

# ELIMS

## The Environmental Laboratory Informatics and Management System

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### **Team Labrats**

Julian Bell, Remy Brandriff, and Blake Lawton  
Team Mentor: Ana Steinmacher

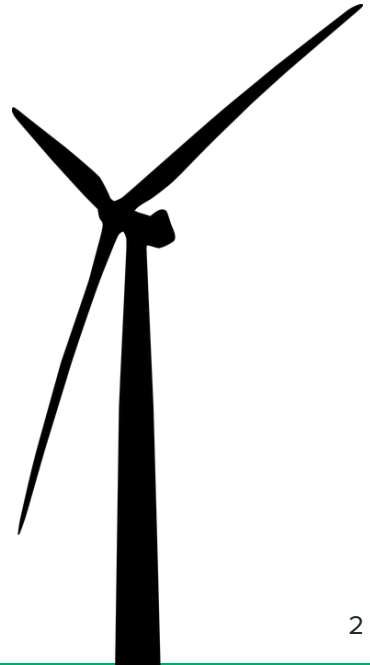
*UGRADS Presentation, 04/26/2019*



# The Field of Environmental Engineering

**Environmental engineering:** the combination of fields and specialties to create solutions to environmental problems, like *acid rain*, *global warming*, and *pollution*

- Protecting human and animal health
- Preserving the planet's ecosystems
- Improving quality of life
- Fighting water and air pollution
- Pursuing sustainable and renewable energy



# About the ENE Lab

The Environmental Engineering (ENE) Lab supports state-of-the-art research for students, faculty, and industry professionals

- Pollution
- Soil and water analysis
- Natural resources
- *And more*



## Why is that important?

Research performed here at the ENE Lab contributes to global environmental engineering proceedings that help ensure the safety and health of our planet



# The Clients

- Terry Baxter, PhD
  - Main project client
  - Civil and Environmental Engineering professor
  - Lab Director, oversees labs with other managers
  - Also supervises student research
  
- Mick Kelly
  - Secondary client
  - Lab and Safety manager for the ENE department

# The Current Lab Management Procedures

## **Request is submitted**

- Submitted as Word doc via email

## **Lab management reviews**

- Reviews request
- Meets with project supervisor and group

## **Revise and repeat**

- Lab management asks for revisions
- Creates multiple copies of same request with small changes

## **Chemical inventory review**

- Lab management checks A.C.I.D. database
- Out of date and hard to update

## **Safety trainings**

- BioRAFT, another system separate from the lab
- Information hard to find and out of date

# Example

Keanu R. tries to...

- Request to use the lab
- Contact any lab supervisors/staff
- Complete his lab safety training

Admin tries to...

- Keep track of inventory
- Check safety module & training completion

**NORTHERN ARIZONA UNIVERSITY** **RAPID REQUEST** EnE Laboratory

**Get started:** Use this form to submit initial project information.  
Complete and submit to [adam.bringhurst@nau.edu](mailto:adam.bringhurst@nau.edu) AND to [terry.baxter@nau.edu](mailto:terry.baxter@nau.edu)  
Submit no less than 2 weeks prior to the intended start date. (Revision 5/25/2018)

1. **Project or Course name:** [Click here to enter text.](#)
2. **Faculty Sponsor or Course Instructor (Name):** [Click here to enter text.](#)
3. **Source of funds/account number used for this project or course:** [Click here to enter text.](#)
4. **Start Date:** [Click here to enter a date.](#) **End Date:** [Click here to enter a date.](#)
5. **Project or Course Objective:** [Click here to enter text.](#)
6. **Contact/Course TA (Name):** [Click here to enter text.](#) **NAU User Name:** [Click here to enter text.](#)
7. **Projects Only:** List all individuals who will participate on this project.  
**Name:** [Click here to enter text.](#) **NAU User Name:** [Click here to enter text.](#)  
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**Note:** The Lab Director or Lab Manager will contact you to discuss your request.

