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myLog: A MODERN, INTEGRATED LOGBOOK FOR SCIENTIFIC COLLABORATION AT EUROPEAN XFEL

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Abstract

Scientific experiments at large-scale research facilities require flexible and collaborative tools to document, discuss, and track the progress of the experiment. We present *myLog*[1], a modern logbook solution developed at European XFEL following four years of iterative prototyping with users and staff of the facility.

Designed to address the evolving needs of scientists and support teams, *myLog* combines a user-friendly interface with a robust, modular architecture. It uses *Zulip* for real-time discussion-thread-based communication and leverages the facility's metadata catalogue, *myMdC*, to orchestrate workflows and deliver enriched interfaces. This tight integration enables seamless linkage between discussions, control system events, experiment metadata, and data analysis artifacts.

myLog emphasises user-driven organization of communication: experiment groups can configure information structure and notifications, while Principal Investigators maintain full access control. Real-time integration with the facility's metadata catalogue *myMdC*, control system *Karabo* and Data Analysis tool *DAMNIT*[2] enables the automatic logging of key events, complemented by manual entries as needed.

Data governance is enforced through embargo policies, ensuring secure handling of sensitive information. By merging communication, metadata, and automation in a single platform, *myLog* provides a scalable, future-proof approach to scientific logging and collaboration. This paper presents an overview of the solution architecture and its integration into the facility infrastructure.

INTRODUCTION

Large-scale scientific facilities such as the European XFEL conduct highly complex experimental campaigns that involve diverse interdisciplinary teams. Their experiments often generate not only petabytes of raw data but also a wealth of contextual information like sample details, instrument settings, operator notes, and real-time observations and communication, which are essential for interpreting the results. Traditional logbooks capture some of this information, but not all, and often fail to provide the structure and traceability needed for complex, distributed workflows [1].

Replacing such a long-standing tool required more than a technical upgrade: it involved introducing new concepts and workflows while preserving continuity for users. The development of *myLog* [2] was therefore driven by the need for a unified solution that integrates logging, context-aware metadata, and automation within the facility's data management ecosystem.

In this paper, we present the design principles, integration strategies, and deployment of *myLog*, a solution built on Zulip [3] and extended by *myMdC* [4] to meet the specific requirements of experiment and operational logbooks at European XFEL.

MOTIVATION AND REQUIREMENTS

The development of *myLog* was driven by several key factors:

- **Complexity of Experiments:** Experiments combine diverse diagnostics, detectors, and data sources with complex control infrastructures, all producing high-throughput data and metadata streams. Beyond raw data, configuration changes such as detector selection, parameter tuning, and adjustments to monitoring and control data sources occur frequently and must be logged with precision to maintain experiment integrity and reproducibility.
- **Collaboration Across Teams Before Beamtime:** Experiment preparation often begins months in advance and involves coordination between multiple groups, including instrument scientists, sample specialists, data and software experts, facility support teams, and user groups. Effective collaboration requires structured communication channels to capture discussions, decisions, and evolving configurations.
- **Collaboration During Beamtime:** Experiment shifts typically involve multiple groups working in parallel, 24/7, requiring collaborative continuous communication to maintain alignment of information.
- **Collaboration After Beamtime:** Post-experiment communication remains essential, especially for complex data analysis workflows that may take weeks or months.
- **Data Governance and Compliance:** Sensitive information as embargoed results and proprietary procedures, must be securely managed according to facility policies.
- **Integration with Existing Infrastructure:** The solution must integrate seamlessly with available data

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[1] available at https://mylog.connect.xfel.eu/
[2] Data And Metadata iNspection Interactive Thing

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systems such as *myMdC* [4] for metadata management, Karabo [5, 6] for control system events, and *DAMNIT* [7] for near-online and post-processing data analysis.

- **Extensibility:** The system should support easy integration with new tools and smooth migration from legacy logbooks.

User studies and early prototypes revealed that a simple digital notebook was insufficient; instead, scientists required a structured, context-aware collaboration platform that unifies communication, metadata, and automation.

