Project management web tools at the MICE experiment

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Abstract. Project management tools like Trac are commonly used within the open-source community to coordinate projects. The Muon Ionization Cooling Experiment (MICE) uses the project management web application Redmine to host mice.rl.ac.uk. Many groups within the experiment have a Redmine project: analysis, computing and software (including offline, online, controls and monitoring, and database subgroups), executive board, and operations. All of these groups use the website to communicate, track effort, develop schedules, and maintain documentation. The issue tracker is a rich tool that is used to identify tasks and monitor progress within groups on timescales ranging from immediate and unexpected problems to milestones that cover the life of the experiment. It allows the prioritization of tasks according to time-sensitivity, while providing a searchable record of work that has been done. This record of work can be used to measure both individual and overall group activity, identify areas lacking sufficient personnel or effort, and as a measure of progress against the schedule. Given that MICE, like many particle physics experiments, is an international community, such a system is required to allow easy communication within a global collaboration. Unlike systems that are purely wiki-based, the structure of a project management tool like Redmine allows information to be maintained in a more structured and logical fashion.

1. Introduction
Project management tools, like Trac [1] and Redmine [2], are standard practice in open-source projects and are beginning to appear in physics software projects. These tools provide issue trackers, wikis, online repository viewers, Gantt charts, and additional management tool plug-ins. The MICE collaboration initially used Redmine to manage a major refactoring of the internal MICE software. After this effort succeeded and the benefits of this tool became apparent, the use of Redmine as a project management tool has been expanded throughout the many collaboration working groups.

2. The MICE Experiment & Collaboration
The Muon Ionization Cooling Experiment (MICE) [3], based at the Rutherford Appleton Laboratory in the United Kingdom, is an accelerator physics experiment which makes extensive use of particle physics detector technology. It is designed to demonstrate the feasibility of manipulating muon beams, using ionization cooling, such that they are easier to accelerate to high energies. In this method,
muons are passed through a series of momentum-absorbing material, which reduces particle momentum both transversely and longitudinally, and accelerating radio frequency (RF) cavities, which replaces the longitudinal momentum of each particle. In this manner, the transverse footprint of the beam is reduced and the beam is “cooled.” The goal of MICE is to design, build, commission, and operate a realistic section of cooling channel. The performance of this channel and the resulting muon beam manipulation will be measured in a variety of modes of operation and beam conditions. The experiment is designed to produce a 10% cooling effect within a 5 m cooling channel. Several particle physics detectors located both up-and-downstream of the cooling channel are used to identify particle type, track muons through the channel, measure particle position, momentum, and energy. Knowledge gained from this R&D project will be applied to design and engineering efforts for intense beams of muons with energies in the GeV range for neutrino physics and in the TeV range for muon colliders.

With approximately 150 members spread across nine countries on three continents, MICE is a relatively small collaboration when compared with particle physics experiments such as ATLAS [4] or CMS [5]. Nevertheless, within this group there is a mix of particle physicists, accelerator physicists, engineers, and both graduate and undergraduate students.

3. Collaborative work
In MICE, as in any particle physics experiment, there are inevitably challenges that stem from the collaborative nature of the work. Before the incorporation of Redmine, communication was primarily done through the use of frequent emails, bi-weekly phone conferences within working groups, and quarterly face-to-face collaboration meetings. The long term schedule of such an experiment leads to turnover of personnel which causes difficulties with information retention, particularly with the email and phone conference communication methods. Technical knowledge about hardware or software can be lost when graduate students advance or key personnel move to new positions. Replacements are often not available for training, and maintaining appropriate documentation of work can be difficult to enforce. While collaboration meetings improve communication and facilitate problem-solving by bringing people together and focusing effort, having presentations posted on numerous websites makes resurrecting information from that effort difficult and time-consuming. With the MICE schedule continuing for many more years, ensuring that information is accurately and efficiently retained over long periods of time is critical to the success of the experiment.

Given this, the collaboration needed to develop ways to mitigate these problems. Specifically, tools were needed that would provide the following features:

- Ability to easily communicate within a global collaboration
- Coordination between members separated by distance and time zones
- Develop schedules, assign tasks, and prevent duplication of effort
- Develop institutional memory and record of work

Since MICE is a relatively small experiment, any solution must not require a large overhead in terms of expense or maintenance, and it must be easy to use with a short learning curve.