**Do Not Complete Below This Line. Administrative Use Only.**

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**Meeting with Project Contact / Course TA:** [Click here to enter a date.](#)

**EnE Lab spaces:**  Room 239  Room 241  Room 242/245

**EnE Lab services:**  Training  SOPs  Experimental/Setup/QC  Fee-based Services

**Environmental samples collected or generated:**  Yes  No

**List all sample matrices and parameters:** [Click here to enter text.](#)

**Hazards Declaration:** [Click here to enter text.](#)

**Project Plan Required?**  Yes  No **Date Plan Submitted:** [Click here to enter a date.](#)  
**Date Safety Completed:** [Click here to enter a date.](#)  
**Access approved?**  Yes  No

**NOTES:**

1. [Click here to enter text.](#)
2. [Click here to enter text.](#)
3. [Click here to enter text.](#)
4. [Click here to enter text.](#)

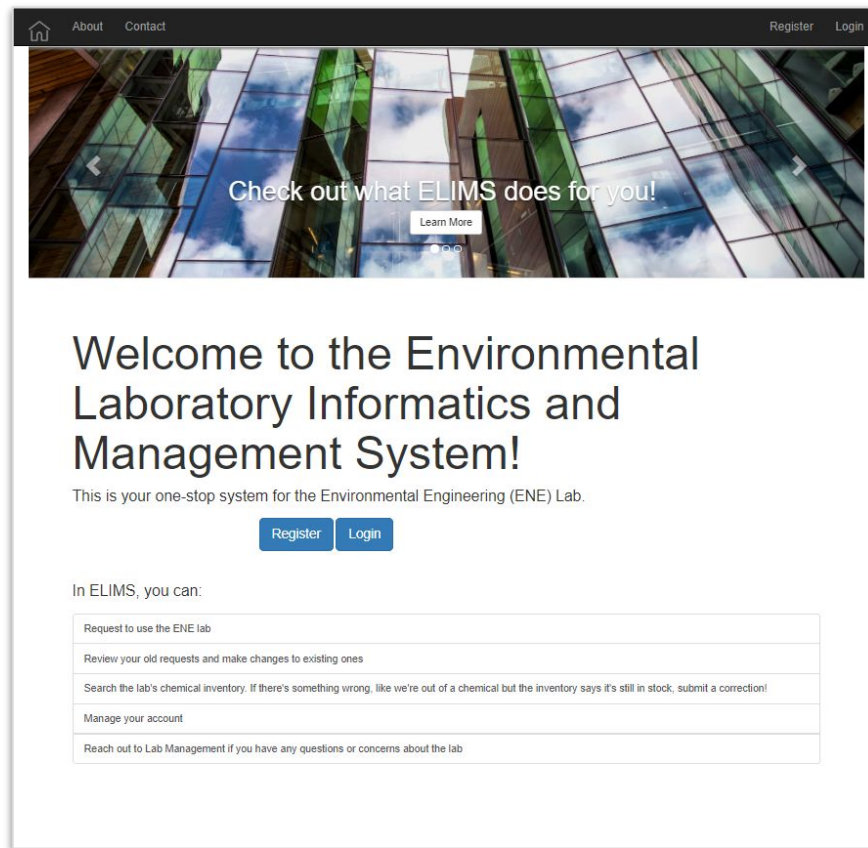
The current process is...

- Inefficient
- Decentralized
- Unsustainable
- Disorganized

# Our Solution: ELIMS

A robust, dynamic web app centralizing the operations for the ENE Lab and streamlining the management into one convenient system that is:

- Efficient
- Centralized
- Sustainable
- Organized

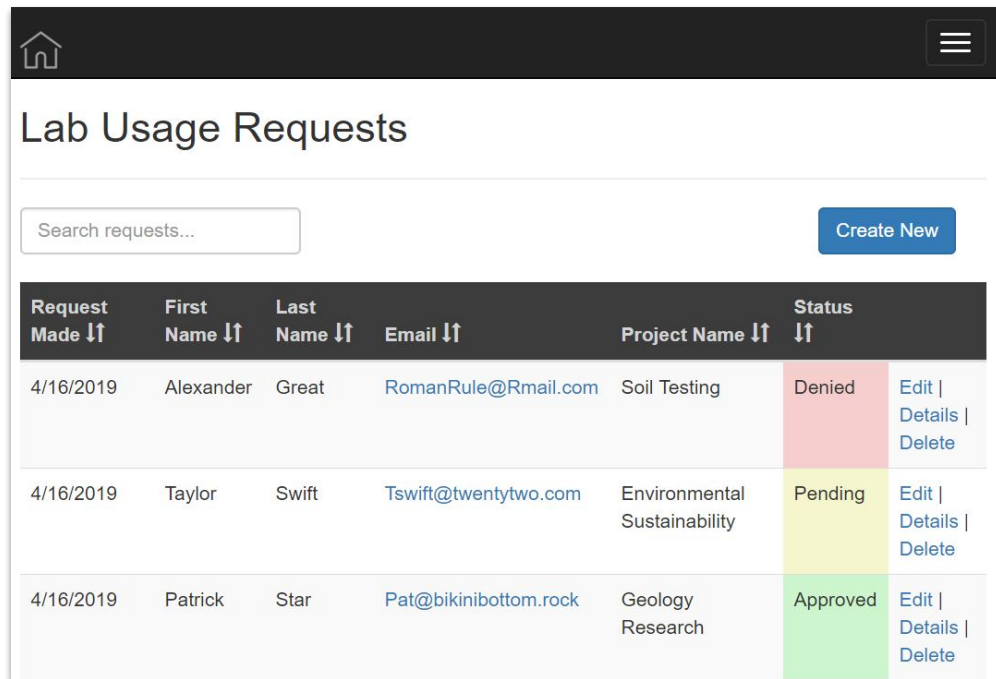


The screenshot displays the ELIMS web application interface. At the top, there is a navigation bar with a home icon, 'About', 'Contact', 'Register', and 'Login' links. Below the navigation bar is a large banner image of a modern glass skyscraper. Overlaid on the banner is the text 'Check out what ELIMS does for you!' with a 'Learn More' button. Below the banner, the main heading reads 'Welcome to the Environmental Laboratory Informatics and Management System!'. Underneath the heading, it states 'This is your one-stop system for the Environmental Engineering (ENE) Lab.' and provides 'Register' and 'Login' buttons. A section titled 'In ELIMS, you can:' lists several features in a table-like format:

Request to use the ENE lab
Review your old requests and make changes to existing ones
Search the lab's chemical inventory. If there's something wrong, like we're out of a chemical but the inventory says it's still in stock, submit a correction!
Manage your account
Reach out to Lab Management if you have any questions or concerns about the lab

# Key Features of ELIMS

- Web forms for:
  - Registering users and logging in
  - Submitting lab requests
  - Contacting lab management
  - Adding new inventory items
- Tables that can be sorted and searched
- Admin dashboard to manage users and their permissions
- Mobile-first design
- Clean, responsive interface



Request Made ↑↓	First Name ↑↓	Last Name ↑↓	Email ↑↓	Project Name ↑↓	Status ↑↓	
4/16/2019	Alexander	Great	<a href="mailto:RomanRule@Rmail.com">RomanRule@Rmail.com</a>	Soil Testing	Denied	<a href="#">Edit</a>   <a href="#">Details</a>   <a href="#">Delete</a>
4/16/2019	Taylor	Swift	<a href="mailto:Tswift@twentytwo.com">Tswift@twentytwo.com</a>	Environmental Sustainability	Pending	<a href="#">Edit</a>   <a href="#">Details</a>   <a href="#">Delete</a>
4/16/2019	Patrick	Star	<a href="mailto:Pat@bikinibottom.rock">Pat@bikinibottom.rock</a>	Geology Research	Approved	<a href="#">Edit</a>   <a href="#">Details</a>   <a href="#">Delete</a>



# Requirements Overview

The main requirements for ELIMS are

1. Users need to be able to **make requests to use the lab**, and the lab admins must be able to **approve or deny requests**
2. **Lab safety** information must be centralized and available to users
3. The **lab inventory** must be accessible and easy to manage
4. Lab administration must be able to **manage users**
5. The system must be **maintainable by ITS**

# Our Technologies



## Frameworks & Tools

ASP.NET Core 2.1 framework



Visual Studio 2017 Community

Microsoft Azure services



## Front end

- Bootstrap & JavaScript
- LINQ/SQL
- C#



## Back end

- C#
- LINQ/SQL



## Hosting

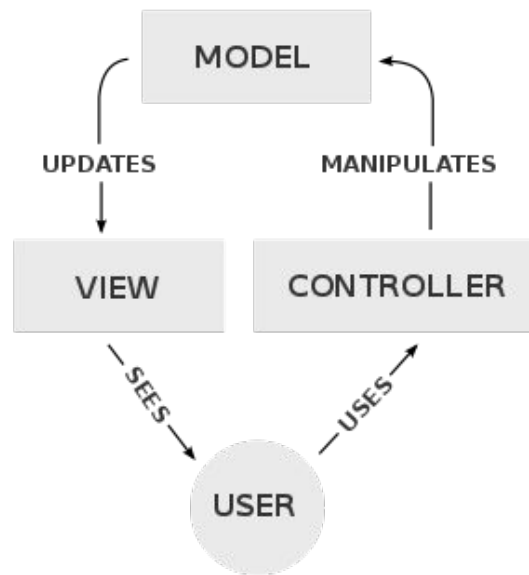
- Microsoft Azure web server and SQL server



