Web-Based Database Project
for the Lawton, OK Police Department:
Interdisciplinary Systems Software Development
at Cameron University

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Abstract – *Teaching systems software engineering to undergraduates can be a challenging task. Cameron University offers a unique interdisciplinary research and production experience for its senior Computer Science, Multimedia, Information Technology, and English majors. This capstone course provides students the opportunity to complete a comprehensive software project working for an actual client, and affords students the opportunity to practice real-life research and professional skills in a setting with multiple feedback opportunities. The client for the Spring 2013 course was the City of Lawton, OK, Police Department Gang Unit. The resulting student-developed product saved the city an estimated $100,000 in the cost of having to purchase a comparable product from industry. From this course, students learned to work as part of an interdisciplinary team, assess needs of the particular client, and use research skills to locate and utilize needed information. Additionally, student learning outcomes were enhanced through the use of a CASE tool.*

Keywords: Capstone Class, Software Engineering, Real-world Project, Interdisciplinary

1 Introduction

The Department of Computing and Technology at Cameron University offers three programs in the computing field: B.S. in Computer Science, B.S. in Information Technology, and B.S. in Multimedia Design. The Capstone is a required core course in these three programs. This course is designed to provide students with necessary skills, techniques, and tools to develop and manage complex software projects. In 2009, one of the authors brought the idea to the department of using an interdisciplinary approach to teach web-based software development classes, to include Computer Science (CS), Multimedia (MM), and Information Technology (IT) students. Since then, each semester's class has been designed to replicate an actual software development company. Recently, English (ENG) student technical writers have been added to these projects. The professors involved in the class act as the Chief Executive Council of the company. Potential projects for each semester are obtained through viral advertising. Once projects are requested, professors from each discipline look at the list of potential projects and choose the best with regards to required rigor and students' ability to achieve a working solution by the end of the semester. Only one project is chosen each semester. Once chosen, the professors meet with the potential clients and explain the clients' responsibilities, as well as how the class is managed. Major client responsibilities include providing an initial briefing to the students, attending two In Process Reviews (IPRs) in which students show their progress to the clients and get clarification for problems encountered, and attending the final presentation of the resulting product. Additionally, clients must provide letters of recommendation for the students involved as the only form of payment, as the students provide services on a pro-bono basis, in a service learning capacity. The client for the Spring 2013 course was the City of Lawton, OK, Police Department Gang Unit.

2 Initial Methods

2.1 Class Arrangement

After initial student team assignment and analysis, the IT and MM students would begin development of a backend database and aesthetic qualities of webpages. Upon backend database completion, focus of the project would shift to the CS students. The CS student emphasis would be on coding, testing, and validation of the project. MM students would continue to improve web page layout while IT students would work on alternatives [1, 2, 3], other documentation, and assisting with SQL code and changes to the backend as required. At this stage, the other teams would work in support of the CS team. ENG technical writers would edit documentation as necessary [1, 4]. Details of these procedures are provided in Section 2.2.

2.2 Organization and Teams

Teams were chosen through blind resumes and cover letters [1, 4]. The two established teams were charged with the developing their own solution to the client's problem. Having

