Deliverable 17.8: Interaction of the MODATS WP with EURAD Knowledge Management Work Packages – Synthesis Report

Work Package 17

EURAD Deliverable 17.8 – Interaction of the MODATS WP with EURAD Knowledge Management Work Packages – Synthesis Report

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Acknowledgement

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Executive Summary

The document "EURAD Deliverable 17.8 – Interaction of the MODATS WP with EURAD Knowledge Management Work Packages – Synthesis Report" presents a comprehensive overview of knowledge management (KM) activities planned and achieved in the frame of MODATS work package (WP) implementation.

The report emphasizes the significance of effective KM within implementation of the joint programme, highlights the benefits of KM in harnessing collective expertise, and importance of interactions with experts in driving knowledge dissemination and exchange. Fostering a collaborative environment in the European Joint Programme on Radioactive Waste Management (EURAD) between experts (knowledge 'owners') from Research, Development, and Demonstration (RD&D) and Strategic Studies WPs and KM WPs plays a critical role in the success of KM activities of the Joint Programme.

RD&D WP MODATS is a pilot RD&D WP in the frame of the EURAD programme, which has in its structure a distinct task aimed at interacting with KM WPs (Subtask 4.1). The objective of this interaction is to share excellence, disseminate knowledge and findings generated within the MODATS WP, and integrate them into the KM system developed within the EURAD programme.

At the outset of activity planning, the primary objectives of Subtask 4.1 were outlined as follows:

- Identification of key areas where collaboration between MODATS and KM WPs would be most beneficial.
- Organisation and maintaining regular interaction between MODATS and KM WPs.
- Facilitating the integration of developments between MODATS and KM WPs.

To achieve these objectives, a comprehensive and systematic approach was adopted for planning and organising interactions with KM WPs. This involved systematically analysing the content of planned MODATS WP activities and developments and aligning these with the scheduled KM programme to identify key areas where collaboration between MODATS and KM WPs would be most beneficial (see section 2). Subsequently, a procedure and roadmap for interaction were devised (see section 3) to guide the organised efforts. To establish mutual understanding, the developed approach and roadmap for interaction were reviewed and agreed upon by MODATS and KM WPs management boards.

This report provides a detailed description of the approach for organising interactions between MODATS and KM WPs developed in the first year of the MODATS WP implementation (see Section 2), along with the outcomes of the conducted KM activities (see Section 3) achieved in the frame of MODATS WP implementation.

Also, report reflects on lessons learned, highlighting challenges in involving experts in KM activities and the importance of integrating KM into work plans from the outset. It acknowledges the effectiveness of systematic interaction between WPs and the flexibility required to adapt to programme needs.

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List of Acronyms

DI:	Domain Insight
DGR:	Deep Geological Repository
EURAD:	European Joint Programme on Radioactive Waste Management
GBS:	Goals Breakdown Structure
KM:	Knowledge management
MODATS:	Monitoring Equipment and Data Treatment for Safe Repository Operation and Staged Closure
RD&D:	Research, development, and demonstration
RE:	Research Entity
RMS:	Requirements Management System
RWM:	Radioactive Waste Management
SoK:	State-of-knowledge
TSO:	Technical Support Organisation
WMO:	Waste Management Organisation
WP:	Work Package

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Glossary

Author

The expert responsible for writing the Domain Insight (DI) document. The author plays a vital role in the creation and development of these documents ensuring accuracy, clarity and relevance of the content.

Domain

Level 3 of Goals Breakdown Structure (GBS). An area of activity, interest, or knowledge, especially one that a person, organisation etc. deals with.

Domain Insights (DIs) Documents

Context documents that provide direct links for each knowledge domain to safety and implementation goals related to deep geological repository (DGR) requirements.

End-users

Organisations, experts, newcomers who are potential users of DI documents in general – EURAD community (Waste Management Organisations (WMOs), Technical Support Organisations (TSOs), and Research Entities (REs)) and non-EURAD community, newcomers (somebody who started out in the field of radioactive waste management (RWM)).

EURAD

The European Joint Programme on Radioactive Waste Management (EURAD) [1]. Also referred to as the 'Joint Programme'.

Expert

Someone widely recognized as a reliable source of knowledge, technique or skill whose faculty for judging or deciding rightly, justly, or wisely is regarded with authority and status by their peers or the public in a specific well-distinguished domain.

Goals Breakdown Structure (GBS)

The EURAD goals breakdown structure is a thematic breakdown of knowledge and activities essential for RWM [3]. It comprises Themes (Level 1), Sub-themes (Level 2) and Domains (Level 3), each formulated as goals. Although hierarchical and numbered, the knowledge and activities presented across the GBS should be considered collectively with no weighting to order of importance. Rather it is emphasised that there are many inter-dependencies and linked data across the GBS, where knowledge and activities can be centred in different ways, depending on the end user role and precise boundary conditions of the RWM programme to which the Roadmap is applied.

Knowledge

Knowledge is the acquisition, understanding and interpretation of information. It is often used to refer to bodies of facts and principles accumulated by humankind over the course of time. Knowledge and information each consists of true statements, but knowledge serves a purpose: knowledge confers a capacity for effective action [10].

Knowledge Management (KM)

An integrated, systematic approach of identifying, managing and sharing an organisation's knowledge and enabling groups of people to create new knowledge collectively to help in achieving the organisation's objectives [24].

Newcomer

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Somebody who started out in the field of RWM (students, early career researchers, new employees etc.).

Radioactive Waste Management (RWM)

All activities, administrative and operational, that are involved in the handling, pre-treatment, treatment, conditioning, transport, storage and disposal of radioactive waste.

Review

Activity undertaken to determine the suitability, adequacy and effectiveness of the information to achieve established objectives. The purpose of the review is also to ensure the accuracy and completeness of the information, evaluate the methodologies, identify potential flaws and limitations, and assess the overall contribution to the field of RWM.

Reviewer

The expert involved in the review of the DI document. The reviewers provide feedback to the authors helping them improve the overall quality and impact of the document. They play a vital role in the decision-making process for publication.

Roadmap

A high-level overview of a programme's goals, typical activities and knowledge needed to implement a RWM programme, from the generation of radioactive waste to disposal [3].

State-of-Knowledge (SoK)

Experts' view of the most relevant knowledge and associated uncertainties in a specific domain applied in the context of a RWM programme.

State-of-the-Art (SotA)

Collection of scientific facts underpinning the knowledge base in a domain. SotA documents are oriented typically on a narrower scope and go into significant detail (e.g. focus on mechanistic or process-level understanding). They would not normally demonstrate the application of that knowledge. They typically include lots of technical references and are long documents.

Themes

Themes are large groupings of related Knowledge Domains typical in RWM. They are the highest level of the EURAD Roadmap Goals Breakdown Structure (GBS).

Work Package (WP)

A work package is a group of related tasks established within EURAD. Because they look like projects themselves, they are often thought of as sub-projects within the Joint Programme.

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1. Introduction

1.1 Background

European Joint Programme on Radioactive Waste Management (EURAD) [1] creates a platform of collaborative effort among Member-States in the realm of radioactive waste management (RWM), where the complexities of nuclear technologies intersect with environmental stewardship and public safety. Embracing a diverse spectrum of nations, EURAD encompasses those with and without operational nuclear power programmes, spanning various stages of advancement in their RWM programmes. As these Member-States navigate the challenges posed by differing quantities of radioactive waste, varied geological landscapes and host rocks, and differing disposal concepts, the significance of effective knowledge management (KM) within EURAD cannot be overstated.

KM is an integrated, systematic approach of identifying, managing and sharing a knowledge and enabling groups of people to create new knowledge collectively to help in achieving objectives. KM in the EURAD programme involves systematically capturing, organising, sharing, and utilizing knowledge to support decision-making and ensure the sustainability of RWM. This includes collecting and sharing knowledge, ensuring its preservation and transfer for future generations, creating repositories for data, facilitating information exchange, and fostering collaboration among stakeholders. More information about the EURAD KM&Networking Programme may be found at [2].

