areas through robotics and remote operations. Efficiency gains arise from faster data acquisition, automated data processing, and improved mission planning, while cost optimization is achieved through reduced manual surveys, minimized rework, and better resource allocation. The platform further strengthens data and knowledge management by ensuring completeness, traceability, and interoperability of information across tools, and supports sustainability through improved material accounting and waste reduction.

To ensure traceability of impact, the project applies a hierarchical indicator framework linking Key Business Indicators (KBIs) to System-level KPIs (S-KPIs) and Technology-specific KPIs (T-KPIs). This structure enables the translation of strategic objectives, such as improved worker safety, into measurable outcomes (e.g. reduced person-Sieverts), which are further supported by granular technical metrics such as robotic coverage rates or digital twin accuracy. This layered approach enables continuous performance evaluation, evidence-based decision-making, and transparent communication of value to operators and regulators. Practical use cases, including ALARA-informed mission planning, automated site characterization, and ontology-driven data integration, demonstrate how these indicators are operationalized and underpin the overall business case for digital transformation in nuclear decommissioning.

2.2 User Requirements and Data Security

The development of the DORADO platform was driven by an extensive stakeholder engagement process involving workshops, questionnaires, and expert interviews across research, industry, and regulatory domains. This process identified key operational requirements, including robust offline functionality for environments with limited connectivity, user-friendly interfaces suited to high-risk contexts, and comprehensive training to support technology adoption in the conservative nuclear sector. Additional priorities included accurate and frequent updates of digital twins, integration of radiological and geometric data, and automation of reporting tasks. Strong emphasis was placed on cybersecurity, favoring local data hosting and strict access control. These requirements informed the definition of representative use cases, such as intelligent mission planning, localization and change detection, ontology-driven reporting, and autonomous monitoring, demonstrating the platform's potential to enhance safety, efficiency, and data quality.

The system architecture is centered on a secure data management server that enables communication through a REST API using the DTXS protocol, with authentication handled via OAuth2.0. Security considerations were further addressed through a STRIDE-based threat modeling analysis, identifying risks such as data flow interruption, spoofing, SQL injection, and privilege escalation. Mitigation strategies include enforcing secure communication protocols, implementing logging and auditing, applying input validation, and maintaining strict access control mechanisms, aligned with ISO 27005 and ISO 27002 standards.

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The hardware architecture comprises mobile robotic platforms and complementary sensing systems tailored for nuclear environments. Quadruped and wheeled robots provide mobility and payload flexibility, while integrated sensors — including LiDAR, RGB-D cameras, thermal imaging, and radiological instruments — enable precise environmental mapping and radiation assessment. Additional handheld and stationary devices support detailed data acquisition. A Linux-based central server manages heterogeneous data, including BIM models and point clouds, ensuring secure, real-time interoperability across system components.