4. Redmine
The Redmine package was chosen to help mitigate the challenges of collaborative work experienced in MICE. It provides the features of a standard project management tool: a document store for internal notes, a repository viewer for code branches, issue tracking with a corresponding Gantt chart for bugs or meeting actions, and a wiki. The server-side web application is written in Ruby on Rails and is hosted at mice.rl.ac.uk. The hardware requirements for hosting this tool are minimal.

The simple user interface and ability to quickly learn how to use the tool worked in favor of Redmine as an option for MICE. While it was originally designed as a tool for software experts, in this instance, all members of the experiment, including undergraduate students, technicians, engineers, and professors, would need to use this tool. Therefore, a clean and simple interface was required. Of the options considered, including Trac, JIRA [6], and Bugzilla [7], Redmine provided the best fit for MICE requirements.
5. Solutions: Redmine in MICE

Since the introduction of Redmine to MICE, use of this tool has expanded from the initial applications within a software project into many other groups within the experiment. The Online, Operations, and Software Groups, the Speaker’s Bureau, and the Executive Board are among the MICE groups making use of the project management tools available in Redmine. Each applies the tools in a manner tuned to the requirements and needs of the group. An overview of the use of Redmine in MICE groups will be given here along with several specific examples.

5.1. Online Group

The MICE Online Group creates and maintains all tools (hardware, software, documentation, etc.) within the MICE Local Control Room and rack room that allow the experiment to efficiently record high-quality data. This group has a wide range of responsibilities, including Data Acquisition (DAQ), Controls and Monitoring, Online Reconstruction, Networking, and Computing. A strong connection also exists between the work done in this group and the MICE Operations and Software groups. It is essential for the continued smooth taking of MICE data that a complete record of work exists and that continuity of functionality can be maintained through personnel turnover.

Redmine is used within the Online Group as a source of information for members of the group and the collaboration as a whole, and as a management tool to coordinate group efforts. A description of group responsibilities and membership list are given, as well as the schedule for all regular meetings. The wiki serves as an easy-to-use tool to organize all group meetings as it provides a simple method for developing the agenda, providing necessary call-in information, giving each member the ability to upload slides or material, and as a single source for all meeting minutes. It is easy, fast, and reliable and has improved communication and removed any confusion regarding meetings. As such, it is also used by the MICE Analysis Group in the same way. Computing information about networking, access, and hardware is also available to those with MICE Redmine accounts on the wiki.

The Redmine issue tracker is also used extensively by the Online Group (see figure 1). It allows tasks of any timescale to be added as needed, be they required for immediate intervention or related to

![Figure 1. The MICE Online Group issue tracker in Redmine, showing a subset of tasks with ID number, a brief description, and assignee.](image-url)
long term milestones. It also facilitates the tracking of effort, as a function of both individuals and the group, aides in assignment of work across available personnel, and ensures that there is no confusion as to who is responsible for each task.

While individual group members can add tasks to the issue tracker, they are primarily created and assigned by the group leader. For each issue, a description of the task is given, a priority level and deadline are assigned, and it is labeled either a “bug” or a “feature” under the Redmine system. Typically, errors or problems that need to be fixed are designated as bugs, while tasks that would improve online systems are called features. If the issue contains any sensitive information, it can be privatized and it becomes visible only to people with accounts on the MICE Redmine system. For each issue, the assigned group member can then add information as work progresses on the task. Each issue also usually has “watchers” attached who are individuals with either an interest in the problem or who may be able to contribute relevant information during the execution of the task. The record of work created by the issue tracker is searchable and permanent, thus automatically creating documentation of decisions made and solutions found for problems. To illustrate this process, several example issues will be shown here.

![Figure 2. MICE Online Group issue #665. This is an example of how each issue works within the Redmine system. A brief description of the task is given, the assignee, due date, and completion date are shown. The History shows progress made on the task over time.](image)

In the first example, Feature #665 (see figure 2), access to the RAL network was needed in a lab space being used for cosmic ray testing of the MICE scintillating fiber trackers. This was deemed to be a “feature” because it would enhance the capabilities of the experiment. The Online Group member responsible for networking was assigned to the task which was time-sensitive due to the testing
schedule. A record of progress on the work was generated, and the task was completed on time. The Redmine page for this issue is shown in figure 2.

In the next example, Bug #684, one of the event-builder machines in the DAQ system failed to recover correctly from an unexpected power outage. This issue was described as a “bug” because of the nature of the problem. It was given a high priority since this machine was one of two that needed to function in order for the DAQ to run dependably. In this instance, the assignee changed hands as a new systems administrator for the group took over. In spite of the change in personnel, no information was lost because each person had the ability to contribute to the record of work. A record of progress on the work was generated, and a solution to the problem was found. The Redmine page for this issue is shown in figure 3.