At the heart of EURAD's mission lies a robust framework for KM, recognizing it as an indispensable tool for fostering coherency, efficiency, and innovation across Member-States' RWM endeavours. This KM framework encompasses the facilitation of access to existing knowledge, the guidance in devising and executing research, development, and demonstration (RD&D) plans, as well as the provision of specialized training and mobility opportunities aligned with core competencies in the field.

The role of KM in EURAD [2] is to better harvest this existing knowledge and integrate with it newly created knowledge, giving weight to:

- Importance: Improved orientation of knowledge - how knowledge contributes to specific implementation goals and activities in RWM;
- Proficiency: Improved definition of needed competences – what level of proficiency is needed and available to support programmes;
- Codification: Improving accessibility to knowledge by signposting to people and documents, use of a common structure, digitisation, or other codification activities – how knowledge is documented, stored and easily re-used;
- Diffusion: Improving socialisation, training, and networking – how knowledge is transferred and spread.

Implementation of such large Joint Programme as EURAD provides the opportunity to improve KM in the field of RWM. As examples of possible benefits:

1. Harnessing collective expertise: RWM is a field with technical, environmental, and societal complexities. Through effective KM in the Joint Programme, the collective expertise of Member-States in EURAD may be harnessed, pooling together diverse perspectives, experiences, and technical know-how. This collective intelligence serves as a cornerstone for informed decision-making, ensuring that strategies and solutions are informed by reliable knowledge.

2. Mitigating risks and uncertainties: RWM entails inherent risks and uncertainties, ranging from the long-term behaviour of waste repositories to the socio-political dynamics surrounding nuclear energy. KM within the Joint Programme plays an important role in mitigating these risks by facilitating the dissemination of up-to-date scientific findings, technical advancements, and lessons learned from past experiences. By staying abreast of emerging research and good practices, Member-States can proactively address challenges and uncertainties, enhancing the safety and effectiveness of their RWM strategies.

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3. Optimizing resource allocation: In an era of budget constraints and competing priorities, efficient resource allocation is paramount. KM supports the optimisation of the allocation of financial, human, and infrastructural resources across Member-States. By identifying areas of common interest, sharing resources, and avoiding duplication of efforts, the Joint Programme maximizes the impact of its investments in RWM research, development, and training.

4. Facilitating technology transfer and innovation: The field of RWM is constantly evolving, driven by advances in science, technology, and regulatory frameworks. KM within the Joint Programme serves as a catalyst for technology transfer and innovation, facilitating the exchange of cutting-edge methodologies, tools, and solutions among Member-States. By fostering collaboration and cross-pollination of ideas, EURAD can accelerate the pace of innovation, driving continuous improvement in RWM practices.

5. Building institutional capacity: Effective RWM requires not only technical expertise but also robust institutional capacity within Member-States. KM initiatives within EURAD, such as training programs and methodological guidances, play a role in building and strengthening this capacity. By equipping professionals with the necessary skills, knowledge, and resources, EURAD empowers Member-States to effectively navigate the complexities of RWM, both now and in the future.

In EURAD (2019--2024), KM is being considered in three separate foundational WPs:

- WP11 'State of Knowledge' (SoK) - Aims to help maintain and preserve current state-of-knowledge in RWM;
- WP12 'Guidance' - Provides guidance and assistance on KM methods, aimed at developing a comprehensive suite of instructional guidance documents that can be used by Member-States with RWM programmes that are at an early stage of development with respect to their RWM programme;
- WP13 'Training & Mobility' – Aims to develop a diverse portfolio of tailored basic and specialised training courses under the umbrella of a "School of Radioactive Waste Management This involves taking stock of and building upon existing initiatives (i.e., International Atomic Energy Agency (IAEA) and Nuclear Energy Agency (NEA)) and creating new initiatives to bridge identified gaps. Additionally, the programme organises a mobility initiative to provide access to dedicated infrastructures within EURAD.

Separate KM WPs were launched at the beginning of the EURAD and it was determined from the very beginning that productive KM activities rely heavily on interactions with experts who possess the necessary expertise. EURAD gathered a pool of experts, that span various disciplines within RWM, and are crucial to knowledge dissemination and exchange. Fostering a collaborative environment in EURAD between experts (knowledge 'owners') from RD&D and Strategic Studies WPs and KM WPs plays a critical role in the success of KM activities of the Joint Programme.

RD&D WP MODATS (Monitoring Equipment and Data Treatment for Safe Repository Operation and Staged Closure) was established to address the issue of confidence in monitoring data used in support of the post-closure safety case through RD&D on data acquisition and management, the use of the data to enhance system understanding, further development of specific monitoring technologies, and consideration of how interactions with civil society on repository monitoring can proceed.

MODATS WP was prepared to launch in the third year of EURAD (the second wave) and was scheduled for implementation over a span of three years. During the initial two years of EURAD implementation, KM WPs encountered difficulties in establishing consistent communication and interaction with the RD&D and StSt WPs. There were also challenges in engaging experts in the development of KM documents and training courses. As a test of a different approach to address these issues, during the preparation of the MODATS WP, a specific subtask was proposed. This subtask aimed to integrate KM activities into the RD&D WP. The goal was to enhance the effectiveness and outcomes of both KM and RD&D efforts within the Joint Programme. By embedding KM tasks within the RD&D framework, the

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initiative sought to foster better collaboration, ensure consistent expert involvement, and improve the overall efficiency of the programme's objectives.

MODATS WP is a pilot RD&D WP in the framework of the EURAD programme which has in its structure a distinct task aimed at interacting with KM WPs (Subtask 4.1). The objective of this interaction is to share excellence, disseminate knowledge and findings generated within the MODATS WP, and integrate them into the KM system developed within the EURAD programme.

The objectives of Subtask 4.1 were outlined as follows:

- Identification of key areas where collaboration between MODATS and KM WPs would be most beneficial.
- Organisation and maintaining regular interaction between MODATS and KM WPs.
- Facilitating the integration of developments between MODATS and KM WPs.

1.2   Objective and scope

The purpose of this report is to provide a concise overview of the approaches and outcomes of the interactions between MODATS and KM WPs within EURAD. The report compiles the work conducted under Subtask 4.1 of the MODATS WP, detailing the approach developed and employed to organise these interactions, methodologies used for conservative identification of key areas where collaboration would be most beneficial, the practical steps taken to implement these interactions offering insights into the processes and outcomes of these efforts, and the lessons learned. The experiences gained from this work provide a framework for similar future endeavors and can be valuable for members of the joint programme community who are involved or will be involved in organising and enhancing regular systematic interactions and networks between KM teams and knowledge providers from different work packages in subsequent programmes. This enhanced interaction and networking capability will contribute to the overall success and efficiency of future programmes within the Joint Programme framework. The report aims to support and guide those who are and will be involved in organising and expanding these vital collaborative networks.