# System Architecture Overall

- **Model-View-Controller** design pattern
- Example: the contact form
  - The model determines we want data for *first name, last name, email, topic, and the message*
  - The view displays the form to the user
  - The controller gets the information from the form to the database

Visual Studio also has built-in support for the MVC pattern



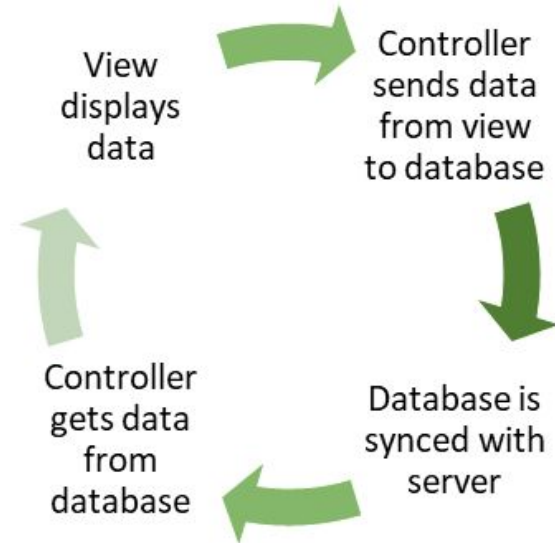
# System Architecture: The Database

Our SQL database is hosted by Microsoft Azure services on the same server as the app

It consists of multiple tables, including

- *Requests*
- *Contact form submissions*
- *Users and user permissions*
- *Inventory*

Data is regularly saved to and retrieved from the database using SQL/LINQ, and displayed on the app the controller



# Implementation



[About](#)

[Contact](#)

[Lab Requests](#)

[Lab Safety](#)

[Inventory](#)

[User Control](#)

Hi, Mr.Reeves!

[Logout](#)

- A contact page that enables users to get in touch with lab instructors and lab managers
- Online lab request forms that can be approved or denied by lab management
- Inventory tracking system for chemicals
- Organized informational page for safety trainings
- User control allows admin to give any permission and also delete accounts



