


CS486C – Senior Capstone Design in Computer Science

Project Description

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| Project Title: Environmental Laboratory Informatics and Management System | |
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Introduction:

The environmental engineering laboratory supports the teaching, research and special project activities of the environmental engineering program, but has also been made available to others across campus for special project or workshop activities requiring a laboratory space where chemical or biological agents may be safely used. The laboratory also has an ability to develop a fee-based service for performing certain analyses of water, soil and plant tissue samples. Because of the laboratory's limited physical space, managing these different types of activities throughout the year can become a challenge because as the programs' student enrollments increase, requests to use the laboratory have also increased. With recent increases in students, faculty, courses, and their related needs, this management challenge has become more and more acute, causing difficulties with scheduling and managing of laboratory space, chemicals, equipment and other laboratory supplies, as well as adequately managing the laboratory wastes generated by these various activities.

Currently, the environmental engineering laboratory is managed through a manual process that begins with a request being submitted to use the laboratory for a specific activity (courses, workshops, research or special projects). Through this process, the needs of each activity are identified, and the ability of the laboratory to support that activity is assessed. This process includes identifying and assessing the safety training requirements and hazards associated with the activity based on the information that is submitted and what can be determined through interviews with the individuals requesting use of the laboratory. Identifying the space, chemicals, equipment and other supplies needed is also a critical part of this process.

Problem Overview:

This current process for managing the laboratory's information is not only inherently time-intensive for the one or two laboratory personnel available, but also imperfect because nearly all requests are inadequately planned before the individuals making the request hope to begin their work in the lab. The timely processing of these requests is important because of a need to support activities constrained by semester-bound course work requires use of a laboratory space (e.g., capstone projects, special projects by student organizations or student teams from a classes not regularly scheduled in the lab). This particular constraint can lead to incomplete hazard assessments and multiple and potentially incompatible activities that overlap in their work scheduling leading to conflicts with use of bench space, equipment, chemicals, and supplies – all of which can increase the potential for reduced laboratory safety and decrease the ability of the lab to support those activities. A more uniform and robust ability to manage the laboratory and access all the information regarding the laboratory is needed, to increase the ability to avoid conflicts between



activities that could create an increased potential for exposure to hazards (physical, chemical and biological) within the environmental engineering laboratory.

Solution Vision:

The capstone project proposed intends to initiate work that would develop a comprehensive Environmental Laboratory Management System that suitably integrates academic, research and commercial laboratory activities. While commercial software is available, these are not necessarily readily adaptable for use in the academic, mixed-use type laboratory found in most if not all universities around the world. This project would use the environmental engineering laboratory as a site-specific case to develop the platform and some functional modules that could eventually lead to a commercial product or integrated product enhancements. Specifically, while the longer-term vision is to have a secure, modern web-application accessible from anywhere using any desktop or mobile browser, the shorter-term goal for this project is to have a web application. Key features of this system would include the following:

- A Laboratory Use Request system will allow new users to register and create profiles, provide existing user verification and profile editing, allow users to create and submit project and laboratory use requests, as well as allow for feedback, documentation and other request-related communications to be conducted completely on-line, as well as to allow for scheduling meetings.
- A Chemical Inventory system will allow local entry and modification of the laboratory's current inventory data, allow registered users to submit searches for inventoried chemicals and will enable the updated inventory data to be uploaded to the A.C.I.D system used by Environmental Health and Safety.
- A Project and Analytical Data system will allow registered users to enter the analytical and other environmental data or project information they generate into a secure central data storage.
- A secure centralized storage will be used, hosted either in the commercial cloud (e.g. AWS) or on similar platform made available by NAU ITS.
- A secure data storage warehouse will allow individual modules to input data, share data, analyze data, and generated both automatic and requested reports.
- The overall system will provide for different levels of user access and data/information security or restrictions depending on the need of individual administrative and non-administrative users.

This software product will be used predominantly by laboratory managers, principal investigators, individual laboratory users and laboratory customers, but also should allow non-laboratory administrative access to certain reporting and data transfer features. Although initially the use of this product would be focused at NAU, use beyond NAU at other academic institutions and commercial laboratories, and for laboratories other than just what has been identified herein as environmental must be considered. Additionally, the potential use of a commercial version of this product could ultimately include significant established and emerging global markets, such as those in Africa, Australia, China, Europe, India, Indonesia/Oceania and South America.

Knowledge, skills, and expertise required for this project:

- Database design, front-end user tools, and cloud computing architecture with ability to integrate with existing core applications
- Analytics architecture, comprehend and implement statistical methods of data analysis
- Strong programming skills and knowledge of distributed objects/computing environments
- Information security principles. Application must be secure at all levels.
- Skill in the areas of application testing and quality assurance
- Quick and effective communication of problems

Equipment Requirements:

- There should not be any equipment or software required other than what is freely available online or through current NAU licenses.

Software and other Deliverables:

The primary deliverables of this project include, but are not necessarily limited to, the following.

- Design, implementation and maintenance report. This professional-level document provides a clear basis for the design and implementation of all software code created and includes information that supports future development and maintenance of the product.
- API Documents and commented code that successfully builds.