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Project Data Management Plan Update 1 (WP7)

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Executive Summary

Deliverable D7.7 provides the first update of the MARCO-BOLO Project Data Management Plan, originally delivered as D7.2. This update does not introduce structural changes to the project data management strategy, but documents how the approach defined at project level remains valid and is being operationalised through the technical developments carried out under WP1. In particular, D7.7 acknowledges the availability of updated and extended guidance provided through Deliverables D1.1 and D1.2, which specify concrete tools, workflows and examples to support Work Packages in the description, publication and interoperability of MARCO-BOLO data and knowledge outputs. This deliverable therefore serves as a light-touch update, ensuring consistency between the project-level Data Management Plan and the evolving implementation practices, while avoiding duplication of content already documented in detail in WP1 deliverables

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Introduction

D1.1 outlined the high level strategic direction and idealized approach for the capture, description and publication of knowledge artifacts generated from the Horizon Europe funded MARCO-BOLO project. The overall aim is to achieve FAIR, linked-open (meta)data for MARCO-BOLO by using schema.org JSON-LD, established community vocabularies, and persistent identifiers, with harvesting through ODIS to facilitate the widest possible discoverability and interoperability. D1.2 reports how this approach has been tested and operationalised across the consortium, focusing on a user-friendly metadata authoring pathway and concrete repository routes.

Principles and Continuity with D7.2

The update presented in this deliverable remains fully aligned with the data and information management principles established in Deliverables D1.1 and D1.2, which continue to constitute the foundation of MARCO-BOLO's overall strategy. No changes to the core conceptual framework are introduced. Instead, this update reinforces existing commitments and clarifies how previously defined principles continue to guide implementation during the current reporting period.

In line with D1.1 and D1.2, MARCO-BOLO maintains the principle of **“publish once, use many times”** as a central organising concept for data and metadata management. This principle underpins the project's approach to minimising duplication of effort while maximising the long-term value, reusability, and visibility of data assets generated within the project. Once data and metadata are curated according to agreed standards, they are intended to support reuse across systems, disciplines, and downstream products without requiring repeated manual intervention.

Additionally the activity outlined in D1.1 and D1.2 establishes and defines the workflows to connect MARCO-BOLO outputs to the IOC ODIS architecture facilitating a lasting legacy and interoperability beyond the project lifespan.

The alignment with the established framework is further reflected in the continued prioritisation of web-scale interoperability. As defined in D1.1 and reaffirmed in D1.2, MARCO-BOLO adopts schema.org expressed through JSON-LD as the core metadata representation. This choice ensures consistency with existing commitments and supports the embedding of structured, machine-readable metadata directly within web resources. Such an approach enables automated discovery, indexing, and integration by external systems, including search engines, aggregators, and knowledge graphs, in line with the project's FAIR objectives and beyond domain-specific infrastructures.

Persistent Identifiers (PIDs) remain a foundational component of the MARCO-BOLO data strategy, fully aligned with earlier deliverables. As described in D1.1 and D1.2, PIDs provide globally unique and resolvable references for datasets, software, protocols, and related research objects. Their continued use ensures traceability, citability, and long-term accessibility of MARCO-BOLO outputs beyond the project lifetime, supporting transparency, reproducibility, and long-term stewardship. The implementation and wider utilisation of PIDs supports the needs of the academic community to gain





recognition for their contributions through data citation and effective usage tracking.

This update also remains aligned with the project's commitment to complement FAIR principles with **CARE** and **TRUST** considerations, as already articulated in D1.1 and D1.2. These frameworks are recognised as essential when dealing with sensitive, contextual, or community-related data, ensuring that ethical responsibilities, governance considerations, and accountability are embedded alongside technical interoperability and reuse.

Overall, this deliverable does not introduce new data management principles, tools, or governance mechanisms. Instead, it confirms continuity with the established MARCO-BOLO data and information management framework, ensuring that all updates remain consistent with previously agreed strategies while supporting their ongoing implementation.

Alignment with WP1 Data Management Deliverables (D1.1 and D1.2)

Since the outset of MARCO-BOLO, Work Package 1 (WP1) has acted as the backbone for data and information management across the consortium, supporting the knowledge generation activities of the other WPs. Work Package 1's role has been to translate project-level data management principles into practical guidance, specifications, and tools that can be adopted by the technical work packages (WP2–WP5) in support of their scientific activities. This approach has been developed from established principles supporting open data, but done in an iterative manner through a cycle of engagement with representatives of the technical work packages to develop digital literacy and increase engagement.

Deliverables D1.1 and D1.2 provide a significantly more detailed and operational perspective on data management than the project-level DMP. While D7.2 and this update (D7.7) focus on governance, principles, and overall strategy, WP1 deliverables address the *how* of data and metadata generation, publication, and interoperability.

