# Development of web tools for fault tracking of the Linear IFMIF Prototype Accelerator (LIPAc)

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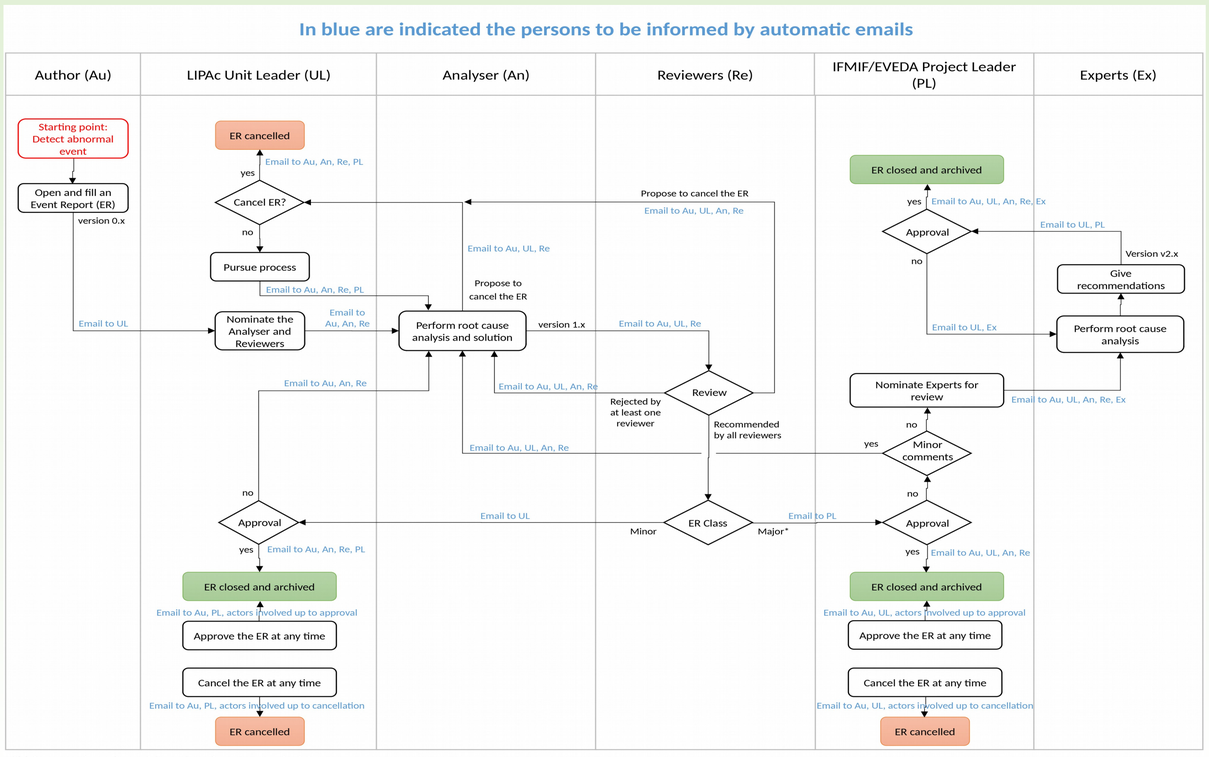
## Introduction

In order to improve the workflow of the people working on the construction of the Linear IFMIF Prototype Accelerator (LIPAc), several web-based tools have been implemented. One of the most important ones is a custom fault tracking system, developed in-house.

Previously, when a problem was found, workers had to fill an “event report” (a Word document) and upload it to the document management system for discussion, analysis and eventual approval. Any change to the document meant downloading, modifying and reuploading it. Furthermore, there was no search capability, so a separate register with a summary of every report had to be filled manually. The whole procedure was time consuming, and user satisfaction was low. As a result, small problems would not be reported.

The new tool offers an easy to use web-based interface, with an integrated workflow, search capabilities, and automatic email notifications. User satisfaction is higher, and as a result more problems are being reported, which means that they can be solved faster.

## Application workflow




*Major means impact on safety, cost, performance or schedule

The workflow is based on the lessons learnt from previous commissioning and maintenance phases, and directly integrated in the web tool:

- Users are classified as the Project Leader, the Unit Leader, and other workers.
- When a user submits a new report, the UL assigns an analyzer and one or more reviewers.
- The analyzer will write the detailed analysis, causes, impacts, and proposed solution, that will be submitted to the reviewers.
- There are two different levels of review: technical, managed by the Unit Leader, or managerial (significant schedule impact, cost, safety, etc.) managed by the Project Leader. Initially all reports are considered technical, but the reviewers can call for the involvement of the Project Leader, who in turn can add more expert reviewers to the report.
- Any report can be cancelled at any moment by the Unit Leader or Project Leader, if it is deemed not important enough.
- When any action is performed on open report, all the relevant users are notified by email.