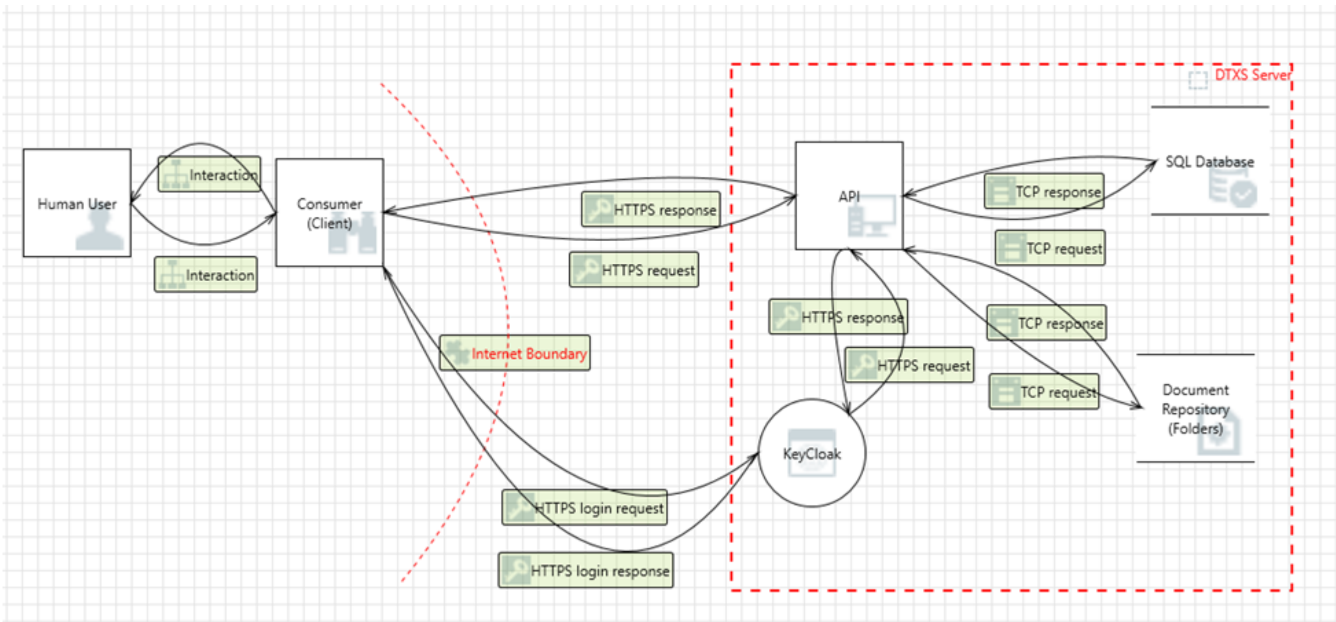

Figure 3: Illustration of the threat modelling (Räty et al., 2025)

3. Technical Implementation

DORADO will integrate new technologies into the server. A total of eight technologies will be researched and integrated into the platform:

1) Sensor data fusion with temporal dimension;
2) Environment data comparison against BIM (validation of the BIM model);
3) Point-cloud and 3D model change detection (similar as previous point, but aimed for regular updating of the model);
4) Digital twins based ALARA dose estimation;
5) Server-based integration with IFC file format and extended data queries;
6) Mission control, robot route optimization;
7) Human to System smart voice assistant interface;
8) Standardization using a common ontology.

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Many of these technologies inherently involve AI, robotics, and integrated sensor networks. Within DORADO, mission planning and feedback mechanisms are developed around a dedicated decommissioning core ontology. The overarching objective is to enable wider adoption of these concepts, including in conventional demolition contexts.

While DORADO primarily addresses data management and BIM-based digital models, complementary Euratom projects focus on hardware and robotics. In particular, DORADO will cooperate with the XS-ABILITY project (Accessing hard-to-reach areas with Advanced and Breakthrough Innovation for reLiable In-situ characterization of a facility) (XS-Ability website, 2024) through joint demonstrations, leveraging clear technical synergies in later project stages.

3.1 DORADO Central Server

The DORADO platform combines various digitalization and 3D visualization technologies.