SYSTEM ARCHITECTURE

MyLog adopts a modular architecture with four primary components, designed to ensure scalability, fault tolerance, and seamless integration with existing facility services:

1. **Collaboration Engine:** At the core of the solution is *Zulip*, an open-source platform that enables real-time, topic-based threaded discussions linked to proposal-specific or operational logbooks.
2. **Metadata Orchestration:** The orchestration and management of the logbooks is handled by *myMdC*, which ensures context-aware logbook creation and the automatic association of metadata, such as user permissions and bot[3] provisioning.
   Automated accounts that can post messages or react to events
3. **User Interfaces (UI):** *myLog* supports different user workflows by providing several interfaces, including the **Zulip web interface**, which is ideal for instrument experts and operators using shared computers in the instrument station and offers quick access to multiple logbooks (see Fig. 1); the **Zulip desktop and mobile applications**, which are optimised for personal devices and day-to-day communication, allowing users to stay connected during and between shifts; and the ***myMdC* web interface**, which provides context-specific access for logbook configuration, metadata management, and advanced WYSIWYG[4] editing (see Fig. 2, Fig. 3, and Fig. 4). All interfaces provide structured navigation, clear organisation of information, and advanced search capabilities with full-text and contextual filtering.
4. **Application Integration Layer:** This component ensures that external applications can be easily integrated with the *myLog* ecosystem through RESTful APIs.

FEATURES AND FUNCTIONALITIES

Collaboration Engine: Zulip

MyLog leverages the robust capabilities of *Zulip*, an open-source team communication platform, to fulfil a broad spectrum of users' requirements:

- **Threaded Conversations:** Messages are organised by topics within streams, ensuring structured and traceable discussions. Topics can be adapted to chat-like

[3] Automated agents in Zulip used to integrate with external systems. They can post messages, react to events and send notifications.

[4] WYSIWYG acronym for: What You See Is What You Get

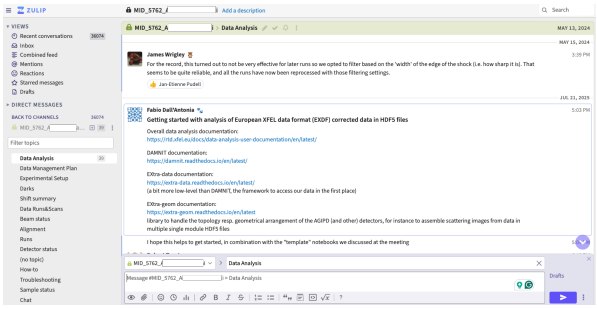

Figure 1: Zulip GUI depicting Logbook topics and entries.

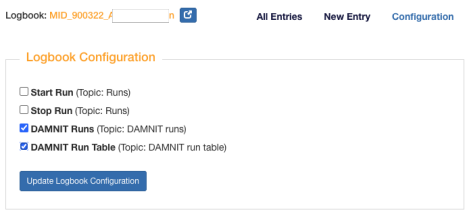

Figure 2: MyLog GUI in myMdC: Logbook configuration available to Instrument Experts.

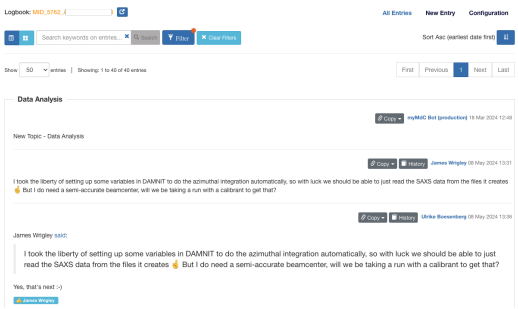

Figure 3: MyLog GUI in myMdC: Logbook entries reading in Detailed View mode.

