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NEXT GENERATION DIGITAL TWINS TO SUPPORT OPTIMISATION, CONSTRUCTION AND OPERATION OF SURFACE AND SUBSURFACE RADIOACTIVE WASTE MANAGEMENT FACILITIES - DITOCO2030

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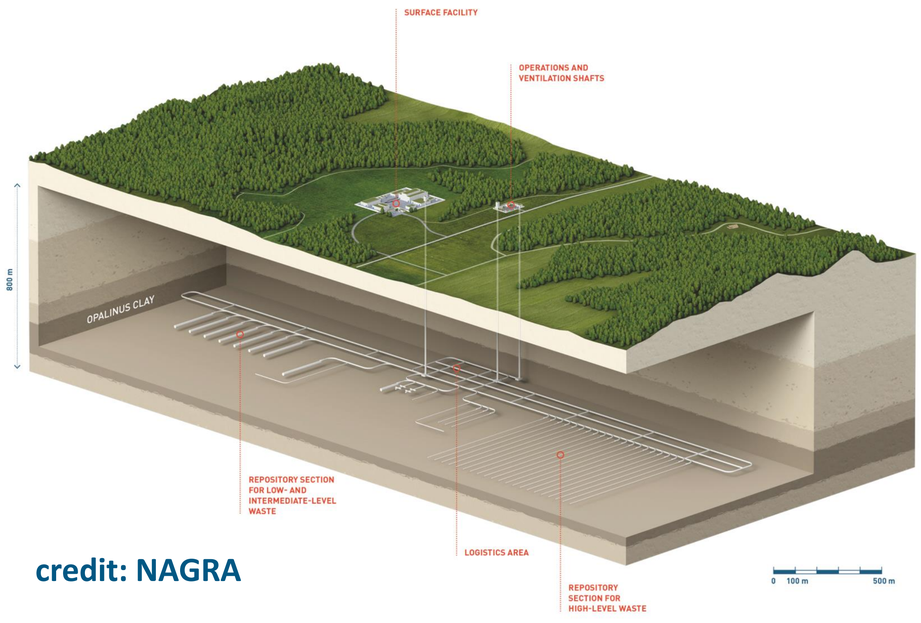
INTRODUCTION

Radioactive waste must be isolated from human habitats for extended periods until its radioactivity decays to a safe level. Deep Geological Repository (DGR) projects are transitioning from research and development to implementation, with Finland at the forefront. Safety is the primary concern in these projects, which are subject to strict regulations, with a strong focus on ensuring long-term safety over thousands of years.



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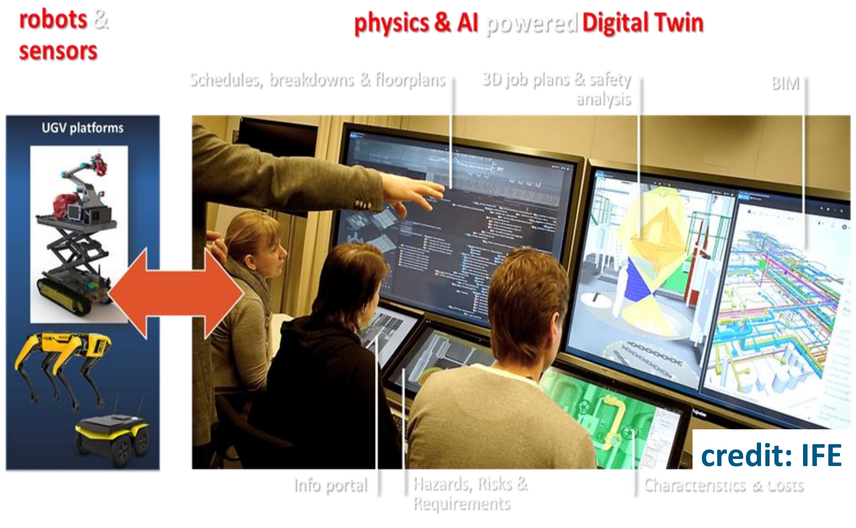

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Digital Twins (DT) are expected to play a key role in the development of such projects, by assisting safety-cost assessments, data integration, stakeholder communication, and predictions regarding the evolution of the site over time. DITOCO2030 work package aims to develop a roadmap for bridging the R&D gap between the currently fragmented Digital Twins of individual disciplines (i.e. engineering, safety, geology, infrastructure development, etc.), data management systems and decision-making platforms.

RESEARCH PROBLEM

One of the main challenges is the Fragmentation of Existing DT Systems: Current DT applications are limited to specific disciplines, which are not yet interconnected. This fragmentation hampers the creation of a unified system for managing nuclear waste. Aligning and integrating the diverse objectives of DT technologies, such as digital engineering and long-term safety, across disciplines such as geology, performance assessment, systems optimization, realization and infrastructure is a significant challenge.

METHODOLOGY

The methodology combines a multi-disciplinary, collaborative approach with a focus on data collection (sate of the art and gap analysis), stakeholder engagement via surveys and webinars and feedback evaluation, followed by strategic recommendations for future DT development, specifically addressing the requirements of end-users. Qualitative and quantitative performance indicators will also be developed to differentiate between effective and ineffective DT in the long term.

RESULTS and CONCLUSIONS

The primary goal of DT is not for real-time operation during the active lifecycle, but rather for supporting the operational management of facilities and ensuring long-term safety. It involves linking various data systems, including 3D models, historical records, and radiological data, to create a cohesive and traceable representation of the assets. The work will support future directions for DT development and research opportunities examining how DT can support regulatory compliance and improve safety by providing real-time monitoring, analysis, and reporting of asset performance and condition.

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