D1.2, in particular, reaffirms the principles laid out in D1.1 while providing additional context, clarifications, and practical guidance. It consolidates the project's approach around the concept of "publish once, use many times", aiming to minimise duplication of effort and maximise the reuse potential of MARCO-BOLO data assets across multiple systems and downstream products in a manner that will continue beyond the completion of the MARCO-BOLO project.

This update therefore recognises that the effective implementation of the project-level DMP is closely linked to the uptake of WP1 guidance by the technical work packages. At the same time, it acknowledges that WP1's role is supportive and enabling: WP1 provides frameworks, tools, and assistance, but the actual generation, curation, and publication of data remain the responsibility of the respective work packages.





Practical Implementation and Current Limitations

While the strategic and technical foundations for data management are well established, the practical implementation of these principles depends on active engagement from all technical work packages. As highlighted in discussions with WP1, variations in levels of engagement and responsiveness have affected the pace and consistency with which data management guidance is adopted across the consortium.

This update does not seek to attribute responsibility or introduce corrective measures but rather to transparently acknowledge this dependency. WP1 continues to provide support, guidance, and opportunities for alignment; however, it cannot implement data management practices on behalf of other work packages.

These observations do not represent a deviation from the project's data management strategy but reflect the practical realities of implementing a common framework across a diverse, multidisciplinary consortium.

An appreciation of the experimental and iterative approach undertaken by WP1 improved engagement and understanding across the project partners, highlighting the importance of transparent communication and shared understanding of approaches in effective adoption of project data management activities.

WP1 Outputs Supporting Implementation

Beyond strategic alignment, WP1 has progressively delivered a set of concrete outputs that support the practical implementation of MARCO-BOLO's data management strategy across technical work packages.

These outputs include:

- metadata authoring templates and structured guidance to support consistent dataset description across WPs;
- clarified repository pathways and publication routes aligned with project-level interoperability objectives;
- protocol and workflow recommendations supporting reproducibility and standardisation;
- persistent identifier (PID) assignment guidance ensuring long-term traceability and citability of project outputs.

While these outputs are described in detail in Deliverables D1.1 and D1.2, their relevance for D7.7 lies in demonstrating the relevance and accuracy of the project-level Data Management Plan and how the DMP is actively supported by operational instruments, rather than remaining a purely conceptual framework.

WP1 continues to act as an enabling layer, lowering the barrier for adoption of FAIR-aligned practices while recognising that implementation ultimately depends on the engagement and capacity of individual technical work packages.





Evidence of Progressive Operationalisation

Since the delivery of D7.2, the MARCO-BOLO data management framework has moved from initial definition towards progressive operationalisation.

This evolution is reflected in:

- increased clarity around roles and responsibilities for data and metadata generation;
- improved alignment between technical workflows and project-level governance principles;
- growing integration of FAIR-aligned practices within ongoing WP activities, particularly where data publication and interoperability are central.

While levels of adoption remain heterogeneous across work packages, this variability reflects the diversity of scientific domains and maturity levels within the consortium rather than a weakness of the underlying framework.

D7.7 therefore documents a consolidation phase, in which the project-level Data Management Plan remains stable while its practical implementation continues to mature through iterative engagement and support.

Risks, Constraints, and Mitigation Measures

The main risks associated with the implementation of MARCO-BOLO's data management strategy are not technical in nature, but organisational.

These include:

- variable engagement levels across work packages;
- differing disciplinary norms around data sharing and publication;
- timing constraints linked to scientific workflows and data readiness.

Mitigation measures focus on continued support rather than enforcement. WP1 addresses these risks through guidance, consultation, and alignment opportunities, while avoiding prescriptive or centralised implementation that would conflict with the distributed responsibility model adopted by the project.

These constraints do not constitute deviations from the Data Management Plan, but rather define the operational context within which it is applied

The final deliverable of WP1 (D1.3: Final report, gap analysis, and demonstrators of digital exchange) will serve as record of the challenges encountered, lessons learned and operationable solutions.

Summary and Outlook

In summary, Deliverable D7.7 confirms the continued validity of the MARCO-BOLO Project Data Management Plan as defined in D7.2. No changes to the project-level data management principles are introduced through this update clearly demonstrating the effort and value the MARCO-BOLO project team placed on placing data management activities at the core of the project.

The document highlights the strong alignment between the project-level DMP and the more detailed, technically focused deliverables produced under WP1, particularly D1.1 and D1.2. Together, these





documents form a coherent and complementary framework supporting FAIR, interoperable, and responsible data management across the project. D7.7 therefore reflects a consolidation and maturation phase of the MARCO-BOLO data management framework, in which strategic principles remain stable while operational uptake continues to expand across work packages.

Future refinements and examples of implementation are expected to continue emerging through WP1 activities and through the ongoing work of the technical work packages, within the boundaries of the existing data management framework.

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