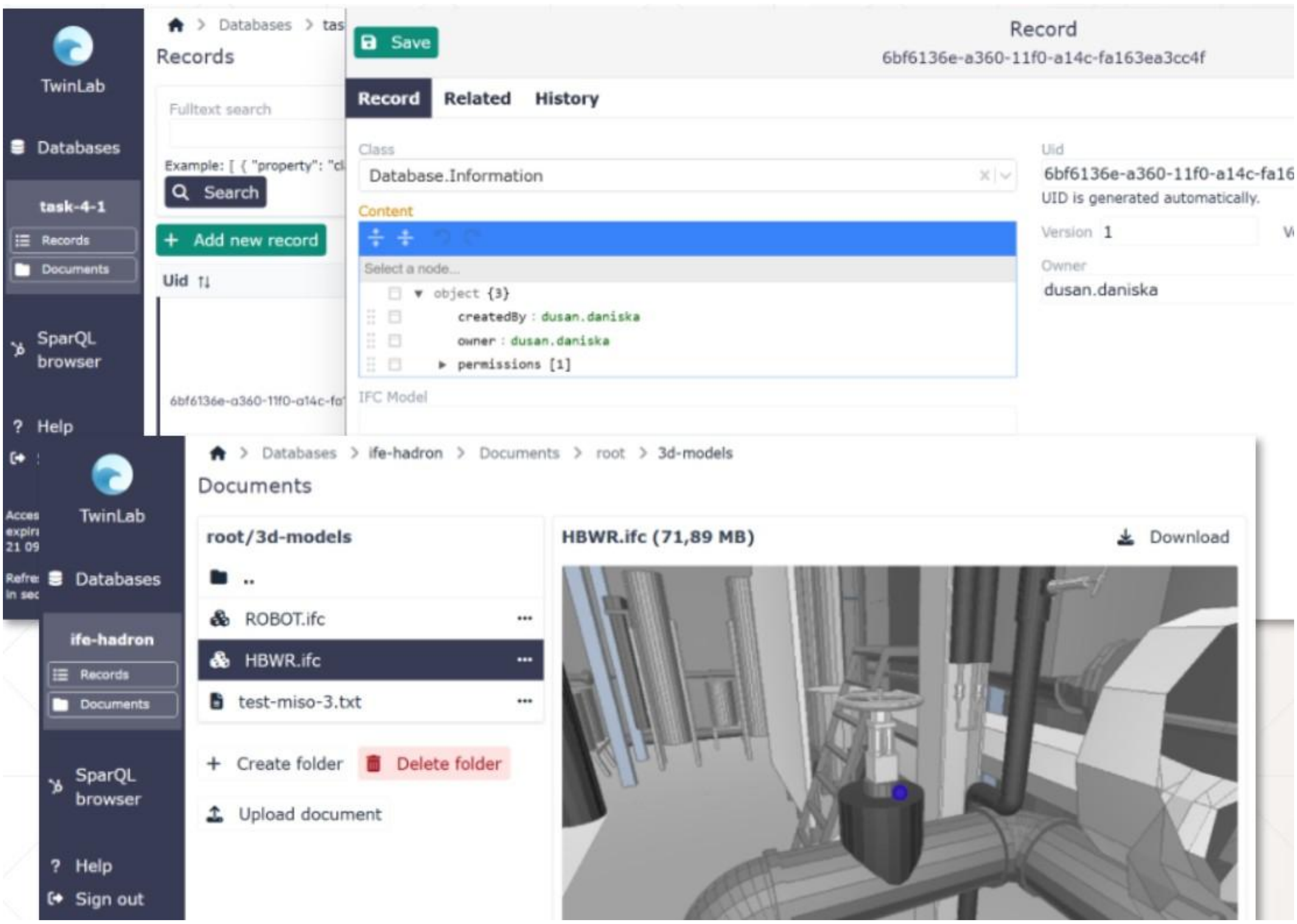

Figure 4: Overview of the platform (Daniska et al., 2025)

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In order to bring a comprehensive solution, it also works with many different formats like IFC for 3D models, E57 for point clouds, XYZ for spatial dose rate maps, CZT / SPE for spectrometry data, JSON for custom metadata, RVIZ for robotic visualization configuration, etc. The integration is made via a REST API (REpresentational State Transfer Application Programming Interface), available to upload or download data. Opensource Python client is available on Github (https://github.com/). Thus, storage for 3D model metadata of any structure is implemented. In addition, various types of information can be stored, like representing non-structured data (e.g. Word or PDF documents) or representing structured data (e.g. radiological measurements). The data visualization is web-based: a specialized tool was developed to visualize data, like shown in the Figure 4.

3.2 Sensor Data Mapping

A wide variety of sensor data are collected during the decommissioning process, ranging from LiDAR (Light Detection And Ranging) scans and photographs to radiation measurements. For this data to support visualization and multimodal sensor fusion, it must be accurately aligned within a common coordinate frame.

When sensor data are collected by a robot, there are two practical ways to align the measurements to a common coordinate frame. The first is a real-time approach, in which the robot continuously localizes itself against a reference point cloud that is already expressed in the common coordinate frame. This allows all sensor measurements to be aligned to the shared frame during data collection. The second is an offline approach, in which the robot records its sensor data and reconstructs a point cloud of the environment using its onboard LiDAR sensor. This reconstructed point cloud is then registered to the reference point cloud in the common coordinate frame, so that all recorded sensor data are expressed in that same frame. The same principles can be applied to both ground robots and aerial platforms such as drones.

Aligning data collected using handheld sensors or wearable devices is generally more challenging, as these platforms often lack direct access to LiDAR-based localization against the reference point cloud. Nevertheless, several methods can be applied depending on the available sensors. In DORADO, visual localization based on RGB images is used for these scenarios. This approach requires the device to include a camera; however, this requirement is typically easy to satisfy in practice. Furthermore, many mobile devices and head-mounted displays already estimate their pose within a local coordinate frame. Visual localization is therefore used primarily to align this local frame with the global reference coordinate system.

We employ a novel visual localization method that directly matches an RGB image to a reference LiDAR point cloud of the environment. This enables the use of continuously updated point clouds as the localization reference, which is particularly important in dynamic environments such as decommissioning sites. The localization process runs on a server and is exposed through a simple REST interface, allowing integration across a wide range of platforms.

3.3 Dedicated Decommissioning Ontology

Existing software solutions typically rely on implicit, proprietary ontologies closely coupled to their internal data models. Building on earlier work in the PLEIADES project, DORADO focuses on aligning the ontologies of the IAEA (International

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Atomic Energy Agency) and EC-JRC (European Commission – Joint Research Centre) to enable standardized access to key knowledge bases such as INIS (International Nuclear Information System) (https://www.iaea.org/resources/databases/inis) and the IAEA Nuclear Wiki (https://www.iaea.org/resources/nucleus-information-resources). Although these ontologies serve different purposes, their alignment allows regulations, standards, guidance, and case studies to be retrieved directly within operational workflows. Given the endorsement of the IAEA approach by Member States, wider adoption of compatible national knowledge structures is anticipated. The resulting common ontology also supports future applications by enabling new inferences, transparent AI integration, and explainable, accountable use of predictive models, as illustrated in next Figure:

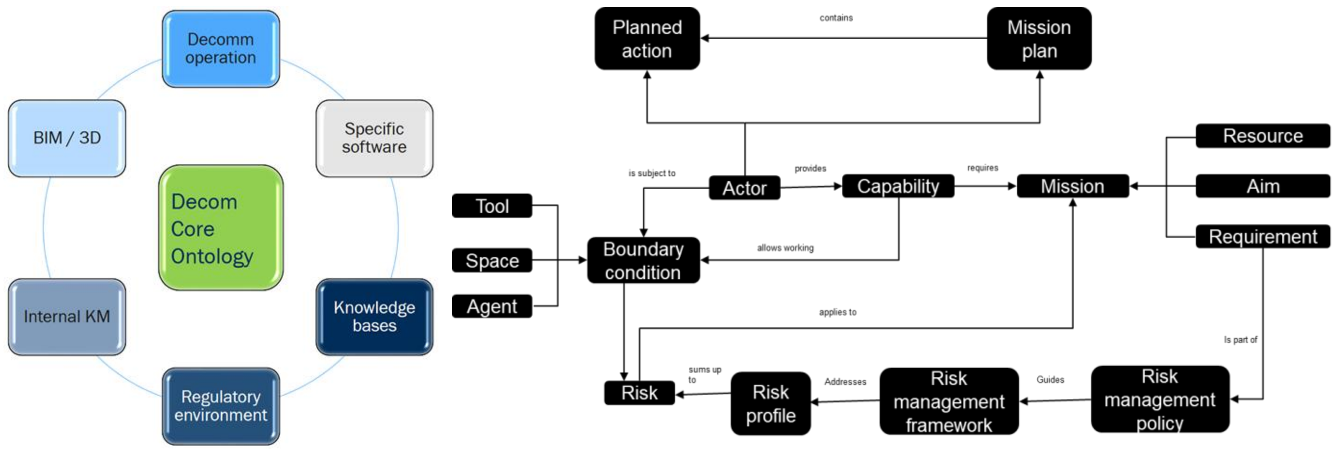

Figure 5: Decommissioning core ontology (Borrmann et al., 2021)

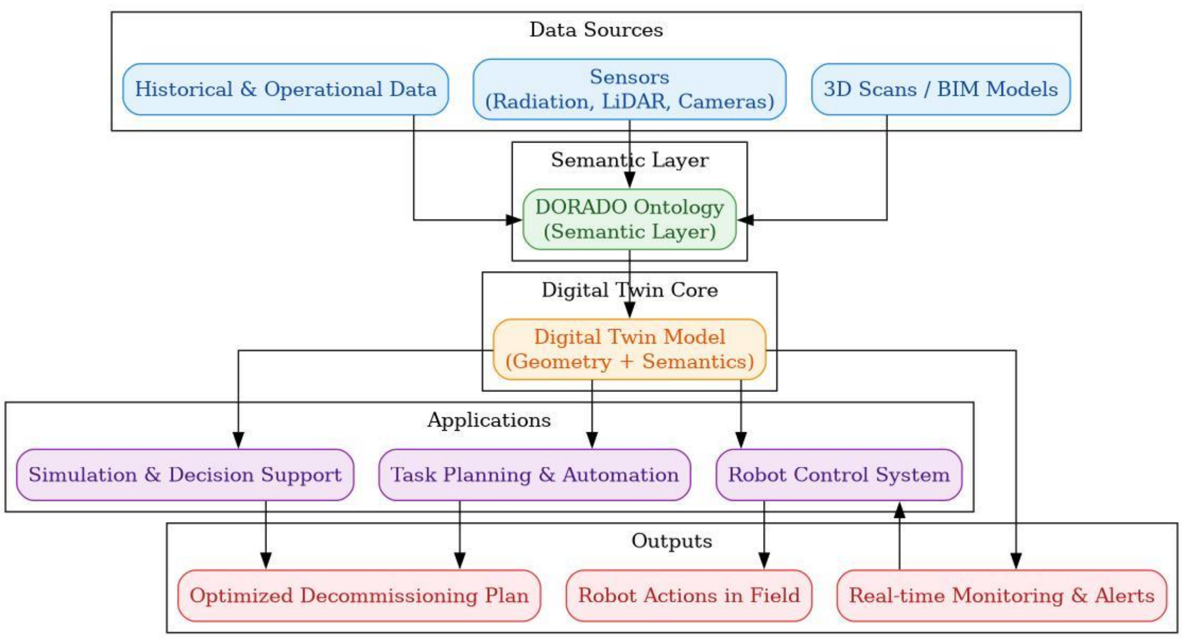

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Figure 6: Data Sources, Semantic Layer, Digital Twin Core, Applications, and Outputs (AI generated)