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2. Identification of key areas of possible collaboration between MODATS and KM WPs

According to the EURAD KM Programme [2], the EURAD Roadmap [3] was developed as a central tool for organising, structuring, and facilitating the sharing of available knowledge on RWM. The EURAD Roadmap Goals Breakdown Structure (GBS) [3] serves as a comprehensive framework designed to systematically categorize and disseminate RWM knowledge, and aims to ensure that all relevant information is easily accessible and well-organised, facilitating efficient knowledge transfer and supporting the identification of knowledge gaps and the development of new knowledge resources. The GBS comprises 7 Themes (Level 1), 27 Sub-themes (Level 2) and 79 Domains (Level 3), each formulated as goals. The GBS is fully presented at [3]. As example, Figure 1 shows the breakdown of one theme (Theme 6 – Siting and Licensing) of the EURAD GBS into the three levels (theme, sub-theme, domain) and the formulated "goals" [23].
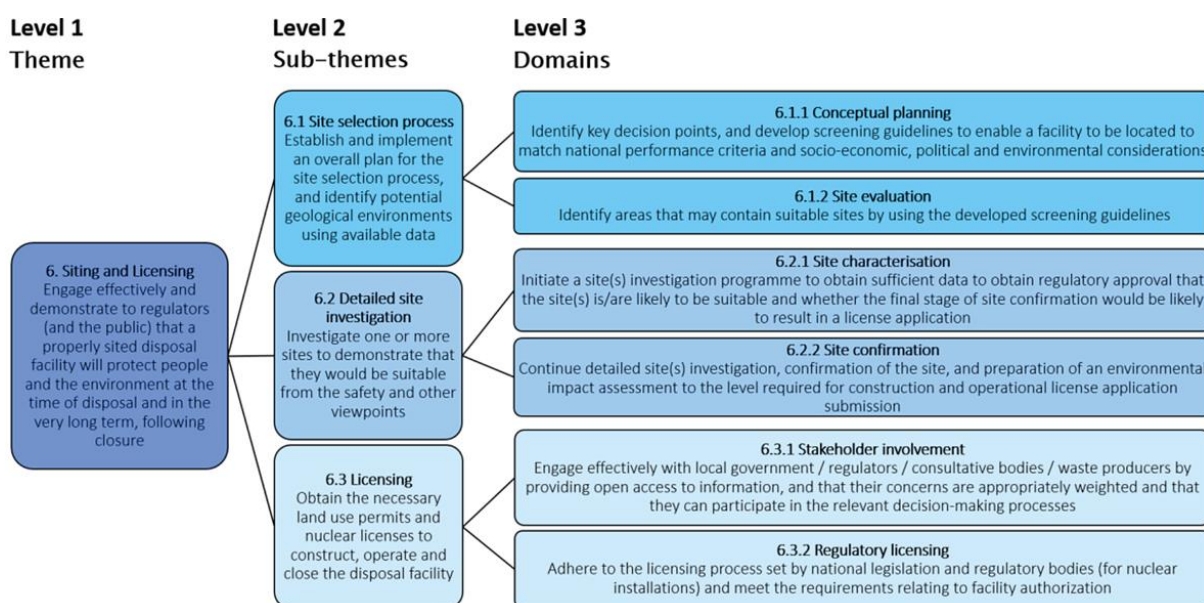

Figure 1 – Example for the breakdown of one theme (Theme 6 – Siting and Licensing) of the EURAD GBS into the three levels (theme, sub-theme, domain) and the formulated "goals" [23]

The EURAD KM Programme goal is centred around the use of the EURAD Roadmap as the main structure (schema, GBS, glossary, safety functions and implementation goals) to guide experts during their development of new knowledge (in RD&D and StSt WPs) and transfer and codification and contextualisation of existing knowledge (in KM WPs). Therefore, at the outset of planning for collaboration ways between MODATS and KM WPs, key areas were identified considering the EURAD Roadmap and GBS.

The analysis for identification of key areas for possible collaboration involved systematically comparing the planned activities and developments in the MODATS WP, as outlined in [4], with the provisions of scheduled EURAD KM Programme, EURAD Roadmap and developments in KM WPs. A conservative approach was adopted for the analysis. This approach involved evaluating the main areas where experts from the MODATS WP could make direct contributions to the EURAD KM Programme. It also proposed ways to integrate developments from MODATS WP into the EURAD KM Programme, and explored how outputs from KM WPs could be utilized within MODATS WP. This detailed examination aimed to find the way for enhancing the effectiveness and outcomes of both MODATS and KM efforts.

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It also should be noted that representatives of Subtask 4.1 in the MODATS WP were also active participants in KM WPs, that helped organise this initial comprehensive work of KM representatives 'from the inside' of the RD&D WP. Their dual involvement ensured a more integrated and informed approach to identifying collaborative opportunities.

The specifics and key results of the analysis for identification of key areas for collaboration between MODATS and each KM WPs are presented below in Sections 2.1-2.3. These sections outline the methodology used for the analysis, the identified key areas for collaboration, and the proposed strategies for integrating the efforts of MODATS and KM WPs.

2.1   MODATS WP and KM WP11 'State of Knowledge'

KM WP11 'State of Knowledge' (SoK) populates the EURAD Roadmap by capturing relevant knowledge and associated uncertainties in the field of RWM and make it available to end-users through dedicated KM documents. These documents are written on different levels of detail to allow the end-user to access the knowledge on their suitable level of expertise (KM documents hierarchy is presented on Figure 2 [23]).
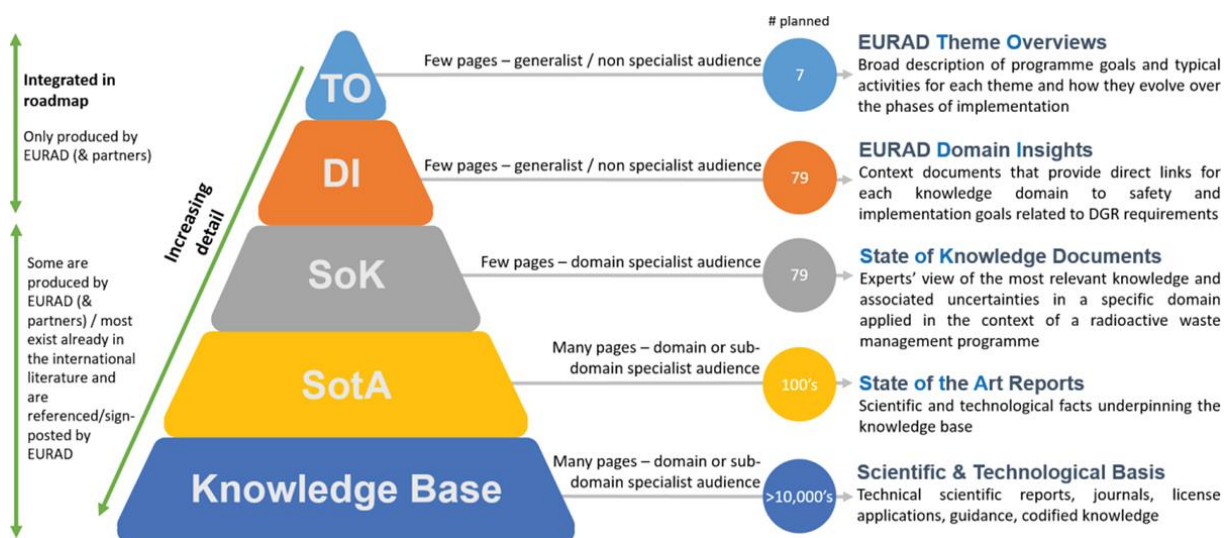
Figure 2 – Hierachy of documents that are relevant for the work of KM WP11 in the EURAD KM programme [23]

The production of State-of-Knowledge (SoK) and Domain Insights (DI) documents is one of the key tasks of the KM WP11. In the frame of KM WP11 work it was planned to develop only two State-of-Knowledge documents as demonstration cases, while primarily focusing on the creation of Domain Insights (DI) documents. To identify potential areas for collaboration between MODATS WP and KM WP11, a comparative analysis was conducted. This analysis compared the planned activities and developments in the MODATS WP, as detailed in [4], with the EURAD GBS as a list of Domain Insight documents scheduled for development within KM WP11.

The description of MODATS WP planned activities and developments [4], which were used for comparative analysis, includes:

- overall objective of MODATS WP activities;

- breakdown of activities into tasks (main research Task 2 'Data Treatment for Increased Confidence in Repository Monitoring' and Task 3 'Novel and Optimised Monitoring Technology or Repository Monitoring');

- breakdown of tasks into Subtasks (5 Subtasks within Task 2 and 3 Subtasks within Task 3).