two separate solutions would provide an opportunity for the clients to select the end product that would best fit their needs. Technical writers from the ENG department were assigned to the teams upon integration. A typical integrated team consisted of a project leader, a lead programmer, a lead database designer, a lead webpage designer and a tech writer [4]. Other members were placed under these leads. An organization chart is shown in Figure 1.
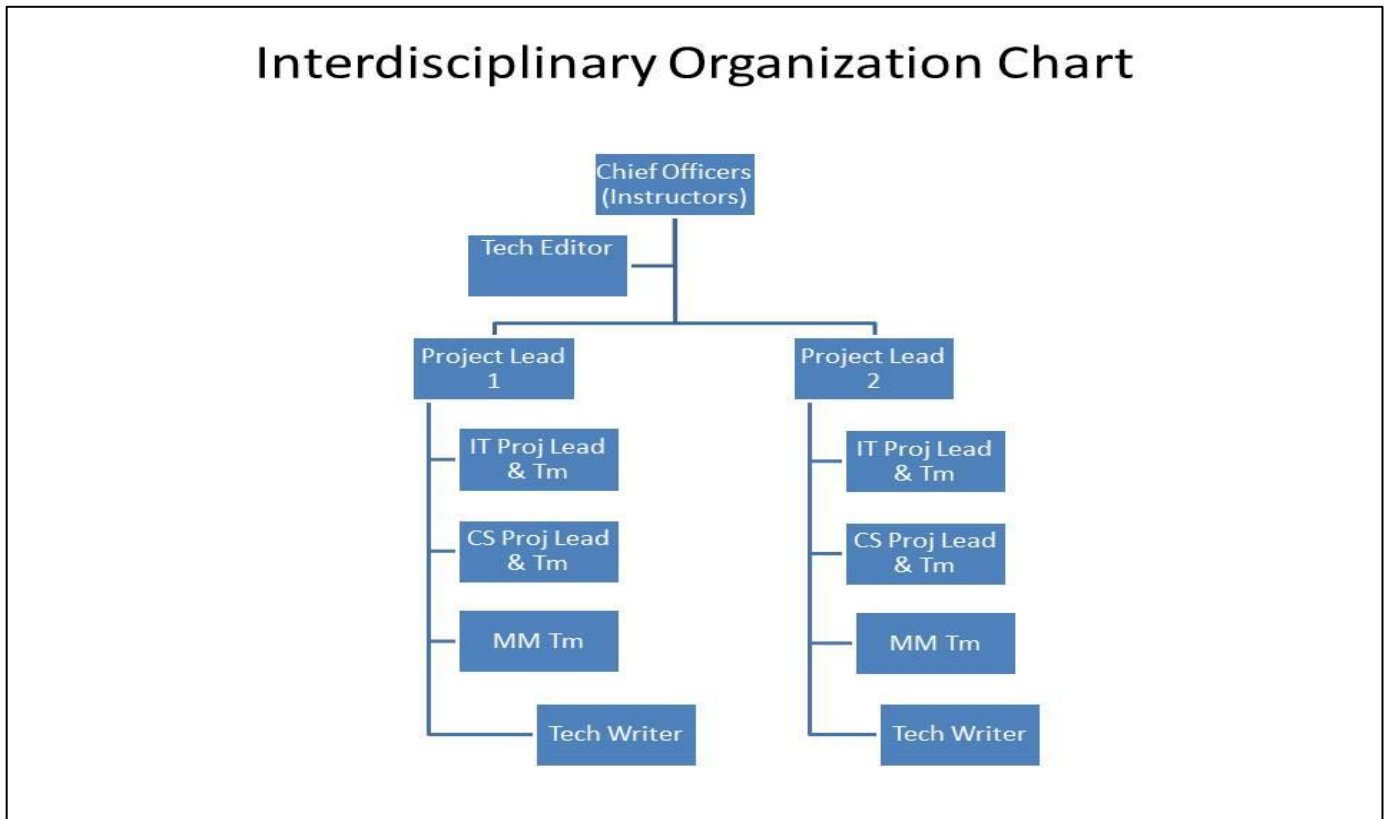

Figure 1. Organization Chart

2.3 Project Components

Development of the project components occurred in the following order:

(1) IT students developed a MySQL database through client interviews and analyzing the old client system.
(2) MM students began webpage development, and used HTML/CSS/JavaScript to code pages.
(3) CS students developed middleware using PHP to connect the frontend of the system to the backend database.
(4) CS students continued to refine webpage aesthetic qualities.
(5) Technical writers reviewed all the documents of the project and made all necessary corrections and editing.