3.4 ALARA Dose Estimation Tool

The Digital Twin–based ALARA (As Low as Reasonably Achievable) dose estimation tool employs 3D simulation models to evaluate radiation exposure in hazardous environments. In DORADO, the VRdose® platform (https://ife.no/en/service/hvrc-vrdose/) developed by IFE is integrated with the ALARA planning tool from SCK CEN to enable dynamic rather than static dose assessments. An AI/ML model tracks and predicts changes in radioactive sources, maintaining digital twin fidelity, and identifying the need for new measurements. Real time, adaptive dose planning improves accuracy, supports informed decision making, and reduces exposure risks while optimizing resources. Integration within the DORADO platform further enables combined use with complementary technologies, such as voice assistance.

3.5 Change Detection in Point Clouds

Change detection is a well-established methodology applied across a wide range of domains, including traffic monitoring, damage assessment, and the documentation of urban development. One-dimensional (1D) change detection, which focuses on vertical variations, is commonly employed in urban development studies using large-scale point cloud datasets acquired via airborne or unmanned aerial platforms. In contrast, more complex changes occurring in arbitrary directions are typically identified within a three-dimensional Cartesian coordinate system (X, Y, Z). Within the Architecture, Engineering, and Construction (AEC) sector, change detection has gained increasing importance in recent years, particularly for monitoring construction progress and verifying as-built conditions.

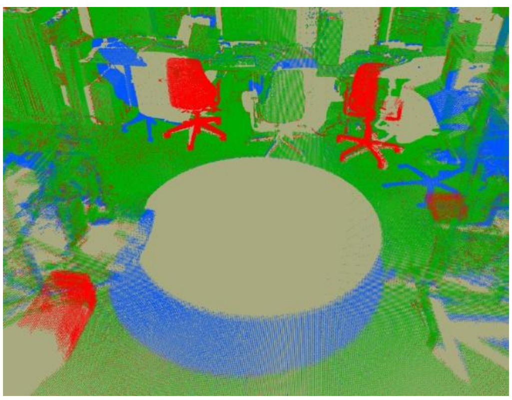

Figure 7: Example of highlighting the changes in an office environment (Räty et al., 2024)

Despite these advances, the application of change detection in demolition and dismantling operations remains at an early stage. Traditionally, change detection in demolition has relied on manual visual inspections and direct measurements. However, recent improvements in sensing and measurement technologies have led to a substantial increase in the availability of digital data, creating new opportunities for automated and semi-automated analysis. In particular, the comparison of point clouds

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acquired at different time steps, as well as the comparison between point clouds and three-dimensional models, enables the identification of geometric deviations and the generation of heatmaps based on predefined tolerance thresholds. Such visualizations support quantitative assessment of changes and enhance situational awareness, as illustrated by the example heatmap of changes in an office environment shown in Figure 7.

Contemporary autonomous robotic platforms are capable of performing high-resolution three-dimensional point cloud scanning and photographic imaging, allowing accurate capture of real-world geometries for the creation or updating of digital models. Ongoing developments aim to further extend these capabilities through the integration of gamma scanning, enabling the combined analysis of geometric and radiological information. Within the DORADO framework, semi-automatic change detection is introduced to compare point clouds acquired at different times, with particular emphasis on automating key processing steps. The objective is to enable the transfer of three-dimensional scan data into Industry IFC models through a well-defined semi-automatic workflow. Artificial intelligence techniques are employed to enhance the efficiency of autonomous change detection, supporting the identification of geometric deviations, the generation of tolerance-based heatmaps, and related analytical tasks.

3.6 Voice Recognition Assistance

Digital tools remain challenging for front-line workers, as generic voice interfaces lack the reliability required for operational use without domain-specific ontologies and integration with industry software such as BIM and SSC (Structures, Systems and Components). In DORADO, a voice assistance system developed by Spix Industries is coupled with an ontology database to improve reporting, traceability, and safety in demanding environments requiring PPE (Personal Protective Equipment). Workers will use voice commands to document discrepancies between BIM or SSC models and on-site observations, as well as to log equipment status or failures in real time. The recognition process combines speech input with optical identification, OCR (Optical Character Recognition) from images, and spatial context.