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Considering the EURAD GBS and MODATS WP structure, the comparative analysis of the planned in [4] MODATS WP developments and the EURAD GBS (as a list of Domain Insight documents scheduled for development within KM WP11) was carried using the following approach:

1)   At the first level, descriptions of the MODATS WP overall objective and 7 EURAD GBS Themes were compared to determine the matching level (High, Average, Low) between MODATS WP and each Theme. Example of the comparison result for one EURAD GBS Theme (Theme 3 – Engineered Barrier System) is provided in Table 1.

MODATS WP Overall Objectives	EURAD GBS Themes	Matching Level	General Content of Matching
The overall objective of the MODATS R&D WP is to evaluate, develop and describe methods and technologies, and to provide the means to measure, treat, analyse and manage data in a consistent manner. The ambition of the project is to address the detailed questions regarding monitoring data that have been identified, but not resolved in previous EC projects. At the end of the WP, a series of tools, methods and guidance documents on, and examples of how, data acquisition, management and treatment can be undertaken during operation will be available for programmes to use in designing monitoring programmes for specific repositories	3. Engineered Barrier System Develop an engineered barrier system, tailored to the characteristics of the waste and compatible with the natural (geological) barrier, that performs its desired functions, for the long-term disposal of radioactive waste (EBS)	High	The properties of the engineered barrier system and the programme to monitor the condition of barriers (monitoring types, methods, scopes, etc.) are in strong interaction

Table 1 – Example of the comparison result for one EURAD GBS Theme (Theme 3 – Engineered Barrier System) and the descriptions of the MODATS WP Overall Objective

2)   At the second level, descriptions of MODATS WP Task 2 and Task 3 objectives and the 16 EURAD GBS Sub-themes were compared. Only the Themes with a "High" matching level from the first level were chosen for comparison. Example of the comparison result for 3 EURAD GBS Sub-themes (Sub-themes 5.1-5.3) is provided in Table 2.

MODATS WP Tasks	EURAD GBS Sub-themes	Matching Level	General Content of Matching
Detailed description of MODATS Task 2 (Data Treatment for Increased Confidence in Repository Monitoring) and Task 3	Theme 5. Design and Optimisation		
	5.1 Design and develop a disposal system for the national radioactive waste inventory (Design)	High	The disposal facility monitoring programme and design features are an important part of the disposal facility design. However,

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(Novel and Optimised Monitoring Technology for Repository Monitoring) are provided in [4]			monitoring is not the main driver for the facility design.
	5.2 Demonstrate and verify that facility components and barriers can be practically manufactured, constructed and installed in accordance with detailed design requirements and specifications (Constructability, demonstration and verification testing)	Average	MODATS WP does not address monitoring during construction of a disposal facility. The construction results may influence the monitoring programme at the operational and post-closure stages. Here are the QA/QC aspects
	5.3 Prevent theft of nuclear material or sabotage of nuclear facilities and protect sensitive technology, software and information (Security and safeguards)	Low	MODATS WP does not address these aspects

Table 2 – Example of the comparison result for 3 EURAD GBS Sub-themes (Sub-themes 5.1-5.3) and the descriptions of the MODATS WP Task 2 and Task 3 Objectives

3) At the third level, descriptions of MODATS WP Subtasks objectives and 31 GBS Domains were compared. Only the Sub-themes with a "High" matching level at the second level were chosen. Example of the comparison result for 2 EURAD GBS Domains (Domains 4.4.1 and 4.3.3) is provided in Table 3.

MODATS WP Subtasks	EURAD GBS Domains	Matching Level	General Content of Matching
Detailed description of MODATS Subtasks (5 Subtasks within Task 2 and 3 Subtasks within Task 3) are provided in [4]	Theme 4. Geoscience		
	4.1.1 Develop a model of the host rock and surrounding geological environment, including distributions of rock types, geometry and properties of structural features, geotechnical properties and the hydrogeological and hydrogeochemical environment (Site descriptive model)	High	The monitoring program significantly depends on the role of natural barriers in achievement of safety objectives and on the properties of natural barriers. On the other hand, MODATS WP summarizes monitoring data for the geological environment. The geological environment is also modelled in MODATS WP in integration with monitoring data
	4.3.3. Assess the effects of future human actions (human intrusion by exploration activities, exploitation of natural	Low	Human intrusion into a disposal facility is not addressed in MODATS WP

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	resources within, above and below the host rock)		

Table 3 – Example of the comparison result for 2 EURAD GBS Domains (Domains 4.4.1 and 4.3.3) and the descriptions of the MODATS WP Subtasks Objectives

Based on the comparative analysis results outlined in Tables 1, 2, and 3, the following key areas of possible collaboration between MODATS WP and KM WP11 were identified:

1)   "High" matching has been observed for MODATS WP and 4 EURAD GBS Themes:

-   Theme 3. Engineered Barrier System;

-   Theme 4. Geoscience;

-   Theme 5. Design and Optimisation;

-   Theme 7. Safety Case.

2)   Within Theme 3 'Engineered Barrier System', "High" matching is noted for 2 Sub-themes (3.3 and 3.4) and 5 Domains (3.3.1, 3.3.2, 3.3.3, 3.4.1, and 3.4.2). Results from the development of Domain Insights documents for mentioned Domains could be used within MODATS WP (for students, newcomers, etc).

3)   In Theme 4 'Geoscience', "High" matching is observed for 4 Sub-Themes (4.1, 4.2, 4.3, and 4.4) and 6 Domains (4.1.1, 4.1.2, 4.2.1, 4.3.1, 4.3.2, and 4.4.1). Insights from MODATS WP developments could be used in the development of Domain Insights documents for these Domains and vice versa. Collaboration between MODATS WP and WP11 is beneficial here.

There's potential for MODATS WP experts to develop Domain Insight document for Domain 4.4.1 'Provide commented tables with key data, key figures (conceptual models) and comments on the interrelationships of site characteristics, perturbations and long-term evolution (stability). This report should contain the so-called Geo-Datasets for long-term safety analyses and repository concepts (layout and construction) for each licensing phase'.

4)   Theme 5 'Design and Optimisation' shows "High" matching for 3 Sub-Themes (5.1, 5.4, and 5.5) and 8 Domains (5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.4.2, 5.5.1, 5.5.2, and 5.5.3). Results of the MODATS WP developments could be used in the development of Domain Insights documents for these Domains and vice versa. Interaction between MODATS WP and KM WP11 is important in the development of Domain Insights documents for these Domains.

There's high potential for MODATS WP experts to develop Domain Insight documents for Domains:

➢   5.5.1 'Establish plans and methods for implementing baseline environmental monitoring programme ready for the start of site characterisation (Baseline monitoring)';
➢   5.5.2 'Establish plans and methods for implementing a monitoring program to be performed during site investigation, construction and operational phases of the repository (Monitoring with regard to onsite investigation, construction and Operations)'.

5)   Within Theme 7 'Safety Case', "High" matching is noted for 3 Sub-Themes (7.1, 7.2, and 7.3) and 7 Domains (7.1.1, 7.1.2, 7.2.1, 7.2.2, 7.3.1, 7.3.2, and 7.3.3). Results of the MODATS WP developments could be used in the development of Domain Insight documents for these Domains and vice versa. Collaboration between MODATS WP and WP11 is beneficial here.

MODATS WP experts could contribute to EURAD KM Programme through:

➢   being main authors of Domain Insights documents for Domains 5.5.1 and 5.5.2;
➢   being potential co-authors of Domain Insights document for Domain 4.4.1;
➢   performing reviews of Domain Insights documents, at least for some of Domains marked with "High";

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➢ sharing WP results and insights for consideration in the development of Domain Insights documents, at least for some of Domains marked with "High";

➢ enhancing dissemination of available Domain Insights documents (for example, sharing documents with students, newcomers, etc. in MODATS WP members organisations).