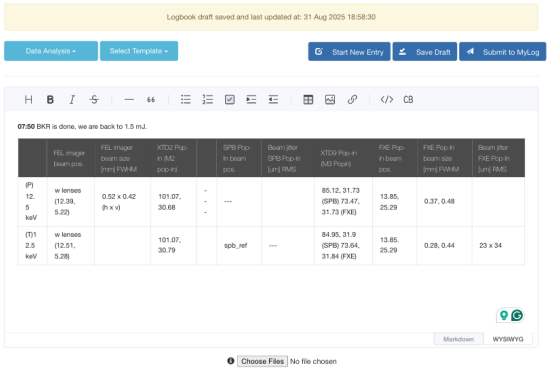

Figure 4: MyLog GUI in myMdC: entry in *WYSIWYG* mode.

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or documentation-style formats, making *Zulip* suitable for communication and logbook documentation before, during, and after beamtime, where users' interaction requirements differ [8].

- **Customizable Notifications:** Fine-grained, user-level notification settings complemented by centralised configurations allow Instrument Experts to manage automatic alerts at the proposal level [4, 9].
- **Access Control and Permissions:** Stream-based roles enable granular access management, while *myMdC* programmatically enforces logbook permissions for consistency and security.
- **Advanced Search and Filtering:** Full-text search combined with Boolean operators, stream/topic filters, sender-based queries, and date constraints enables efficient retrieval of information across logbooks [10].
- **Cross-Platform Access:** Available as a fully responsive web application, native desktop clients (Windows, macOS, Linux), and mobile apps (iOS, Android), ensuring real-time access from any device [10].
- **Offline Functionality:** Recent messages remain accessible offline, and composed replies synchronise automatically once reconnected.
- **Integration and Extensibility:** Built-in support for REST APIs, webhooks, and bots facilitates seamless integration with facility services and external applications, such as *myMdC*, Karabo, DAMNIT, and Jupyter Notebooks [11].
- **Rich Message Formatting:** Markdown-based syntax supports equations, tables, images, and code blocks, enhanced with inline previews and link expansions. Zulip created its own implementation of Markdown (called *Bugdown*) [10].
- **Stream and Topic Management:** Users can mute (suppress new content notifications) less important topics or entire irrelevant streams to reduce disturbance while focusing on critical updates [4, 9].
- **Security and Compliance:** Encrypted communication (TLS), support for Single Sign-On (SSO) integration, and configurable retention policies ensure data security and alignment with facility standards.

Metadata Orchestration: myMdC

Integration with the metadata catalogue (*myMdC*) is a key advancement at European XFEL compared with the previously generic elog solution. Acting as the orchestrator and feature enhancer for both experiment and operation logbooks, *myMdC* provides the following capabilities:

- **Management of Experiment Logbooks:** *myMdC* orchestrates logbooks, ensuring consistency and flexibility throughout the experiment lifecycle:
  - **Logbook Creation:** Enables logbook creation for Instrument Experts once the corresponding beamtime is confirmed.
  - **Instrument-Specific Defaults:** Each instrument benefits from predefined configurations and a standard set of topics to promote uniformity and best practices[5] across instruments' logbooks.
  - **Dynamic Configuration:** Instrument Experts can adjust logbook settings on the fly, including managing automatic notifications and topic structures, to accommodate evolving operational needs, as depicted in Fig. 2.
- **Dynamic Team Synchronisation:** Logbook permissions are automatically and continuously synchronised with the team structures defined in *myMdC*. Any changes to the experiment team, such as the addition or removal of team members, are immediately reflected in *myLog*. Instrument Experts are granted full access to all logbooks of their scientific instrument, while proposal team members receive read/write permissions for their experiment logbooks. Additionally, designated facility support roles are provided with read-only access to ensure operational oversight without interfering with experiment documentation.
- **Customisation to Scientific Logbooks:** *myMdC* allows *myLog* to extend its capabilities beyond a generic messaging platform like Zulip by introducing features tailored to the specific needs of scientific experiments.
  - **Operational Information Sharing:** During beamtime, proposal-specific logbook entries can be shared with facility support groups to improve coordination and situational awareness. Entries are accessible in two display modes, Detailed View and Tabular View, allowing users to quickly inspect individual records or efficiently scan multiple entries (see Fig. 3).
  - **Compliance with Open Data Principles:** Logbooks support export in standard formats to facilitate alignment with facility data policies and Open Data principles. While this ensures technical readiness for data sharing, actual dissemination remains governed by experiment-specific access controls, managed through *myMdC* [4] in accordance with facility policies [12].
  - **Enhanced Editing Experience:** Provides a *WYSIWYG* editor alongside a Markdown editor, allowing users to create and edit rich, structured content with toolbar options, per-instrument message templates, and per-user drafts with auto-save.
  - **Advanced Search and Context Awareness:** Enables time-based queries with powerful filtering, extending Zulip's native search capabilities.
  - **Collaborative Editing:** Facilitates shift crews "shared account" to be used on a restricted list of IP addresses in each of the Instrument stations.
- **Customisation for Operational Logbooks:** *myMdC* provides additional features beyond standard Zulip, supporting long-term records of ongoing experiments or operational activities. It offers three access modes (*Pri-*