![Bug #684](image1.png)

**Bug #684**

**micraelid2 failed to reboot after power outage**

- **Added by:** Convey, Linda 9 months ago. Updated 5 months ago.
- **Status:** Closed
- **Priority:** Urgent
- **Assignee:** Robinson, Matthew
- **Category:** -
- **Target version:** -
- **Description:**
  - It did not boot up after the power outage. It stopped at the CMOS self-check. We got past the bios.
  - What is wrong with it? Is it recoverable? Is it on a bootable disk? Is it on and can we function without it? (I suspect not.) And if it is not recoverable, how do we replace it?
  - MOM - please work with Yordan and Simon Fayer on this. It is a DAQ machine, and we need it to do the Online Reconstruction test.[1+10].
- **History:**

  - **Updated by Fayer, Simon 9 months ago**
    - Does anyone know what error this machine was showing in the BIOS? (If any at all?) If it’s not showing any errors and just “sticking” on the BIOS screen, it might be worth removing the power completely for a few minutes and trying it again...

  - **Updated by Fayer, Simon 8 months ago**
    - I’ve seen this sort of problem with some motherboards before... after power-ups they sometimes decide that you might have tried to over-clock them so drop all the clock frequencies down to the minimum possible and then refuse to boot... It should just be a case of changing the “user-defined” CPU field back to 2.33GHz (or whatever seems sensible in the BIOS), or might instead make you set the “internal bus” speed which should probably be 33MHz with a multiplier of 1, giving an estimated CPU clock of 233MHz and then saving the settings.

  - **Updated by Nebraska, Henry 9 months ago**
    - I’d prefer to leave it to someone with a direct responsibility for the machine.
    - My concern is that sometimes the expansion bus speed can also be changed somewhere, and that what appears to be corruption is actually an attempt to fix a problem else where (so we get a machine that boots but won’t talk to its RAID card or similar). micraelid has booted up, so presumably the correct settings could be copied from that.

  - **Updated by Convey, Linda 9 months ago**
    - Due date set to 21 September 2011.
    - In progress. Simon will take a look and try to fix when next at RAL.
    - Added deadline of Sept 21

  - **Updated by Convey, Linda 8 months ago**
    - Status changed from Open to In Progress
    - % Done changed from 0 to 50

  - **Updated by Robinson, Matthew 8 months ago**
    - Craig and I just booted the machine to see if there was anything we could learn and it’s come straight up.

**Figure 3.** MICE Online Group issue #684, another example of how each issue works within the Redmine system. The History shows progress made on the task over time with contributions from several group members.

These examples give only a brief look at how the issue tracker is used. As Online Group needs evolve, issues are assigned, worked on, completed, and closed. New issues are created as problems
arise or changes are made to the online systems as the experiment advances. Use of Redmine within this group has grown as more features are used and new ways to apply the tool are created. As milestones are solidified, the issue tracker will become even more important as another way to ensure that the experiment continues on schedule as planned.

5.2. Operations Group

The MICE Operations Group is responsible for running the experiment, taking data, organizing shifts, training personnel involved with operating the experiment and ensuring that the MICE physics program is implemented. As in the Online Group, the Redmine wiki is used to organize operations, plan regular meetings, bring successive MICE Operations Managers (MOM) up to speed on current issues, and to provide a source of information related to operations.

One of the most productive uses of Redmine within the Operations Group has been to incorporate it into run planning. During a recent data-taking period to commission a new detector, Redmine was used to organize the commissioning schedule, determine the physics plan, track equipment readiness, and schedule available operations personnel. This plan evolved over time with input from multiple individuals. The primary experimenter responsible for the new detector set the initial plan which was then modified by the MOM, the Software Group, the beam line expert, and members of the Analysis Group. A portion of an early version of this plan is shown in figure 4.

![Figure 4](image.png)

**Figure 4.** An early version of the Run Plan for a MICE data-taking period in May 2012. Redmine allows input from multiple experts and provides a single source of run information.

This method of creating an evolving run plan greatly improved communication across the collaboration. The Redmine page provided a single, reliable source of information on the run that was viewable by all members of MICE. Even the electrical contractors used this page to understand when the experimental hall was available in order to make plans to shift electrical work elsewhere. In
addition, this simplified the MOM handover which happened to be scheduled for the middle of the run period. Often, passing on all relevant run information is a difficult process; however, in this case, the transition was much easier and there was no doubt as to what had happened and what still needed to be done. This run planning method also eased the scheduling of shifters. Collaborators could check the schedule and sign up for available shifts. It was clear in advance when they should arrive, what was planned, and what they should expect during their shifts. Finally, after the run has finished a permanent record remains. The daily plan is in place, beam line configurations are clearly shown, and the next time a data-taking period is scheduled, it will be easy to determine what was done in the past.