An example of the inputs, processing, storage, and outputs can be seen in Figure 2.
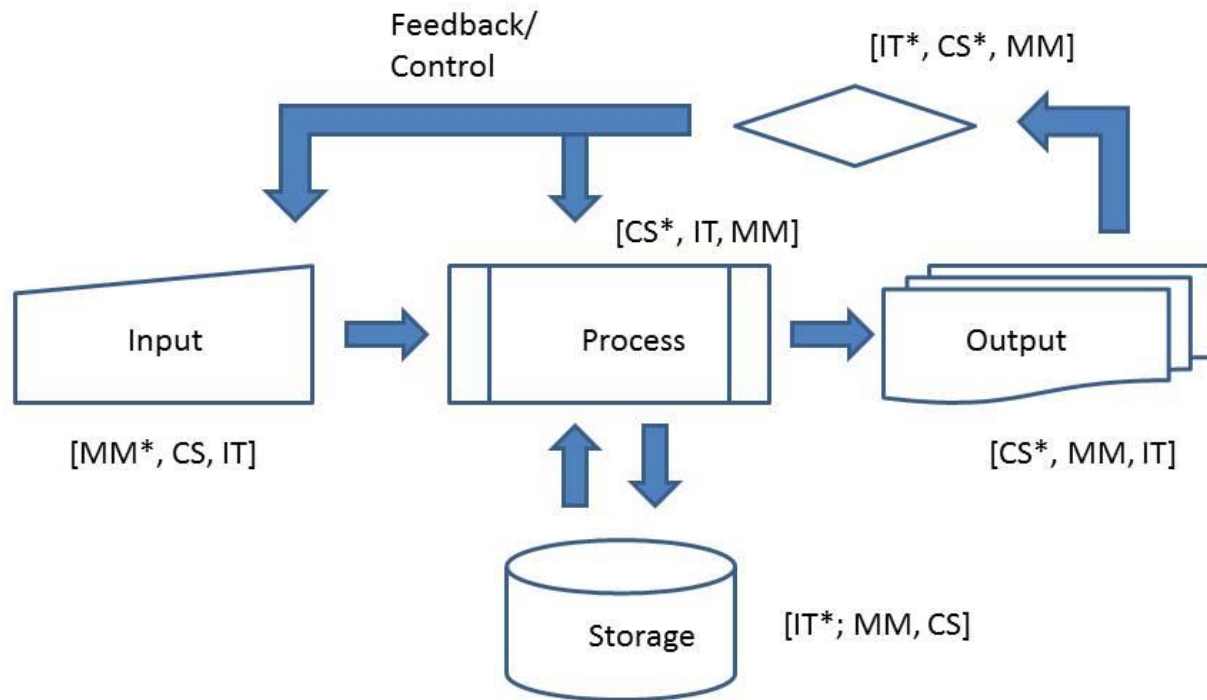
Figure 2. Web Project Components and Procedures

2.3.1 Requirements

After the teams were integrated, a brief synopsis of the project was provided to the students along with a milestone list. From this, students developed interview questions for the client. This interview took place in the third class period after team formation. Based on the results of the synopsis and interview, students obtained a signed Statement of Work (SOW) [3] and started their analysis portion of the project.

2.3.2 Analysis

Students utilized various modeling tools integrated within their CASE tool to determine the solution to the business problem provided by the client. These tools included Data Flow Diagrams, Entity Relationship Diagrams, and UML tools with Use Case diagrams. An example information flow diagram is shown in Figure 3 [3].
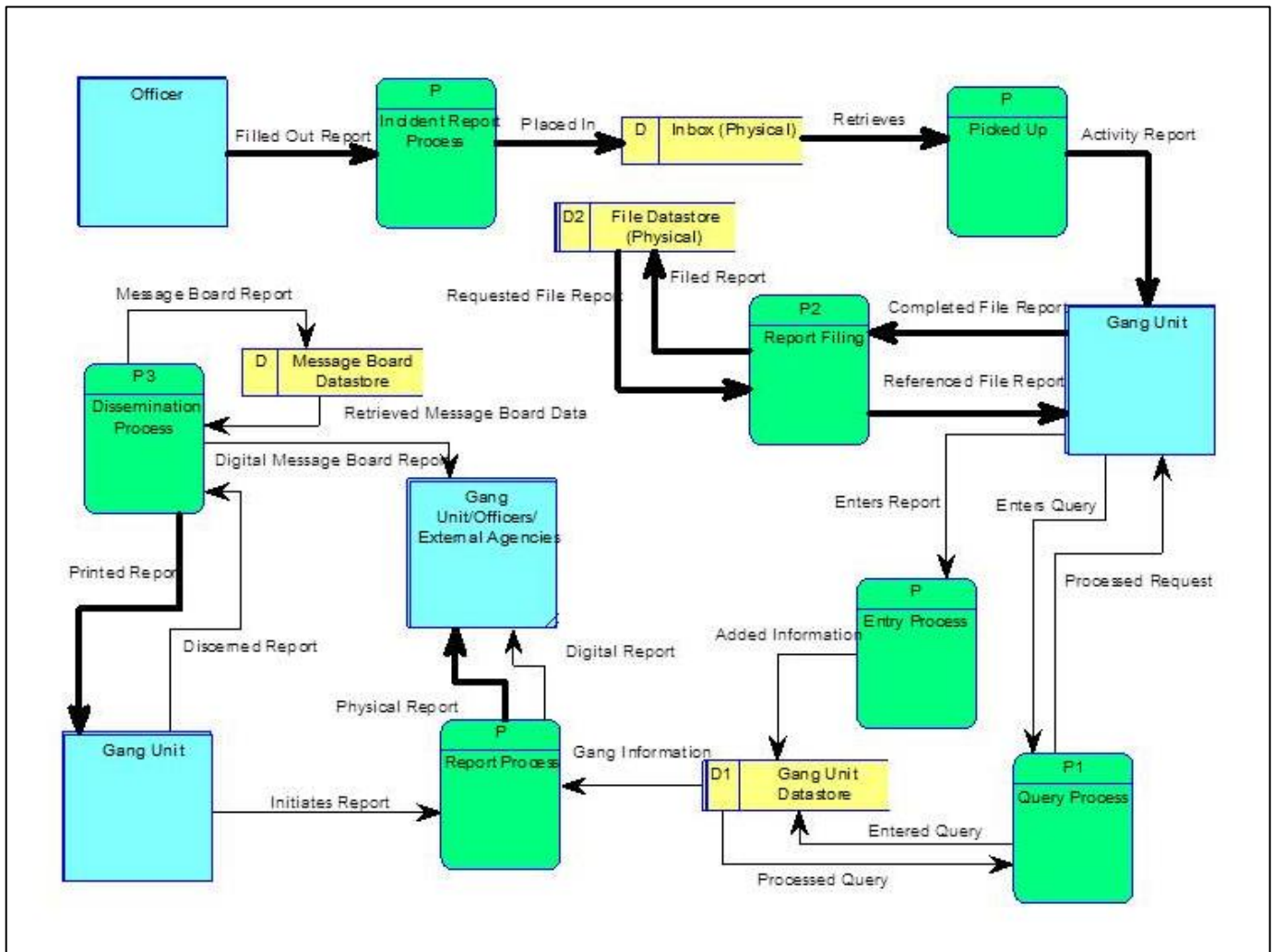
Figure 3. System Information Flow Diagram