3.7 Robot Mission Control

Current decommissioning operations suffer from the absence of ontology-based planning in mission control and robotic route optimization, which limits semantic reasoning, structured knowledge representation, and the effective exploitation of heterogeneous robotic platforms. As a consequence, task allocation is often suboptimal and system adaptability to dynamically changing site conditions is reduced. The DORADO framework addresses these limitations through the use of ontological knowledge representation to explicitly model spatial relationships, operational constraints, and task dependencies. This enables context-aware mission planning and dynamic task allocation across a heterogeneous fleet of robots with differing mobility characteristics, sensor suites, and payload capabilities. In addition, the system integrates real-time worker safety monitoring and risk assessment by combining sensory data, semantic mapping, and artificial intelligence techniques to identify and

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mitigate hazards. High-level mission planning is performed within a visual BIM-based environment, allowing intuitive definition of waypoints and scan points, which are subsequently translated into detailed technical mission plans.

The preceding sections report the main interim results achieved during the first part of DORADO, including the requirements analysis, security assessment, data-management architecture, and initial technical integration concepts. The following section describes the demonstration cases that are currently being prepared or executed to validate these developments during the remaining part of the project.

4. Planned demonstration cases

The Work Package (WP) 4 of the DORADO project consists of demonstrations in real use cases. This WP includes 4 specific Tasks: Creation of a parametric 3D model (Task 4.1), utilization of the parametric 3D model for mission planning (Task 4.2), detection of changes in the 3D model over time (Task 4.3), and assessment of safety and risk/hazards for decommissioning (Task 4.4).

For that, data from real facilities will be used:

- The Halden Research Reactor (HRR), located in Halden, Norway. The model of this facility was used in the scope of the PLEIADES project for comparison of manual versus remote radiological characterization land for selected components, including robots equipped with measuring devices whose simulation results were compared with manual characterization approach. This model contains simplified IFC (Industry Foundation Classes) data that can be visualized and used in DORADO for the above-mentioned purposes.

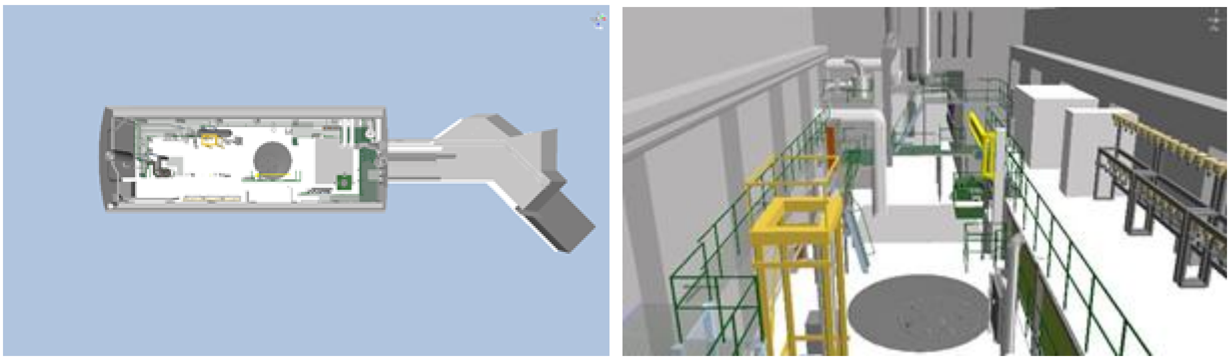

Figure 8: IFC model of the Halden Research Reactor [14]

A point cloud (E57) of a boiler room is also available for 3D reconstruction:

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Figure 9: Point cloud of a boiler room (Daniska et al., 2021)

- The Finland Reactor 1 (FiR1), located in Espoo, Finland. This facility, that was operated by the Technical Research Center of Finland (VTT), is already dismantled. Point cloud data coming from scans, robot operated dose rate, and contamination measurements, are available for research within the scope of the DORADO project. The models are being used for technical development of sensor data fusion and change detection.