## System requirements

To replace the old system, we had the following requirements:

- Easy to use web based interface.
- Hosted on our own servers: the LIPAc network is connected to our web server but not to the Internet.
- Able to import the existing documents from the old system, and generate new documents in our own format.
- Customized for our workflow.
- Capability to easily obtain statistics: most affected accelerator subsystems, number of reports over time, etc.

For these reasons we decided to write our own tool instead of adopting an existing one.

## System implementation

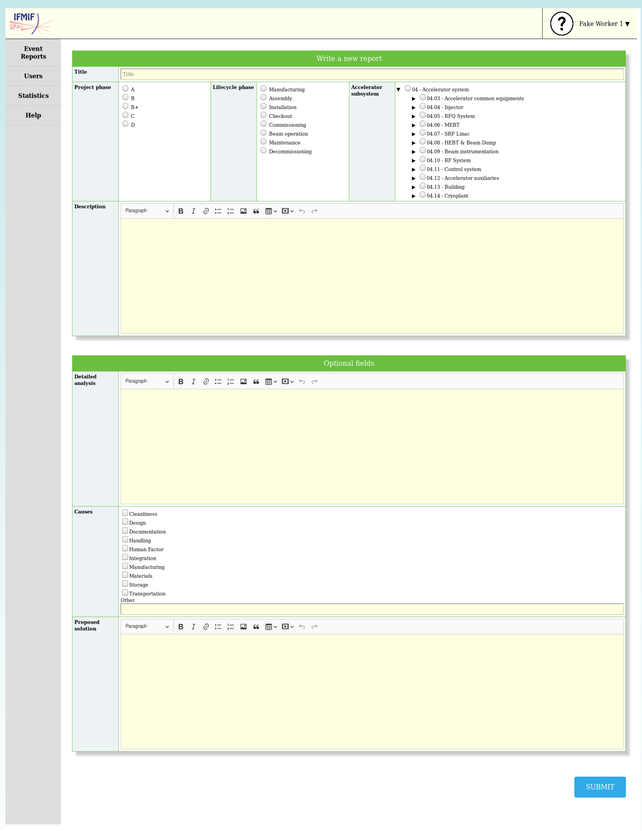
The new system is implemented in three layers:

- An Apache server, acting as a proxy to our application and other applications written in different languages, and providing SSL/TLS support.
- A backend written in Rust, a modern programming language with a strong focus on safety and performance.
- A PostgreSQL 11 database, with extensive usage of PL/PgSQL.

This combination gives us a robust and secure system.

## User interface

The new interface has been designed to be as easy to use as possible, while providing rich functionality and preventing data entry errors that were common in the old system.




In the mandatory part, the user has to fill:

- The title.
- Select the project phase.
- The subsystem lifecycle phase
- The subsystem itself
- Provide a description of the issue. The text editor allows rich text: lists, tables, images, etc.

Optionally, the user can:

- Write an initial analysis.
- Give a list of causes.
- Write a solution proposal.

This information can provide the analyzer and reviewers a starting point for more detail analysis.

## Printed document generation

- Both closed and work-in-progress reports can be exported to PDF.
- The main purpose of printed documents is supporting any justification of design change or purchase order
- The export template is shown on the right, it tries to follow the old document style as much as possible.
- It is possible to get either the final revision of a report, or the whole revision history.

| ER xxxx v1.0 | Title | IFMIF LIPAc |
|---|---|---|
| Author: | | Analyzer: |
| Reviewers: | | Approver: |
| Project phase: B | Lifecycle: Installation | Opening date: xx/xx/xx — Closing date: xx/xx/xx |
| Item: | | PBS #: |

**Description**

*You should indicate the date when the event was discovered or when it happened (and time if possible)*

**Root cause analysis**

| Causes | | | | | | |
|---|---|---|---|---|---|---|
| | Cleanliness | Design | Documentation | Integration | Handling | |
| | Human Factor | Manufacturing | Material | Storage | Transportation | |
| | Other: | | | | | |

**Proposed solution**

**Class and Impacts**

| Major | Minor | | |
|---|---|---|---|
| Safety | Assembly | Integration | Check-out |
| Schedule | Commissioning | Beam Operations | Maintenance |
| Cost | Documentation | Interface | Reliability |
| Performance | Other: | | |

**Maintenance**

Duration: Machine down time:

Maintenance description:

## Conclusions

- The new system has been under testing during October 2019, and it is now operational.
- Users are satisfied with the new system, but there are still suggestions of improvement to implement. Some of the problems arise from the users’ lack of experience with the new system, so it’s expected that with proper training the problems will go away.
- Our next goal is to integrate the new system with all the other web services we run, so that users have an integrated portal for all their needs.

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