Furthermore, for each Domain KM WP11 team is looking for sign-posting to available documents. MODATS WP contribution would be extremely beneficial in case of providing a table with references and sign-posting information.

Results of practical interaction between MODATS WP and KM WP11 in EURAD are stated in the Section 3.1.

2.2   MODATS WP and KM WP12 'Guidance'

KM WP12 'Guidance' populates the EURAD Roadmap by developing a comprehensive suite of instructional guidance documents that can be used by Member States with RWM programmes. To identify potential areas for collaboration between MODATS WP and KM WP12, a comparative analysis was conducted. This analysis compared the planned guidance-like documents in the MODATS WP, as detailed in [4], their relation to the EURAD GBS, and guidance documents slated for development within KM WP12.

1.   According to [4], specific guidance documents were planned to be developed within MODATS WP:
-    In the frame of Subtask 2.2 'Data Management Start' it was planned to develop guidance on the development of databases for monitoring data and provision of the data to support enhanced system understanding;
-    In the frame of Subtask 2.3 'Development of Enhanced Understanding through Integration of Monitoring Data and Models' it was planned to develop a set of guidelines describing the data analysis process and software tools supporting this process.

These described topics for guidance documents were compared with the EURAD GBS and it was noted that inclusion of MODATS WP guidance documents into the set of guidelines within KM WP12 could be considered. For MODATS WP Guidance documents, which are candidates for use in KM WP12, it should be determined through interactions whether they can be directly used or need supplementation/modification for KM WP12 purposes.

2.   Initially, KM WP12 team created a short list of topics for pilot guidance development [6] that included following topics:

-    Funding and Financing Aspects of Radioactive Waste Disposal;
-    Optimization of Disposal of Radioactive Waste;
-    Derivation of Requirements for the Disposal System;
-    Waste Acceptance Criteria.

The first guidance was developed on cost assessment and financing schemes of RWM programmes. Then, a screening of current guidance documents and materials similar to guides regarding the geological disposal of spent nuclear fuel and radioactive waste [8] was conducted and existing gaps were analysed as part of the work. Additionally, a list of prioritized topics for future guidance documents was compiled taking into account the interests and needs of end-users [7]. The requirements management system (RMS) issues were chosen as topics for the next 3 guidance documents slated for development within KM WP12.

The possible ways for MODATS WP collaboration with KM WP12 were identified as follows:

1) In the frame of report [8] finalisation, at the request of KM WP12, MODATS WP experts may evaluate individual sections of this deliverable if relevant scientific groups and experts have the time and resources;

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2) Within KM WP12, several workshops aimed at preparation for developing the set of Guidelines "Requirements Quality Management" (RQM) were planned. MODATS WP experts could participate in these workshops if relevant scientific groups and experts have the time and resources.

3) MODATS WP guidance documents could be included into the set of guidelines within KM WP12. It should be determined through interactions whether they can be directly used or need supplementation/modification for KM WP12 purposes.

Results of practical interaction between MODATS WP and KM WP12 in EURAD are stated in the Section 3.2.

2.3   MODATS WP and KM WP13 'Training & Mobility'

To identify potential areas for collaboration between MODATS WP and KM WP13 'Training & Mobility', a comparative analysis was conducted. This analysis compared the planned activities and developments in the MODATS WP, as detailed in [4], with the list of training courses announced for development within KM WP13.

KM WP13 aims to establish the 'School of RWM', serving as the executive body for all training and mobility actions organised within EURAD. For training courses, a diverse portfolio of tailored basic and specialized courses was established, aligning with the EURAD Roadmap. A list of training needs from RD&D and StSt WPs in EURAD was prepared and outlined in [9]. These new training courses were planned to be developed by KM WP13 in close collaboration with RD&D and StSt WPs, as well as external training providers. Table 4 below provides information from [9] on topics for training courses aligned with the EURAD GBS that have at the same time both 'High' priorities for end-users and 'High' matching levels between these topics and MODATS WP activities fields (based on data from the analysis described in Section 2.1).

Topics aligned with the EURAD GBS	Level of matching with MODATS WP	Common training themes
3. Engineered Barrier Systems Develop an engineered barrier system, tailored to the characteristics of the waste and compatible with the natural (geological) barrier, that performs its desired functions, for the long-term disposal of radioactive waste (EBC)	High	Monitoring of engineered barriers of a disposal facility. Monitoring types, methods, scopes, duration, instrumentation, etc. depending on the functions and properties of engineered barriers (barrier materials, barrier design features). Analysis and management of monitoring data.
4. Geoscience Assemble geological information for site selection, facility design and demonstration of long-term safety (Geoscience)	High	Monitoring of the properties and behaviour (evolution) of the geological environment as natural barriers of a disposal facility. Monitoring types, methods, scopes, duration, and instrumentation depending on the properties and role of natural barriers in achieving safety objectives. Analysis and management of monitoring data and modelling of the geological environment in integration with the monitoring data.

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5.1 Design Design and develop a disposal system for the national radioactive waste inventory (Design)	High	Development of a monitoring system in designing a disposal facility. The design basis (requirements and criteria) of the monitoring system as part of the disposal facility design basis. Interrelation of functions and design features of engineered and natural disposal barriers with functions and design features of the monitoring system. Development of technical specifications for the monitoring system of the disposal facility.
7.1 Safety strategy Establish the safety fundamentals as a basis for the safety assessment (Safety strategy)	High	Establishment of safety fundamentals for the disposal facility monitoring programme as the basis for safety assessment of the disposal facility.
7.2.1 Safety case production Maintain and develop a synthesis of all available information relevant to facility safety, required for regulatory compliance, and to guide forward disposal programme activities (Safety case production)	High	Analysis and management of monitoring data for development of models and other purposes. Performance of disposal facility safety assessments. Development of integrated vision of how the monitoring data will contribute to a shared understanding of the repository system and its evaluation.
7.3.1 Performance assessment and system models Quantify how the facility and its components behave and evolve to provide continuing safety (Performance assessment and system models)	High	Monitoring of the disposal facility and its components as a tool to assess the evolution of the disposal facility (current and predicted) against safety performance indicators.
7.3.2 Treatment of uncertainty Characterise uncertainties and determine their implications for the outcome of the safety assessment (Treatment of uncertainty)	High	Optimization of monitoring for the disposal facility taking into account analysis of its evolution scenarios, behaviour of engineered and natural barriers and assessments of uncertainties.

Table 4 – Common Themes of Potential MODATS WP Training for KM WP13

The possible ways for MODATS WP collaboration with KM WP13 were identified as follows:

1) MODATS WP could consider development of training courses within MODATS WP or WP13 KM on specific issues of DGR monitoring indicated in Table 4.

2) Series of workshops are planned within MODATS WP. The opportunity could be provided for external listeners to participate (via KM WP13) in lectures given at MODATS WP workshops. Also, potential use of workshops materials for development of the training course could be considered.

3) Participants of MODATS WP could participate as end-users in training courses organised by KM WP13 and vice versa.

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4) Participants of MODATS WP could participate in EURAD mobility programme.

The scope, content, and terms of MODATS WP expert participation in training course preparation and execution, as well as the conditions for involving external listeners in MODATS WP workshops, are decided on a case-by-case basis through agreements between KM WP13 and relevant MODATS WP scientific groups (experts).

Results of practical interaction between MODATS WP and KM WP13 in EURAD are stated in the Section 3.3.

3. Experience of practical interaction between MODATS WP and KM WPs

Firstly, it is important to note that the interaction with KM WPs was facilitated by the MODATS WP leader and the Steering Committee. Main communication regarding KM within MODATS WP was conducted through exchanging information on the status of MODATS WP and KM WPs implementation and discussions during periodic meetings of the MODATS WP Steering Committee and Annual face-to-face meetings.