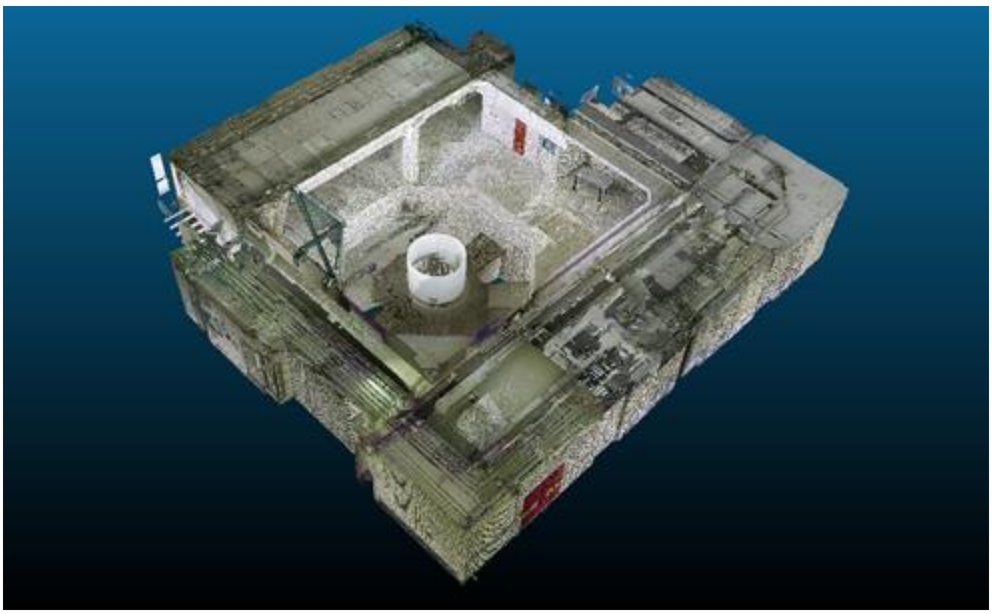

Figure 10: Point cloud scan of the FiR1 reactor hall. The data is collected after dismantling and removing nuclear waste from the reactor site (Räty et al., 2026)

- The Belgian Reactor 3 (BR3) in Mol, Belgium.

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The DORADO platform is integrating data from these facilities in different formats such point clouds, 3D models, dose rate surveys, historical photogrammetry inventory data, etc. Some of this data already exist, while other data is being acquired during the project using various technologies like Terrestrial Laser Scanners (TLS), pictures, as well as robot data such as LiDAR (Light Detection and Ranging), RGB-D, or SLAM (Simultaneous Localization And Mapping). For this purpose, cooperation with the project XS-Ability is being carried out.

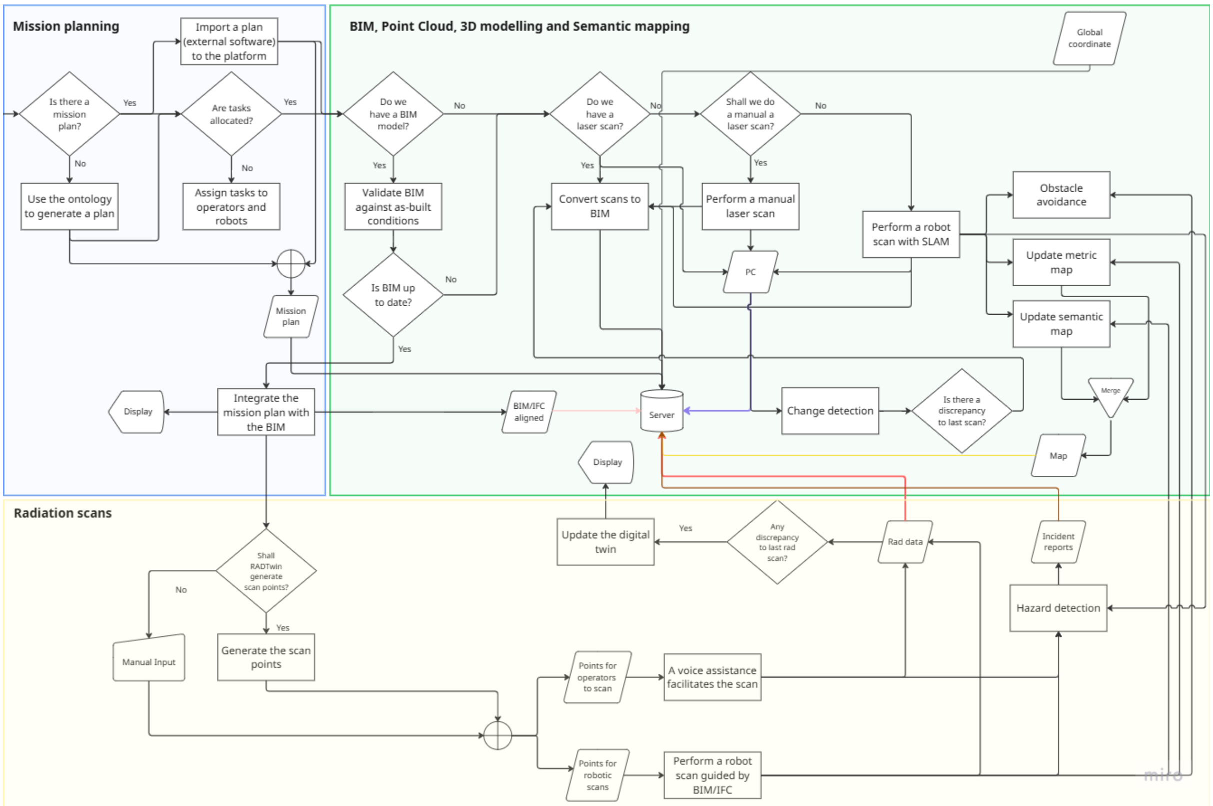

Figure 11: Flow chart illustrating a collective use case for the DORADO platform (Räty et al., 2026)