2.3.3 Design

Instructors acted as "living" reference books, as they monitored and approved each stage of development. After completing Data Flow Diagrams and Conceptual Model Entity Relationship Diagrams, students gave an IPR to the client and the instructors. Other faculty and administration were invited to attend. Client representatives provided feedback and verified their requirements [4]. Necessary modifications were then made. An example flow chart for a proposed login page is shown in Figure 4.
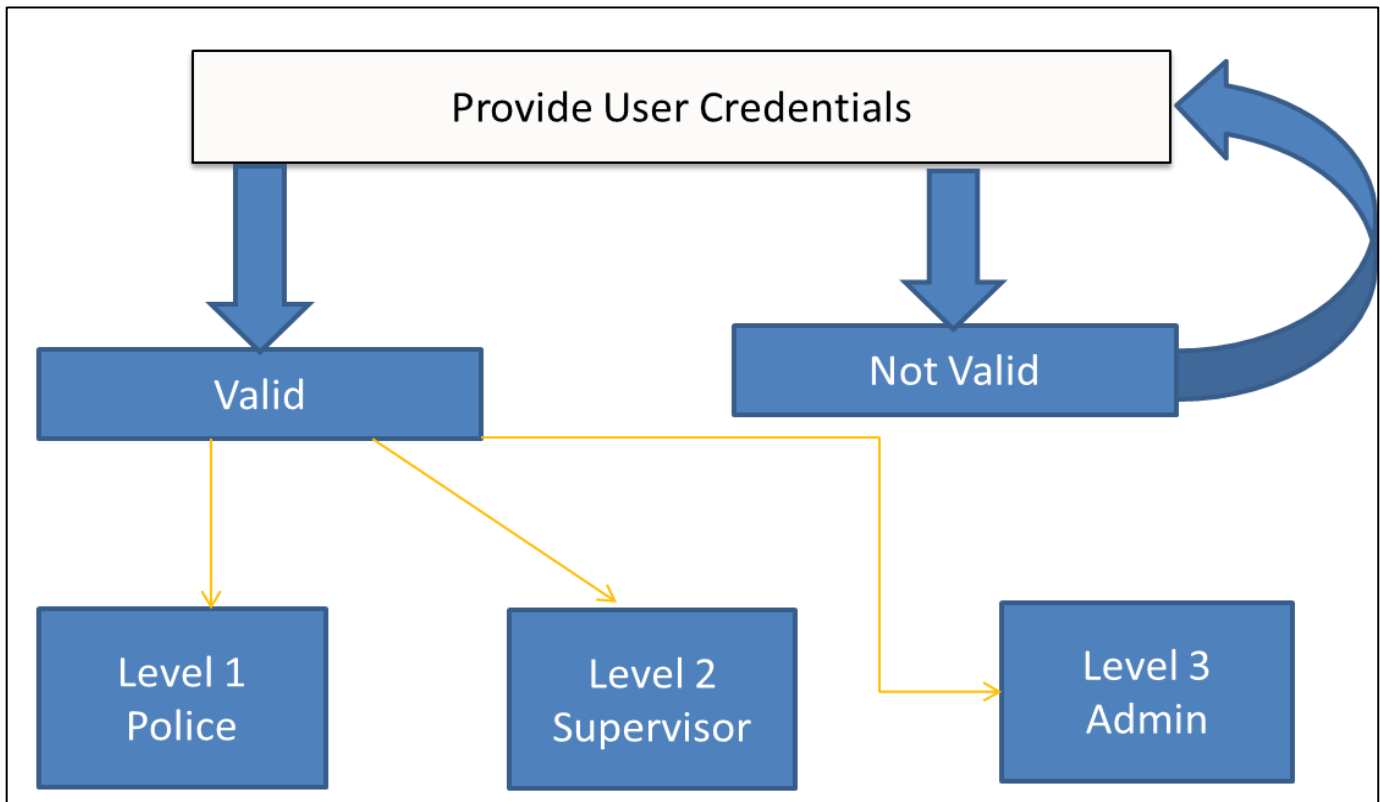
Figure 4. Login Page Design