As with the Online Group, the issue tracker is now essential to MICE operations. MICE Operations Managers serve only for one month before a new member of the collaboration takes over. While this process has its advantages, the high rate of turnover makes it difficult to develop a “positional memory.” There must be an accessible, reliable, easily modified record of work done, old problems solved, and new problems that require attention. With Redmine incorporated into the process, the issue tracker allows the MOM to know immediately how to prioritize what needs attention. Successive MOMs contribute and a history for each issue is developed. This system allows intervention by several people while still maintaining knowledge of past actions. Information is retained no matter how many different individuals work on a single problem. The ability to tag issues as private or public also allows any sensitive operations information to be kept to MICE members only.

Finally, all operations-related documentation is located on the Redmine document store. This allows a single source of important information, and creates an automatic history for each document. All document versions are stored together, with only the most recent and correct instance applied to work in the control room.

5.3. Speaker’s Bureau
In MICE, the Speaker’s Bureau is responsible for identifying relevant conferences on the calendar and assigning collaborators to represent the experiment where either a poster or talk will be given. This group must also maintain a record of contributions, including proceedings, talk slides, images, etc. This provides a history of MICE presentations, improves experimental visibility, and facilitates the creation of future talks or posters.

This task is well-suited to the Redmine wiki pages since each member of the collaboration has the ability to edit the page, post material, or add conferences that would be of interest to the collaboration. This flexibility compares favorably against the features of a static website. It allows members to contribute without the need for an expert to help them store posters or talk slides. While wikis are more complicated than having a dedicated server-side web application for the task, this option was chosen because it provides a good balance between manpower requirements and ease of use.

The Speaker’s Bureau Redmine page has a list of conferences that the chair maintains, a corresponding list of talks and proceedings provided by each person attending a conference, and related material including schedules, engineering drawings, and approved public plots and images. This information is visible to the collaboration, easily accessible, and has been successfully used by all presenters since the page was started two years ago. In addition, the infrastructure for the page is easily maintained by a graduate student with little cost in time or effort.

5.4. MAUS – Software Group
The MICE Analysis User Software (MAUS) [8] is used to simulate MICE and analyze data both online and offline. Redmine is used within this software project for issue tracking, wiki documentation, hosting packaged releases, and linking to the Jenkins [9] build server and Doxygen [10] documentation. There have been 222 bugs submitted in the issue tracker, most of which were corrected, and 240 feature requests over the past two years. For the Software Group, the Redmine label “bug” in the issue tracker indicates an error in the code whereas a “feature” request indicates additional functionality within the software that must be developed. For this group, the project
manager handles the creation and assignment of most of the feature requests. The issue tracker is used in parallel with phone meetings as the dominant modes of communication between the five senior developers, twelve junior developers, and all software package users. This is an example of using Redmine in a more classic sense to facilitate software engineering.

5.5. Executive Board
The MICE executive board is responsible for management of the MICE project. It consists of the spokesperson, deputy spokesperson, project manager, several working group leaders, representatives from several geographic regions, and a secretary. Transparency within the collaboration with respect to how the EB manages the project is important, and a clear record of decisions made at monthly meetings must be maintained.

Again, Redmine provides an ideal platform for both organizing the executive board and passing on information directly to the collaboration from the management. The secretary handles most of the interaction with Redmine to ensure uniformity. There are two major uses of the system: the news feed allows distribution of agendas and minutes, and, as with the Online, Operations, and Software Groups, the issue tracker is used to store actions from each meeting. The automatic record in the issue tracker of how action items have evolved has ensured that they stay on the agenda with the correct context.

6. Conclusions
The use of Redmine within the MICE collaboration has been a clear success. It can be easily used by individuals with a wide range of skill sets and has a minimal maintenance overhead. Many MICE working groups have integrated this tool into their work with widespread participation from working group members. Redmine has improved information retention and recall within MICE and has facilitated communication within groups and across the experiment. The ability to use the issue trackers to organize tasks, distribute effort, and monitor progress has helped bring several groups in line with critical schedules. Overall, Redmine has proven to be an extremely valuable tool for project management, information retention, and communication in the MICE collaboration.

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