This figure shows a flow chart of data management in a collective use case within the DORADO platform:

- A new plan is created on the platform's ontology. Missions in this plan are broken down into smaller tasks that are assigned to an agent, either a human or a robot, for execution. Tasks can be linked to a digital model (BIM) to provide a centralized reference for mission execution and documentation.
- The system covers cases where model in CAD or BIM is unavailable or becomes outdated due to ongoing activities. In these situations, the model must be completed by remapping the environment first. This remapping can be done by robots or manually, using a sensor package integrating measurements from different sources like LiDAR (Light Detection And Ranging), Inertial Measurement Unit (IMU), or RGB-D cameras. An updated map of the environment is generated by using the sensors. SLAM is applied to create a map in case that no prior one exists. To preserve the semantic detail needed to use the model in BIM, a multi-layered representation is generated by combining metric

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maps with semantic maps of the scanned areas. Then, a global coordinate system is used to ensure accurate localization when multiple agents are deployed.

- Point cloud data is converted in 3D models using semi-automated methods, then compared to previous scans to detect changes. In case of radiological measurements, multiple scan points are defined, either manually or autonomously, based on the planned tasks. Radiological scans can be performed either by on-site workers or robots. When robots perform the scans, the scanning locations are set using the interface in BIM. When humans perform the scans, results are reported through the voice assistance system. The collected data is processed by the dedicated Artificial Intelligence (AI) module to detect discrepancies or anomalies. This information is used to update the Digital Twin (DT) and trigger alarms if needed.

The DORADO project focuses on achieving impact through various use cases where the different modules of the platform can work together to deliver concrete and measurable input.

5. End users group

The consortium of the DORADO project is very broad, consisting of universities, TSOs (Technical and Scientific Support Organizations), research organizations, and SMEs (Small and Medium Entreprises) across Europe. Therefore, an end-users group was created in order to invite interested parties to contribute int identifying gaps and answering research questions, like: What is your technology and how is it used? What are the benefits of using this technology? How can the technology be applied? How does the technology support nuclear decommissioning and dismantling project?

Conclusions

In many industrial fields, digital technologies are under a very fast development. In nuclear, safety is highly regulated and this can provide a challenging demonstration environment for emerging new digital tools. At the same time, benchmarking digital tools with demonstrations from nuclear facilities is an opportunity to assist the regulators to understand the future technical possibilities, as well to update the regulations to cover all the changes in the operating environment. Nuclear safety practices and digital technologies can mutually benefit from reciprocal learning. The use of robotics and remote handling systems can result in significant cost reduction and minimization of exposure in activities like planning waste segregation and packing, as well as clearance of surfaces and infrastructures. Besides, digital technologies may help estimate costs, identify risk, and manage knowledge.

It can be concluded that the DORADO project is the first pilot integration of front-line digital tools for decommissioning and waste management, that creates a holistic digital platform based on a data-driven approach into a coherent suite for decommissioning applications. DORADO employs an ontology that is compatible with existing standard information representations and is comprehensive enough to model nuclear backend processes. A common server combining the data flow following the BIM methodology integrates the different technologies implemented in the project.

A lot of work was done during the project PLEIADES, built around a dedicated decommissioning ontology (Jacques et al., 2025). Although further implementations have been done during the first half of the DORADO project, demonstrations on real use cases are being done during the second half of the project and main results are expected to be available in 2027.

6. Author contributions

Each coauthor of this paper contributed with content related to his corresponding activity in the project DORADO (Digital Twins and Ontology for Robot Assisted Decommissioning Operations):

- AR as Leader of the project DORADO and the *Work Package 1: Project Management*;
- OZ as Leader of the *Work Package 2: User Needs and Conceptual Design*;
- PH as Leader of the *Work Package 3: System Design and Implementation*;
- JARC as Leader of the *Work Package 4: Demonstrations on Real Use Cases,* and the *Task 4.1: Creation of a Parametric 3D Model*;
- DD as Leader of the *Work Package 5: Dissemination, Exploitation, Communication, and Standardization.*

Competing interests

The authors declare that they have no conflict of interest.

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Data availability

Public data from the DORADO project are available on the website https://www.dorado-project.eu/. Results and publications are continuously updated during the project, and any organization interested in the project can subscribe to the newsletter.

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