In the first year of MODATS WP implementation, the Subtask 4.1 team developed an action plan, approach, and roadmap for organising interactions. The approach and roadmap were presented, discussed, and agreed upon with the leaders of MODATS and KM WPs, as well as the MODATS WP Steering Committee.

The representative of Task 4 in the MODATS WP Steering Committee was at the same time an active participant in KM WPs, which made it possible to:

- Provide an up-to-date overview of KM WPs activities at MODATS WP meetings;
- Announce the current needs of KM WPs in collaboration with RD&D WPs experts;
- Suggest possible interaction options to the MODATS WP Steering Committee, considering experts' workload within MODATS WP implementation;
- Discuss potential interaction options and contributions of MODATS WP experts to the KM programme during periodic KM WPs meetings;
- Maintain continuous communication between MODATS and KM WPs;
- Disseminate information about the pilot Subtask try to organise comprehensive interaction, developed approach and collaboration results to the EURAD community.

Based on the discussions at the MODATS WP Steering Committee and Annual face-to-face meetings, decisions were made regarding planning and involving experts in interaction with KM WPs. In specific cases, the Subtask 4.1 team sought additional support from the MODATS WP leader. During the organisation and execution of all interactions between MODATS WP and KM WPs, the Subtask 4.1 team consistently provided support to MODATS WP experts.

3.1 MODATS WP and KM WP11 'State of Knowledge'

3.1.1 Domain Insights Document Production

The main collaboration between MODATS WP and KM WP11 focused on the production of Domain Insights documents. As stated in [12]: "The Domain Insights documents are short context documents (10 – 20 pages long) that provide a general overview and information about safety and implementation goals about a domain that is relevant to RWM. They should function as an entry-point and allow the end-users to orient themselves in the domain at hand. This includes giving information about the context of the domain, its relevance and connection to other domains, and pointing to other knowledge resources to dive further into the domain."

After identifying common needs (see Section 2), two main knowledge domains were identified for the WP's activities:

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➢ 5.5.1 "Establish plans and methods for implementing baseline environmental monitoring programme ready for the start of site characterisation (Baseline monitoring)";

➢ 5.5.2 "Establish plans and methods for implementing a monitoring program to be performed during site investigation, construction and operational phases of the repository (Monitoring with regard to onsite investigation, construction and Operations)".

Decisions regarding the involvement of MODATS WP experts in creating Domain Insights documents and the selection of authors and reviewers were discussed by the Subtask 4.1 team with the MODATS WP leader and representatives of Steering Committee. These discussions were also presented to all MODATS WP participants during annual face-to-face meetings. Following internal discussions, two experts agreed to dedicate time and effort to collaboratively lead the development of Domain Insights documents for domains 5.5.1 and 5.5.2, while two others agreed to serve as reviewers (MODATS WP leader and Steering Committee representatives).

Before commencing production activities for Domain Insights documents, a kick-off meeting involving authors, reviewers, and KM WP11 representatives was initiated by the Subtask 4.1 team on January 20th, 2023. The purpose was to discuss the entire document production process and establish clear expectations for particular documents. The following was discussed and agreed on:

- context of the selected domains;
- objectives of the particular Domain Insights documents;
- distribution of work between authors;
- target audience;
- scope/topics and preliminary structure of the Domain Insights documents;
- writing principles;
- steps of development and approval of the Domain Insights documents;
- reimbursement of work and contracting;
- proposed timeline for the development;
- contacts and roles;
- actions to be taken.

Authors and reviewers were briefed on the procedures and recommendations for producing Domain Insight documents, including QA Procedures for the Generation of SoK Demonstration Cases [10], Procedures to involve Knowledge providers [11], and Authors Guidance & Template [12].

During the development process, authors proposed merging domains 5.5.1 (Baseline monitoring) and 5.5.2 (Monitoring with regard to onsite investigation, construction, and Operations) into a single Domain Insights document. Their rationale was that monitoring supports decisions across all repository monitoring phases, from early site characterisation to closure. Keeping baseline monitoring separate from construction, operational, and closure monitoring could create an unnatural break in the topic, which is likely to result in two disconnected and/or highly repetitious Domain Insight documents. Therefore, they suggested creating one document covering monitoring throughout all repository phases.

This proposal, along with the corresponding rationale, was submitted to reviewers for consideration alongside the drafted document.

At the time of writing, this Domain Insight document is in preparation. The document provides an introduction to monitoring in repository programmes, focussing on activities and knowledge most critical for the implementation of monitoring through the different repository phases. It contains:

- Typical overall goals and activities in the domain of monitoring;
- Features, characteristics, or properties of monitoring that contribute to support long-term safety of the disposal system and to feasible implementation of geological disposal;
- Integrated information, data or knowledge from other domains that impacts understanding of monitoring;
- Information about past and ongoing RD&D projects, long-term safety case, optimisation challenges and innovations;

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- International examples of repository monitoring;
- Uncertainties;
- Links and references to the knowledge sources in domain.

At the time of finalizing this report, reviewers had reviewed the document draft and provided their comments and suggestions to the authors and the KM WP11 team. Overall, the document draft was well-received by the reviewers, and with some minor revisions and simplification of language in places, it will be highly beneficial to end-users.

Next steps toward finalizing the document include:

- authors' response to reviewers' comments;
- agreement on the finalised Domain Insight document;
- publication on the EURAD website [1], [3], EURAD Wiki [13], INIS (IAEA) [14], and EURAD ProjectPlace;
- socialisation through dissemination to end-users and asking them for feedback exchange, organisation of lecture (webinar) to present Domain Insight document etc. The extent of these activities will depend on the document's development timeline and the proximity to completion of the EURAD programme;
- evaluation of production process, authors' and reviewers' feedback, lessons learned and recommendations, closing meeting. The extent of these activities will depend on the document's development timeline and the proximity to completion of the EURAD programme.

3.1.2 Feedback

As part of the process to capture the current State-of-Knowledge and make it accessible to interested end-users, feedback collection is essential [15]. Receiving feedback is foreseen from, in particular, authors and reviewers of Domain Insight documents, and different groups of end-users in the form of answers to the questionnaires [16]-[18], discussions on EURAD online resources, at seminars, workshops, etc.

Information about developed documents and the feedback collection mechanism were presented by Subtask 4.1 team to MODATS WP representatives during Annual face-to-face meetings, inviting their participation in the feedback campaign. Several feedback responses on Domain Insight documents from PhD students, acting as end-users from MODATS WP participating organisations, were received by KM WP11.

Additionally, to optimize the production of future Domain Insight documents, after finalizing the development of the Domain Insight document by MODATS WP experts, corresponding questionnaires [16] and [17] will be sent to authors and reviewers inviting to share opinions on the process and outcomes of producing the document, as well as thoughts on its future use.

3.2   MODATS WP and KM WP12 'Guidance'

The collaboration between MODATS WP and KM WP12 occurred within the framework of developing and promoting guidance documents on the requirements management system (RMS).

It was planned to develop three documents in interaction with the EURAD community: a General RMS guideline and supportive Topic A and Topic B guidelines. The topic for the first main document (Guidance on Developing, Using, and Modifying an RMS for Implementing a Disposal System, DS-RMS) was chosen using literature survey material [8], potential topics considered for the pilot guide selection process [6]-[7], feedback from potential end-users, other EURAD WPs, and the editorial board. The topics of the two supporting documents, Topic A (Guidance on Developing, Using, and Modifying an RMS for Post-Closure Safety of Disposal Systems) and Topic B (RMS Implementation in the Overall RWM Programme) guidelines, were selected through discussions with end-users.

![eurad logo] European Joint Programme on Radioactive Waste Management

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The production of the KM WP12 guidances [5] is based on end-users needs and is developed through interaction with them via workshops, questionnaire(s), sharing draft documents for commenting and through interactions in-between workshops among end-users and groups of end-users having similar questions and needs.