# Our Challenges So Far

**Challenge 1:** CAS user log in

**Solution:** Transitioned to independent user login open to all types of users

**Challenge 2:** Lack of access to A.C.I.D. system

**Solution:** Created our own inventory system with data from client

**Challenge 3:** Inability to connect with BioRAFT lab safety software directly

**Solution:** Organized all information about lab safety into one place, with up-to-date links to BioRAFT

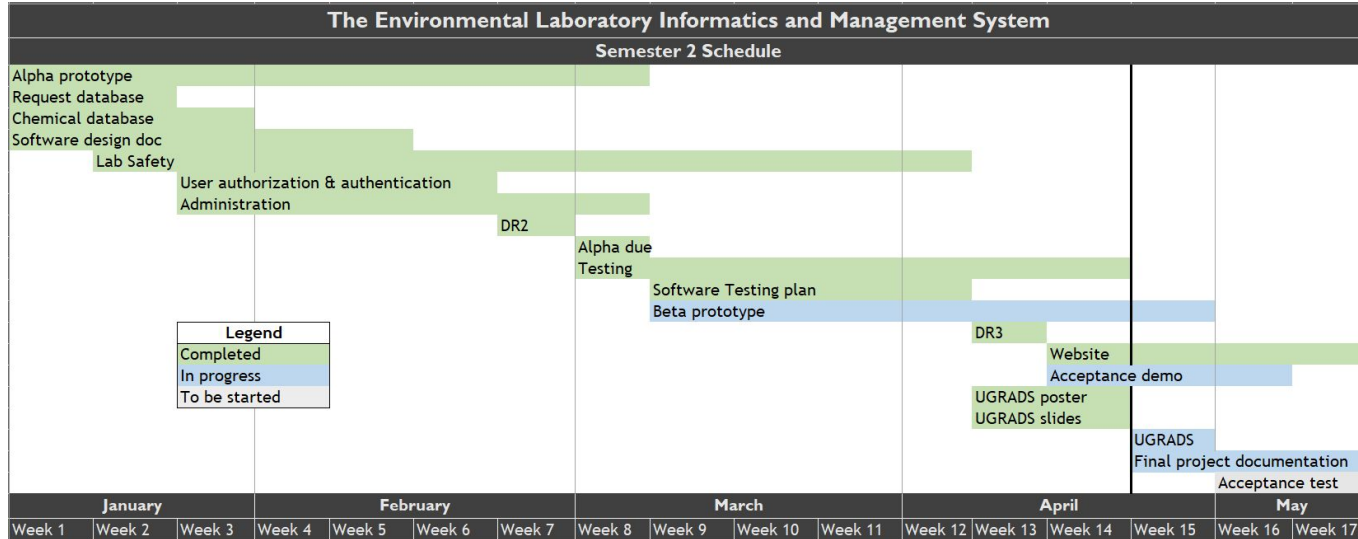
**Challenge 4:** Deployment issues

**Solution:** Development on localhost then sent to deployment manager to test on live server

**Challenge 5:** Expiration of Microsoft Azure trial

**Solution:** Created a new server and coordinated with ITS for migration prior to expiration

# Schedule



- Completed testing
- Finishing up our final product in prep for the acceptance test
- Writing our final documentation and project report
- Acceptance test and checklist to be completed next week

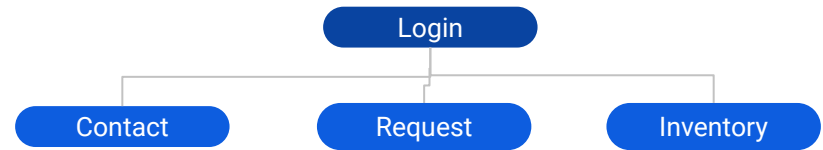


# Testing

Collaborative, team-based debugging

- **Unit Testing**
  - Not much formal unit testing occurred
  - Instead:
    - Go through each critical section of ELIMS
    - Evaluate each subcomponent, i.e., does filtering work, adding items, etc?
  - Factored in non-functioning segments and work on them

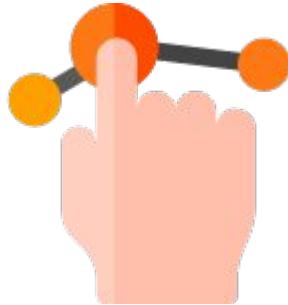
- **Integration Testing**
  - 4 major modules in testing
  - 10 workflow tests



# Usability Testing

To test the UI and UX of ELIMS, we selected several different user groups

1. CS students
2. ENE students
3. Lab Director & Lab Manager
4. Student managers
5. Miscellaneous



Users received the link to the ELIMS web app.

While using it, the users recorded their thoughts and ideas. They were asked a series of questions, such as:

*“Did you find ELIMS easy to start using? Was it easy to use or were some things confusing or difficult to understand?”*

User feedback has been used to improve the ELIMS UI and user experience

# Testing Results

## Unit Testing

- Tested each separate component of website
  - Functions, etc.
- Everything is functional

## Integration

- User based workflows successful
- All modules interact correctly



## Usability Testing

- Generally well received
- No big functional problems; issues focused in the UI
- Big problem areas:
  - “Confusing,” lack of directions and unintuitive
  - “Boring” in a lack of colors
- Overall, easy fixes in a few design areas

# What's Next: The Future of ELIMS

ELIMS will move to ITS next week, and may face further development, including...

- Adding CAS login for NAU students and faculty
- Integration directly with BioRAFT and A.C.I.D. databases
- Expanding ELIMS' management features for tracking experiments, data sharing, and improved tracking of inventory
- Adding the ability to manage individual lab spaces
- Increased interactivity with lab users beyond requests and contact
- Potential commercial use

# Conclusion

- Major takeaways: ELIMS is...
  - Efficient
  - Centralized
  - Sustainable
  - Organized

NAU's ENE Lab needs a robust system to continue its effective operation with scaling population and needs; we are confident ELIMS will fulfill those needs, creating a long-term, sustainable solution.

**Get started:** Use this form to submit initial project information. Complete and submit to [edops@ucr.arizona.edu](mailto:edops@ucr.arizona.edu) AND to [senry.nasider@ucr.edu](mailto:senry.nasider@ucr.edu). Submit no less than 2 weeks prior to the intended start date. (Revision 5/25/2018)

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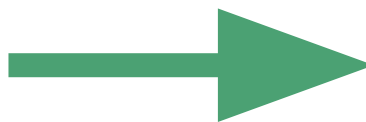
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Check out what ELIMS does for you! [Learn More](#)

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- Manage your account
- Reach out to Lab Management if you have any questions or concerns about the lab

# Thank you for joining us!

*We would like to thank Dr. Terry Baxter and Mick Kelly for this opportunity.*

Please come see our poster at this afternoon's exhibit session

Poster Time: NAU Fieldhouse (2-4 PM), space 13B

Team Website:

<https://www.cefn.s.nau.edu/capstone/projects/CS/2019/LabRats-S19/>

