Application for 2013 University of California Larry L. Sautter Award for Innovation in Information Technology

Project Title: Risk Assessment Determinations in Chemical Academic Laboratories (RADiCAL)

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Project Leaders

• Cheryl Lloyd, Executive Sponsor, Interim Chief Risk Officer, University of California Office of the President
• Erike Young, Director - Environment, Health & Safety
• Safa Hussain, Executive Director, Information Technology Services, UC Davis

Project Team Members

The RADiCAL project’s success has been dependent on the support of the entire IT Services organization, as well as the University of California research community. Numerous staff and faculty provided guidance, feedback, expertise, and insight during the development process. The team members listed below made up the core application development team:

• Colin Aiken, Developer
• Rachel Aurand, Developer
• Michael R. Benning, Project Coordinator
• Jessica Eisner, Quality Assurance Analyst
• Timothy Holmes, Developer
• William Oleksy, Business Analyst
• Dung Phung, Developer
• Ken Smith, Product Owner
• Bow Lee Vang, Graphic Designer

Figure 1: Graphic from RADiCAL Login Page
Summary
Risk Assessment Determinations in Chemical Academic Laboratories (RADiCAL) was conceived as an application to help nurture a culture of safety within the University of California’s chemical research laboratories. This web-based risk management tool quickly determines a control-banded Standard Operating Procedure (SOP) to provide chemical laboratory personnel with pertinent information to conduct their research safely.

Project Description

How It Works
Lab Personnel or Principal Investigators (PIs) provide RADiCAL with their experiment information (chemical components, processes and procedures). This experiment information is run through a series of algorithms to determine a Chemical Safety Level (CSL). Based on the CSL assigned, the experiment is routed for approval. Once approval is received, an SOP is generated and Lab Personnel associated with the experiment are notified. As a final step, Lab Personnel must acknowledge receipt of the SOP before they begin their experiment.

In order to provide the most robust experience in promoting and facilitating chemical research laboratory safety, RADiCAL uses the following 6 features in congruence:

1. **SOP Generation**
   At its core, RADiCAL is an SOP generating tool. While RADiCAL is capable of creating individual Chemical SOPs it truly shines when creating experiment-based SOPs that provide Lab Personnel and PIs with the information that is most pertinent to performing their research-at-hand safely.

![Wolff-Kishner Reduction SOP](image)

**Figure 2: Standard Operating Procedure (Top)**
2. Control Banding of Experiments
RADiCAL applies a unique series of algorithms to assess the risk associated with an experiment's chemical components as well as the processes and procedures applied to them. The system utilizes this information to determine a Chemical Safety Level that indicates the oversight needed for the experiment. Lab Personnel & PIs are also able to review what triggered the Chemical Safety Level so they can further assess the risks an experiment may pose.

3. Routing & Approval of SOPs
By assessing risk associated with an experiment’s chemical components and the processes and procedures applied to them, RADiCAL determines if approval from the Lab’s PI or a campus Chemical Hygiene Officer is needed. It then routes to the appropriate parties for review and approval.

4. Safe Operating Card (SOC)
Each approved SOP includes a Safe Operating Card (SOC). This 8 ½” X 11” printable PDF can be mounted in the researcher’s workspace so that experiment information, procedural limitations, and first aid information can quickly be referenced.

![Figure 3: SOC Front](https://example.com/soc_front.png)

**Chemical Library**
RADiCAL is driven by a comprehensive data set, including GHS information, on almost 100,000 chemical products. Chemical Hygiene Officers can bolster the existing library by adding additional chemicals as needed. Lab Personnel can define laboratory specific novel compounds. These features ensure any ingredients needed for an experiment are covered. The chemical library also mitigates the need for Lab Personnel and PIs to extensively research Material Safety Data Sheets – RADiCAL does that heavy lifting for them.
RADiCAL URLs

Try RADiCAL!
RADiCAL’s test drive site where users can try out each of the roles in a demo environment is available at this URL:
https://ehs.ucop.edu/radical-stage/
Note that this is a demo site and any information entered should be considered temporary.

Use RADiCAL!
RADiCAL is live and currently accessible to any UC Researcher or PI, on any of the 10 UC campuses, at this URL:
https://ehs.ucop.edu/radical/
Note that this is a live site. Information entered should be considered permanent, and certain actions may generate notifications to other system users.

Project Benefits

Improving Chemical Research Safety
RADiCAL offers numerous opportunities for information sharing between Laboratory Personnel and EH&S staff. Chemical Hygiene Officers (CHO) can access SOP and experiment information for labs respective to their campus. They are also required to approve high risk experiments. This workflow was designed to provide CHOs with knowledge of research being conducted on their campus, as well as the opportunity to suggest adjustments that could make a Lab’s approach to research safer.

Improving Access to SOPs
In many instances, SOPs are generated manually as text documents and then printed out and placed in a large notebook or binder that is stored in the physical laboratory. The SOPs generated in RADiCAL are stored online within the application, so they are accessible from any location with internet access. They can also be shared with any research laboratory on all 10 UC campuses. In this way, RADiCAL acts as an always-on central and shared repository for chemical safety information.

Improving UC Chemical Information
RADiCAL contains a shared repository of chemical information – almost 100,000 chemical products – with the potential to grow much larger over time. By providing this comprehensive library in one location, with all chemical information
transparent to any RADiCAL user for review, the quality of information available will improve incrementally with each update to the chemical information set.

**Technology Used**

RADiCAL utilizes Backbone, an MVC Javascript framework as the front-end interface. Backbone provides structure to Javascript code that permits an application to be built in a single-page fashion. The single page experience provides the user with the responsiveness of a desktop application by taking advantage of current browser technology to perform much of the work traditionally performed on the server side. In addition to Backbone, the utility libraries of Underscore and Handlebars are also employed. The user interface is topped off using the Twitter Bootstrap front-end framework for look and feel features.

The backend utilizes the following technology stack:

- Java
- Hibernate
- Spring MVC
- Hibernate Search
- Drools rule engine
- SQL Server
- Tomcat/Apache infrastructure

One sub-success story is the use of Hibernate search. RADiCAL houses a large volume of chemical data that users would like to search. Employing Hibernate Search vastly reduces the time required for users to locate data. It accomplishes this by indexing the database on the application server itself, eliminating the delay associated with executing large queries on the database server itself.

**Project Timeline**

RADiCAL was developed in an iterative Agile software development environment, with new functionality being delivered and reviewed weekly or bi-monthly. This approach allowed the development team to react quickly when Beta tester feedback illuminated areas of the software that would benefit from additional work.

Development on phase 1 of RADiCAL began in September of 2012, and continued until the application launched with a soft roll out at the beginning of March, 2013.

**Customer Satisfaction Data**

“The 1-page Safe Operating Card that's automatically generated is a terrific feature.” Nancy Wayne, Vice Chair, Physiology.

“RADiCAL is a useful and compliant SOP tool. All chemical researchers should use it as a means of mitigating risk in their labs.” Kenneth Smith, Laboratory Safety Manager, University of California Office of the President.

The collective response to RADiCAL has been overwhelmingly positive from both EH&S staff and faculty alike. Due to its unique Control Banding approach to chemical laboratory safety, there is continual growing interest in RADiCAL from campuses outside of the UC system, and even outside of the United States. Many institutions have indicated that RADiCAL is the solution to a problem many researchers have.