The possibility of MODATS WP experts' participation in the development process of guidance documents on the RMS was presented by the Subtask 4.1 team and discussed during periodic meetings of the MODATS WP Steering Committee, as well as during MODATS WP annual face-to-face meetings and KM WP12 meetings. It was decided that MODATS WP experts could provide limited contributions to this work, particularly in communicating the role of monitoring in requirements management, i.e., what monitoring can and cannot do.

During the preparation of KM WP12 workshops for discussing key issues of RMS, possible topics for Topic A and Topic B guidelines, and draft guidance documents, information about the planned event and all preparatory materials were sent by the Subtask 4.1 team

to the MODATS WP leader and Steering Committee. Throughout the creation of the three guidance documents, draft guidance documents were also forwarded by the Subtask 4.1 team to the MODATS WP leader and Steering Committee.

Depending on availability, representatives of MODATS WP contributed by:

- Participating in online workshops and discussions with end-users;
- Providing comments, questions, and feedback on draft guidance documents;
- Participating in face-to-face EURAD Training courses on the application of RMSs (January 16 - January 18, 2024).

3.3   MODATS WP and KM WP13 'Training & Mobility'

3.3.1   Training course

Following the identification of common needs (see Section 2), it was noted that potential cooperation between KM WP13 and MODATS WP could involve the participation of MODATS WP experts in the development and delivery of training courses on specific issues related to deep geological repository monitoring.

The involvement of MODATS WP experts in creating the training course and selecting lecturers was discussed by the Subtask 4.1 team with the MODATS WP leader and Steering Committee representatives and presented to all MODATS WP participants during annual face-to-face meetings. As a result, internal agreement was reached to create a training course, and MODATS WP experts agreed to dedicate their time and resources to prepare and deliver lectures for the upcoming course.

Before commencing activities on developing the monitoring training course, a kick-off meeting with MODATS WP and KM WP13 leaders was initiated by the Subtask 4.1 team on January 10th, 2023. The meeting aimed to discuss possible options, conditions, content, logistics, funding for MODATS experts' contribution, and the overall procedure for course development [19]. The following was discussed:

- future training course topic and timeline;
- quality criteria for preparation of a training course;
- target audience;
- budget;
- recording;
- actions to be taken.

It was decided that the training course from MODATS WP experts could focus on monitoring data management, as it is one of the objectives of the MODATS WP. To showcase most of MODATS WP's results and insights and ensure thorough preparation, the training course was scheduled for the beginning of 2024, the final year of EURAD programme implementation.

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MODATS WP experts, with support from the Subtask 4.1 team, prepared a draft proposal outlining the course's objectives, target audience, content, learning outcomes, required competences, etc.

The "EURAD Training course on Monitoring in Geological Disposal facilities of radioactive waste" was organised from January 22nd to January 26th, 2024. [20]. The training course was targeted to offer an overview of monitoring aspects in the field of geological disposal (in crystalline and clay host rocks) and methodology to conduct a monitoring strategy. The training aimed to provide participants a set of competences based on the work inside the EU project dedicated on monitoring (including MoDeRn, Modern2020). The course programme is presented in Table 5, and more detailed information can be found at [20].

Time	Subject	Presenter
Day One		
10:00-10:30	Introduction to MODATS and the Monitoring Training School	Johan Bertrand, Andra
10:30-12:00	General Aspects of Monitoring	Matt White, GSL
13:00-14:30	Monitoring Technologies, Part I	Johan Bertrand, Andra
Day Two		
10:30-12:00	Monitoring Screening Methodology	Tom Haines, GSL
13:00-14:30	Monitoring Technologies, Part II	Johan Bertrand, Andra
Day Three		
10:30-12:00	Example of Monitoring Approaches in Crystalline Rock	Johanna Hansen, Posiva
13:00-14:30	Example of Monitoring Approaches in Clay Rock	Johan Bertrand, Andra
Day Four		
10:30-12:00	Stakeholder Participation in R&D of Monitoring Systems for Geological Disposal	Julien Dewoghélaëre, NTW
13:00-14:30	Damage zone monitoring, Jan Cornet, ANDRA	Jan Cornet, Andra
Day Five		
10:00-11:00	Monitoring QAPPS	Matt White, GSL
11:00-12:00	Monitoring FEPS	Matt White, GSL
13:00-13:40	Data Treatment	Anoop Ebey Thomas, ESI
13:40-14:20	Artificial Intelligence	Nicolas Hascoët, ENSAM
14:20-15:00	Hybrid Twin	David Munoz Pellicer, ENSAM

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Table 5 – The programme of the monitoring training course developed by MODATS WP experts

During the registration period, a considerable number of individuals expressed interest in participating in the training course (95 participants from 25 countries). During the training course, the online lectures attracted between 31 to 47 participants daily. Distribution of registered participants by types of organisations and countries is shown at the Figure 3 and Table 6 respectively.
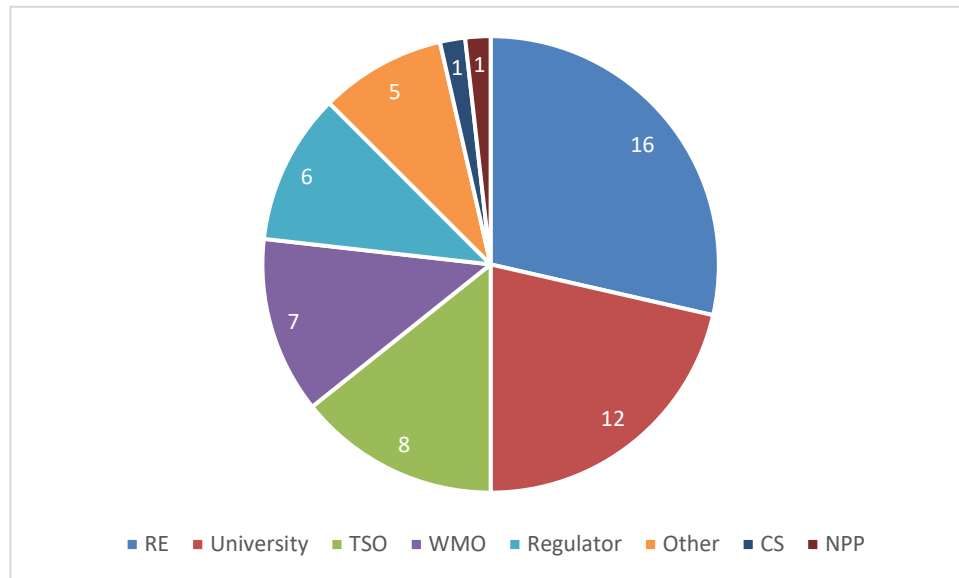

Figure 3 – Distribution of registered participants by types of organisations (RE – Research Entities, University, TSO – Technical Support Organisations, WMO – Waste Management Organisation, Regulator, CS – Civil Society, NPP – Nuclear Power Plants, other)

No	Country	Number of registered participants	No	Country	Number of registered participants
1	UK	17	14	Sweden	3
2	Czech	11	15	Argentine	2
3	Belgium	8	16	International	2
4	Finland	7	17	Italy	2
5	Germany	6	18	Lithuania	2
6	Finland	7	19	Croatia	1
7	Germany	6	20	India	1
8	South Korea	5	21	Netherlands	1
9	Spain	5	22	Poland	1
10	Switzerland	5	23	Russia	1

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11	Ukraine	5	24	Serbia	1
12	France	3	25	South Africa	1
13	Norway	3	Total		95

Table 6 – Distribution of registered participants by countries

During the training course it was shown that successful strategy for radioactive waste disposal should address both technical and societal needs, and monitoring has the potential to contribute to both of these aspects. Monitoring during repository operations can be used to build further understanding of the processes occurring in the repository during operational phase (construction, waste emplacement, backfilling and closure) and early post-closure phase. Monitoring can also contribute to public and stakeholder understanding of processes occurring in the repository, and hence, it can respond to public concerns and be used to build further confidence in geological disposal in addition to that achieved during licensing. Monitoring can therefore play a role in enabling waste management organisations to work towards the safe disposal of radioactive waste.