[5] defined by instrument experts reflecting operational experience and community conventions

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vate, *Internal*, and *Public*) to control who can view or edit entries, ensuring proper sharing of information in a secure and simplified way.

Applications Integration

Karabo Control System *MyLog* integrates with Karabo via a dedicated singleton device (`KaraboLogBook`), enabling seamless communication between the control system and the logbook. This integration allows the Karabo GUI to display the currently active experiments and their associated logbook streams and topics (Fig. 5).

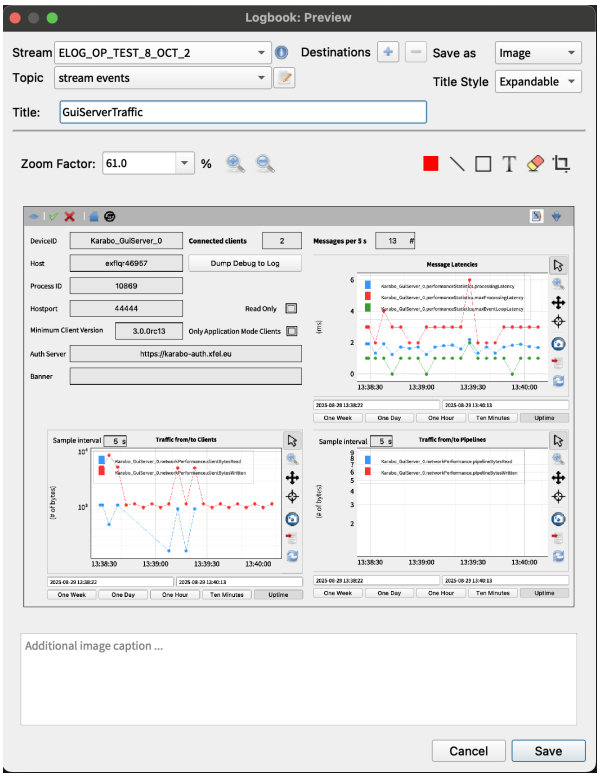

Figure 5: Karabo preview of a graphical log entry and respective annotations to be published in myLog selected *stream* and *topic*.

A dedicated Karabo GUI dialogue provides preview and advanced editing and annotation of images and tables (zoom, crop, shapes, text), selection of the target stream/topic with optional spoiler titles, and adding comments and structured tables with property selection (Fig. 5). This feature enables Karabo to directly post a well-formed and structured entry to Zulip, ensuring consistency and readability.

DAMNIT Data Analysis tool *MyLog* integrates with DAMNIT to streamline experiment data reporting and ensure that logbooks remain tightly linked to processed and reprocessed data. This integration enables users to export selected rows and columns from DAMNIT (corresponding to runs and experimental quantities of interest, respectively) as Markdown-formatted tables, optionally including images and custom annotations for better readability (Fig. 6).

