



Sören Kaps, Thorge Petersen

Efficient Metadata Integration:

User-friendly instrument integration into eLabFTW within CRC 1261

CAU

Christian-Albrechts-Universität zu Kiel

Laboratory book

The laboratory notebook documents the research process and the research data generated therein.

- Traditionally, laboratory notes were recorded on paper.
- Disadvantages of the paper form
 - Illegible handwriting
 - Not automatically searchable
 - Difficult post-processing and use of templates for recurring processes
 - Limited possibilities for collaborative editing
 - Limited data structuring
 - No remote access possible
 - Inclusion and linking with digital information and resources not possible

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Laboratory notebook of Hans Stocker, Kaiser Wilhelm Institute for Medical Research, 1930, Folio 97. Copyright: Archive of the Max Planck Society, Berlin.



Electronic Laboratory Notebook (ELN)

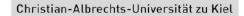
An ELN is a digital platform that allows researchers to electronically capture, organize, and manage their experimental data, protocols, and results.

- Advanced data entry and templates.
- Improved data organization and retrieval.
- Collaboration
- Archiving and versioning
- FAIR principles



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Experiment overview of the ELN "eLabFTW". Source: https://www.elabftw.net/#screenshots



National Research Data Infrastructure (NFDI)

The ELN Working Group ELN (Common Infrastructure/Base4NFDI) aims to develop and implement services that:

- Assist in selecting suitable ELN software.
- Support implementation across consortia, communities, and individual research groups.

However, there is currently no specific ELN recommendation for our research area.





→ CRC 1261 has opted to assess eLabFTW as its current ELN solution.



eLabFTW Overview

eLabFTW serves as the central hub for managing experimental data within CRC 1261.

- **Open Source** .
- User-friendly interface •
- Versatile data and metadata capture .
- User management and access control .
- Categorization, tagging, search and filter functions .
- Electronic signature and timestamp (data integrity)
- Well-documented REST API
- Accessibility across different devices .

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Results			
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Screenshots of the ELN "eLabFTW". Source: https://www.elabftw.net/#screenshots

Experim

Status

Tags

Sichtbark

eLabFTW Demo: https://demo.elabftw.net



eLabFTW Rollout History

The introduction of eLabFTW at Kiel University was significantly driven by the CRC 1261.

	23 ction of eLabFTW in CRC 1261 allation / Initiated by CRC 1261	of central ELN service S for Kiel University members	
2022	2023	2024	
	2023 Q2 Introduction of central eLabF Central infrastructure / CRC 1261 as	 2024 Q1 Instrument integration Started with instrument integration in Cl 	RC 1261

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eLabFTW Adoption Overview

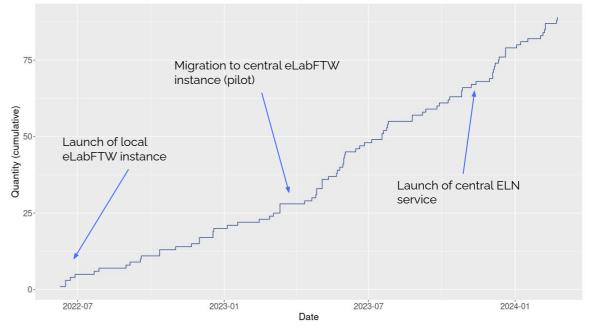
CRC 1261

- >40 users
- >120 experiments
- Multiple groups
- Usage of templates (e.g., for waffercut process flow)
- Resources (mainly for measurement instruments)
- Heavy usage of scheduler for booking resources
- Automated instrument data integration

University-wide

- ~175 users
- >30 teams
- >1.1k experiments
- ~2GB current experiment disk usage Note: Large files are stored externally and linked in eLabFTW.

eLabFTW Experiments of CRC 1261





Instrument Integration

Instrument integration reduces manual data entry, minimizes errors, and improves data reproducibility.

- Laboratory instruments generate a **vast amount of data during experimentation**, including parameters, measurements, timestamps, and instrument settings.
- IoT integration is transforming laboratory operations.

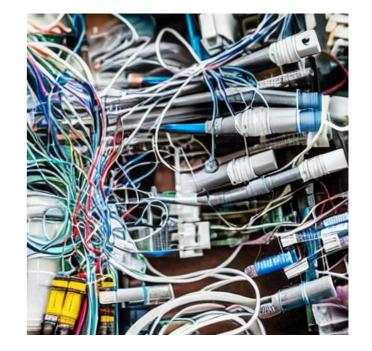
→ Efficient instrument integration into ELNs becomes imperative.