3.3.2 Synthesis session

The Subtask 4.1 team proposed organising an online synthesis session supported by KM WP13 at the end of the EURAD programme implementation (May 22, 2024) to disseminate the results of the three-year activities of the WP after completing the work on the MODATS WP report documents [21]. This proposal was positively received and discussed at Steering Committee and MODATS WP annual face-to-face meetings.

MODATS WP synthesis session aimed to give a summary of the key results, lessons learned, and actions taken in the MODATS WP. The findings covered main research and technical results, complemented with information about the WP management approach (Steering Committee), civil society engagement, interaction with other WPs and contribution to EURAD KM Programme. It was also shown that MODATS results can be used to build confidence in monitoring data by contributing to the three main purposes of monitoring data recognized by the IAEA. Illustrative examples of how the work contributes to each monitoring purpose was given. The recording of the MODATS WP synthesis session will be available at the [21].

3.4 MODATS WP Meetings

It should be also noted that during the implementation of MODATS WP, KM was an integral part of the strategic meetings of the Steering Committee and the annual reporting meetings of WP participants. This served as good practice, allowing the Subtask 4.1 team to provide an up-to-date overview of KM WP activities, discuss current KM WPs needs in collaboration with RD&D WP experts, explore possible interaction options, involve RD&D experts in KM activities, and gather their experience and ideas on KM needs and activities. During the planning of annual reporting meetings for WP participants, a separate session was allocated for KM issues. Leaders of EURAD KM WP11, WP12, WP13, and PREDIS KM WP3 were invited to present and discuss KM activities during annual reporting meetings of MODATS WP.

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4. Summary and outcomes

This document provides a comprehensive analysis of the KM initiatives within the MODATS WP framework in the EURAD programme. MODATS is the only RD&D WP in the programme, within which a separate subtask was provided for organising interaction with KM WPs (subtask 4.1). The objective of this interaction is to share excellence, disseminate knowledge and findings generated within the MODATS WP, and integrate them into the KM system developed within the EURAD programme.

Primary objectives of Subtask 4.1 include:

- identification of key areas where collaboration between MODATS and KM WPs would be most beneficial;

- organisation and maintenance of regular interaction between MODATS and KM WPs;

- facilitation of integration of developments between MODATS and KM WPs.

A systematic approach was adopted to plan and organise interactions, ensuring alignment with both MODATS WP activities and the scheduled KM programme. The report provides a detailed description of the approach and outcomes achieved during the MODATS WP implementation.

The approach presented in Section 2 for identifying potential collaboration pathways between the MODATS and KM WPs was intentionally quite conservative. The results of this analysis helped pinpoint areas where there might be theoretical interest in organising interactions. It is important to note that the aim of Subtask 4.1 of the MODATS WP was not to implement all possible interaction scenarios between MODATS and KM WPs.

The main achievements of subtask 4.1 include:

- developing an approach for identification of key areas for possible collaboration between MODATS and KM WPs and organising interaction;

- regular monitoring of the progress of MODATS and KM WPs on touch points and determination of recommendations for the mutual use of development results;

- participation of MODATS WP experts , as far as possible, in various EURAD programme KM activities, such as:

  - contributing to development and dissemination of Domain Insights documents (as authors and reviewers);

  - providing end-users feedback (improving the effectiveness of KM Programme for the needs of end-users);

  - contributing to guidance documents production process;

  - developing and conducting of monitoring training course;

  - preparing and conducting of synthesis session for dissemination of MODATS WP results;

- KM activities became integral part of MODATS WP (KM Ambassador inside of R&D WP).

A significant advantage was that the KM Ambassador responsible for subtask 4.1 was simultaneously a participant in three KM EURAD WPs and MODATS WP Steering Committee, and was involved in their activities. This facilitated: provision of an up-to-date overview of KM WPs activities at MODATS WP meetings; announcements of the current needs of KM WPs in collaboration with RD&D WPs experts; suggestions of possible interaction options to the MODATS WP Steering Committee, considering experts' workload within MODATS WP implementation; discussion of potential interaction options and contributions of MODATS WP experts to the KM programme during periodic KM WPs meetings; continuous communication between MODATS and KM WPs; dissemination of information about the

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pilot try to organise comprehensive interaction, developed approach and collaboration results to the EURAD community. Interaction with KM WPs was facilitated by the MODATS WP leader and the Steering Committee. Thanks to this close interaction, participants of the MODATS WP had a much better understanding of KM issues than any other WPs, were open to discussions, and suggested their visions on improvement of EURAD KM Programme considering R&D needs.

Based on the results of the interaction between MODATS and KM WPs, it can be said that contributions to the interaction were made by both sides. Specifically:

1)   Contributions of MODATS WP experts to the EURAD KM Programme included developing and reviewing DI documents, creating and conducting specialized training course and synthesis sessions, and preparing comments and feedback on relevant topics of the WP.

2)   Organization and continuous support from the KM Ambassador within MODATS WP and KM WPs leaders from outside, including disseminating information and providing detailed explanations about the EURAD KM Programme, assistance with DI document/guidance/trainings production (meetings for discussions, explanations, editorial reviews, dissemination of developments, publishing on various platforms), and participation in MODATS WP annual meetings with KM-related presentations and trainings.

Key lessons learnt from organising interaction between RD&D and KM WPs in the frame of MODATS WP subtask 4.1:

➢ Joint programme benefits: EURAD gathered a pool of experts, that span various disciplines within RWM, and may be the lifeblood of knowledge dissemination and exchange. Fostering a collaborative environment in EURAD between experts (knowledge 'owners') from RD&D and StSt WPs and KM WPs plays a critical role in the success of KM activities of the Joint Programme;

➢ Systematic interaction: Integrating KM into work plans of WPs from the outset and maintaining regular communication channels is crucial for sustaining programme effectiveness and achieving long-term objective. The presence of a KM Ambassador in R&D WP to build a bridge between R&D and KM WPs is an advantage and is recommended;

➢ Engaging Experts: Difficulties were faced in finding and attracting experts with knowledge in writing KM documents, creating training courses, reviewing reporting documents etc. KM work has often been considered additional by the experts. For future programmes, it would be beneficial to fully recognise the efforts made by the experts (100% reimbursement) and to make KM activities a planned part of the work within the WP;

➢ Flexibility: Flexible mechanism and the ability to adjust the course of work depending on the needs of the programme is needed;

➢ Knowledge Transfer: Various methods are employed for transferring knowledge and forming an end-user community, including publication on platforms like the EURAD website, EURADSchool website, EURAD Wiki, IAEA INIS, social media, webinars, and training sessions, indicating substantial interest and engagement. Nevertheless, considering the breadth of the joint programme.effectiveness of transferring knowledge and forming end-users community might be improved;

➢ Long-term Accessibility: Tools to ensure long-term accessibility and useability of programme results and knowledge should be created;

➢ Dissemination and visibility of results might be improved.

In conclusion, this synthesis report underscores the significant role of KM in the successful implementation of joint programmes like EURAD. Effective communication, collaboration, and integration of KM activities are essential for harnessing collective expertise and ensuring the long-term success and confidence in programme outcomes. Despite challenges, the report demonstrates the

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tangible benefits of systematic interaction between RD&D and KM WPs, emphasizing the need for proactive planning, continuous support, and flexibility to adapt to evolving program needs. Moving forward, integrating KM into work plans from the outset and maintaining regular communication channels will be crucial for sustaining programme effectiveness and achieving long-term objectives. Experience and lessons learned can be used in further organisation of systematic interaction between WPs in follow-up programmes.

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