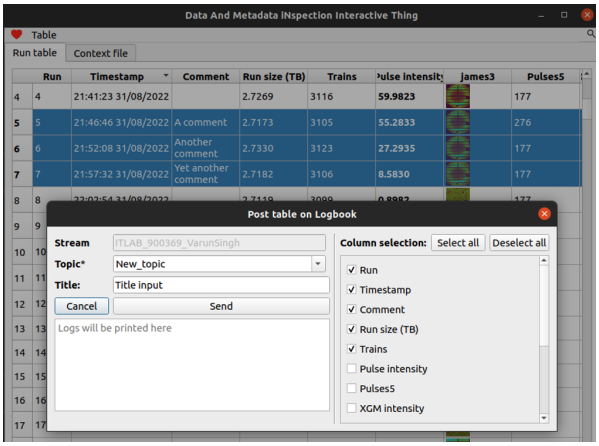

Figure 6: DAMNIT preview of a table selection to be logged and respective annotations to be published in myLog selected *stream* and *topic*.

When acquired data is reprocessed, *DAMNIT* can automatically inject runs-specific information into the relevant *myLog* topics, ensuring that updates are captured without manual intervention, therefore reducing the error-rate. Furthermore, the system supports automatic update of past DAMNIT logbook entries when the data associated with them changes (during subsequent reprocessing), reducing the risk of outdated information. This improves traceability of data evolution in the history and keeps all involved users informed.

DEPLOYMENT AND TRANSITION

The transition from the legacy ELOG [13] system to *myLog* required more than a simple tool replacement: it introduced new concepts, workflows, and integrations that demanded careful user preparation. An iterative, user-centric approach was therefore adopted to minimize disruption, ensure feature validation, and progressively migrate existing logbooks.

Deployment Strategy

This approach combined technical rollout with active user engagement through pilot programs, collaborative design workshops, and continuous feedback loops. Early data migration was introduced during beta phases to validate the system under real conditions and build user confidence.

Phased Rollout and Migration Timeline

The deployment was structured in two main phases:

Phase 1 (2022–2024): Initial deployment and Experiment Logbook integration.

- 02/2022 – Prototype evaluation.
- 06/2023 – Alpha release on SCS, MID, SPB/SFX.
- 08/2023 – Rollout integration with Karabo and DAMNIT.
- 01/2024 – Gold release for Experiment Logbooks.

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- 08/2024 – Beta release for Operational Logbooks and logbook migrations.

Phase 2 (2024–2026): Expansion to Operational and Support Logbooks and complete migration.

- 12/2024 – First migration including all MID logbooks; block new logbook creation in legacy ELOG.
- 01/2025 – Operational Logbooks gold release.
- 06/2025 – Beta release for Support Logbooks.
- 09/2025 – Migrate all user Logbooks.
- 12/2025 – Migrate all non-user Logbooks.
- 03/2026 – Legacy ELOG in Read-Only mode.

This structured rollout ensured minimal disruption to ongoing experiments, while progressively consolidating all logbook types (Experiment, Operational, and Support) into a unified and maintainable platform aligned with facilities' long-term data governance.

FUTURE WORK

Future developments aim to consolidate *myLog* as a central and sustainable solution for scientific and operational logging. Key priorities include:

- **Complete Data Migration:** Finalise the transition of all operational and support logbooks from the legacy ELOG system, eliminating fragmentation and ensuring a unified logging platform.
- **Increased Automation:** Extend automation for logbook creation, topic configuration, and user account provisioning immediately after beamtime confirmation, reducing manual setup and improving consistency.
- **Feature Enhancements:** Introduce advanced visualisation tools and tighter integration with experimental data workflows to improve usability and facilitate data interpretation.
- **FAIR-Aligned Archival:** Enable long-term preservation and reuse of logbook content by ensuring interoperability with the facility's data management infrastructure, in compliance with FAIR[6] principles. This includes robust export mechanisms and linkage to associated experimental metadata.

CONCLUSION

MyLog marks a major advancement in the digital infrastructure for scientific collaboration at the European XFEL. By integrating communication, metadata management, and automated workflows within a unified platform, it effectively addresses the operational complexity of large-scale experiments while improving collaboration, openness, and reproducibility. Its modular architecture not only supports current experiment needs but also provides the flexibility to evolve with future requirements. As part of the broader data management strategy, *myLog* strengthens the facility's digital ecosystem and lays the foundation for sustainable, FAIR-compliant research practices.

[6] Findable, Accessible, Interoperable, and Reusable

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