Challenges in Instrument Integration

The integration of laboratory instruments poses significant difficulties:

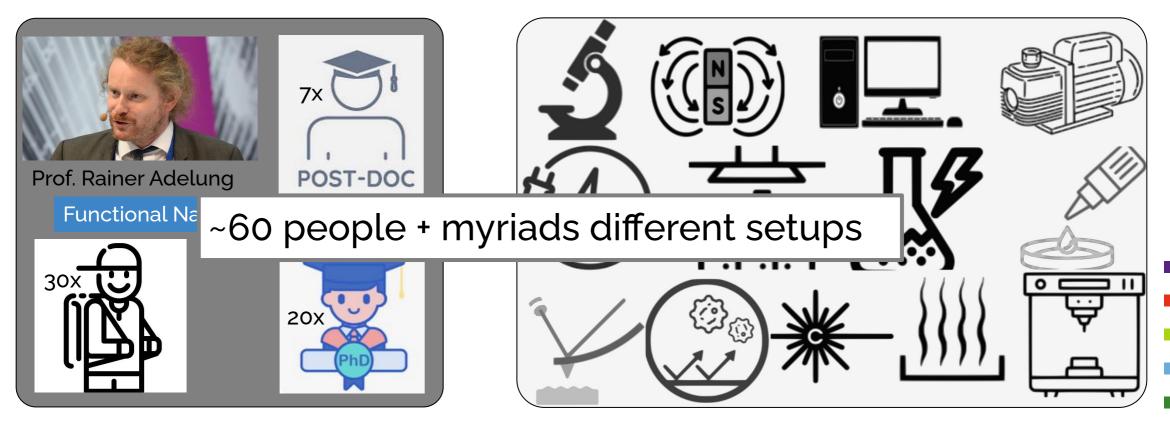
- Heterogeneity: Data in varying formats and protocols.
- Volume and Complexity: High-throughput instruments
- Data Security: Sensitive instrument data
- Flexibility: Workflows and laboratory requirements evolve over time
- Adoption: Complement the researchers' work rather than complicate it
- → Focus on user-friendly integration and specific use cases.





How do people work in a real environment?

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Ideal conditions to learn how to implement a digital lab book.

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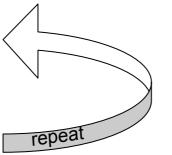
How to motivate 60 people?

- Nobody likes changes
- Scientists are lazy (find an efficient way to get the work done)

External Motivation

"Forcing" people has many drawbacks:

- Define rules
- Explain rules
- Threaten with consequences
- Check if rules are followed



Internal Motivation

The benefit of using must be big enough.



Lasercutter as first device to be included

Before eLabFTW	After eLabFTW	
mechanical key needed	software unlocks laser	
report of errors broken equipment needed	report errors & bugs automatically via GitLab	-
manual documentation	eLabFTW using predefined template	





authorize via RFID using eLabFTW API key



DigitalLab

Implemented Features

- Authorization
 - RFID Tag
 - User + password
- Use predefined eLabFTW template
- Add/Filter/Use Tags
- WYSIWYG Editor
- Attach/Upload files via drag&drop
- Load old experiments
- Copy experiments
- Get help & report bugs
- Show status of connected devices

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Transfer to Experiment View

User DB ElabFTW

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Universal Software for all many setups

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Templates in DigitalLab

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elabFTW templates speed up documentation time

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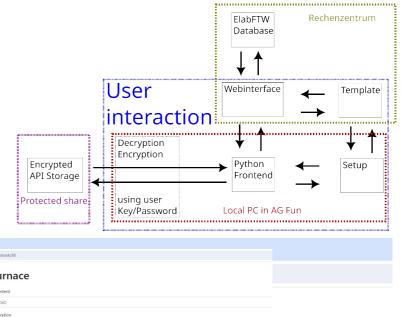


Summary & Outlook

- Successful implementation using a real device
- Positive feedback from the users

Next Steps:

- Include more setups
- Parallel development
 - Web site based version
 - For mobile devices
 - For setups w/o PC
 - Easy Login (RFID tag)
 - Template ID provided via RFID or QR-code
- Codebase will become open source
- PIDs for instruments



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