2.3.4 Implementation

Implementation of the system took place in three phases. IT students completed database design. The CASE tool used provided the SQL DDL script, which was then used to create the backend. Once the backend was running, CS students coded web pages using HTML/CSS, PHP/JavaScript, and MySQL [4]. MM students used these pages as the basis for the frontend. At this point, a second IPR was then conducted, demonstrating a proof of concept to the client.

2.3.5 Testing

Student teams continually tested the system throughout the development of the project. This included both non-executable and executable testing. Non-executable testing consisted of general rehearsal, modeling how users would navigate through the system. Executable testing consisted of locating any logic or syntax errors in the coding process [2, 4].

2.3.6 Validation

The students' final exam was a live presentation of their product to the client. The client was able at that time to determine which team's project would be implemented on the client server. In the case of the Gang Unit database, one team's project was chosen. However, the client also chose some functionality from the other team's deliverable. The City of Lawton's IT staff were given copies of both, and the functionality from the one transferred to the other before full implementation. As a side note, when this occurs, it usually provides for an internship opportunity for one or more students, which was the case here.

3   Discussion

Running an interdisciplinary capstone course as a "virtual" software company is a winning scenario for the students, clients, university, and the professors involved. Here are just a few of the benefits reaped from this type of classroom environment.

- **Students obtain actual software development experience:** Students are provided with real-world software development experience and receive a letter of recommendation from the client for their efforts. Additionally, clients can look at potential employees and determine those that could fit into the client organization.
- **Students experience integrated teams:** Much of software development today is accomplished in teams. In many cases, these teams are composed of different disciplines. In this case, IT, CS, MM, and ENG students must work together to solve the client problem and produce a viable product.
- **Students develop better communication skills:** Soft skills development (oral and written) may not be a main

focus in many computing departments. However, research has shown that these skills are of critical importance to students entering the job market [5]. This course forces students to use both oral and written communication continuously throughout the development process. Students also are able to work with technical writers who enforce these skills.

- **Client organizations utilizing this course obtain products that have required functionality at a minimal cost:** By utilizing the skill sets of the students, organizations can obtain necessary software that may otherwise be unaffordable. As a specific instance of this, this product is in now in use by the Lawton Police Department, and has saved the city of Lawton an estimated $100,000 [4].
- **Faculty is forced to maintain their skill sets.** Faculty must be able to continually respond to student limitations in order to ensure project success.
- **This type of class provides the university with unique service/experiential learning opportunities for its students.** Service and experiential learning are becoming increasingly important to universities in southwest Oklahoma. This course also provides a mechanism for partnering with outside agencies within the regional area [1].

4   Conclusion

Real systems software development and implementation has now become the norm for this particular capstone course. This approach provides students with opportunities to grow in their skills and learn how to work in integrated teams to ensure project success. The approach also enhances networking between the university and local organizations, thereby continuing to provide significant positive social impact [4].

5   References

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