CHAPTER 3

TEN YEARS OF EPICS AT BUTLER UNIVERSITY

Experiences from Crafting a Service-Learning Program for Computer Science and Software Engineering

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ABSTRACT

This chapter describes lessons learned and challenges faced while crafting a service-learning program called EPICS at Butler University. Drawing from such experience, the chapter presents a road map to anyone who is interested in creating a similar EPICS program. Emphasis is given on how a service-learning pedagogical model can be incorporated within a computer science and/or software engineering (CSSE) curriculum successfully. Finally, some qualitative assessment data collected from our students and community partners are discussed that validate the success of EPICS at Butler.

3.1 INTRODUCTION

The idea of EPICS (Engineering Projects in Community Service) started at Purdue University in 1995 as an engineering design project [1]. Since then, it has evolved to be a multidisciplinary service-learning program that has been adopted successfully by several universities [2,3]. In August 2001, the Computer Science and Software Engineering (CSSE) department at Butler University attempted to create an instance of EPICS [4,5]. Ten years later, EPICS is a successful and endowed service-learning program at Butler [6], a private institution with approximately 4000 undergraduate and graduate students located in central Indiana.

This chapter explains how our EPICS program was built based on an effective service-learning pedagogical model whereby students earn academic

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credit by collaborating with various not-for-profit organizations. The chapter also discusses how EPICS is incorporated within our CSSE curriculum. After that, it presents briefly various EPICS partnerships with a focus on a specific project with the WFYI public radio/TV station. The following section presents an assessment of some qualitative data that demonstrate success and key challenges of EPICS at Butler. Finally, the chapter concludes by recommending a road map to help any institution that wishes to establish an EPICS program such as Butler's.

3.2 THE EPICS MODEL

In this section, the author discusses how the CSSE department at Butler University has incorporated, and now requires, service-learning within its own curriculum. In addition, he explains how and why EPICS provides a unique opportunity for creating an effective pedagogical model within the context of a University-wide and multidisciplinary education.

3.2.1 Curriculum

Currently, the CSSE department at Butler has four full-time faculty members and approximately fifty majors and several minors. Since 2001, the department offers two separate undergraduate degrees in CS and SE, respectively. Also since then, it has incorporated EPICS as a sequence of courses, which are now required by both majors. Students can register for these courses during any year of their studies (they may also repeat such courses for additional credit). More specifically, the EPICS courses offered include CSSE 282/283: EPICS I, described in our course catalogue as a "supervised team software project for a local charity or non-profit organization. May be repeated for credit. Prerequisite: Concurrent registration in CSSE 248 [Introduction to Programming] or permission of the department." This course is designed for first/second year students. The CSSE 382/383: EPICS II course has a similar description with different prerequisites: "concurrent registration in CS 351 [Algorithms and Data-Structures] and SE 361[Software Engineering I] and either CSSE 282 or CSSE 283 [EPICS I], or permission of the department." Our third-year students usually take such course. Finally, our fourth-year students can take the CSSE 482/483: EPICS III, which requires SE 461 (Software Engineering II) and either CS 382 or CS 383 (EPICS II).

The rationale behind offering each course as two or three credit hours (e.g., CSSE 482 or CSSE 483) is simply to provide some schedule flexibility to students. For instance, some students only need two hours to graduate, or wish to fill their schedule during a specific semester. Initially, we expected

less workload from students who registered to the two-credit course. However, it quickly became apparent that such distinction was not necessary and was never an issue.

When we first created the EPICS course sequence, we decided to only provide elective credit to any registered student. At that time, the rationale was that service-learning should be elective in nature and not required. Since 2010, however, we started requiring all CS and SE majors to take at least one semester of EPICS for graduation. This decision was made based on the strong recommendations coming from our CSSE advisory board, the positive feedback from our students, as well as the suggestion of an external reviewer. It is worthwhile mentioning that despite the one-semester of EPICS requirement for graduation, we have observed that most of the students tend to register for our EPICS courses for several semesters (some students use the additional hours as elective credit for graduation and some simply accrue extra hours). Once students register for EPICS, they soon recognize the opportunity to gain valuable experience and balance their technical and soft skills. Also, by taking EPICS during consecutive semesters they become experienced and build momentum on a specific project, which allows them to become leaders of their teams.

On the average, approximately 10–15 students enroll every semester in our EPICS courses. They are supervised by a CSSE faculty member who is scheduled to teach EPICS that semester. Also, all of our EPICS teams are guided by at least one designated external mentor from the corresponding client site. Typically, before we launch a new EPICS project (with a new client) we make it clear from the beginning that clients are expected to commit the necessary time to mentor our students on a regular basis. In order to facilitate such mentorship, regular meetings are planned both on the client's site and on the Butler campus. Such meetings have proved to be very valuable learning experiences for our students, who are given the opportunity to sharpen both their technical and soft skills. For instance, one former client had set up a regular seminar for our students so that they could learn Joomla (a content management system) used to create the client's website and eventually our own EPICS website [6]. During another past meeting, the author remembers some helpful comments made by our clients to the students on the importance of business attire during their project presentations and client meetings.

3.2.2 Course Structure

Our EPICS courses are scheduled based on either twice- or three-times weekly class meetings (like every other course). The specific logistics of conducting the EPICS class really depend on each individual instructor.

The author has found that meeting twice a week throughout the semester typically works well. During the first weekly meeting, the team leader describes the status of the project and the progress of each individual team member to the instructor. In order to facilitate that discussion, the team leader is expected to prepare a Weekly Status Report (WSR) and to discuss it with the instructor. The author has used similar WSR templates as a consultant to industrial SE projects. Appendix A contains an example of a WSR template used by EPICS teams. As you can see in Appendix A, the WSR comprises important project information such as the date of the meeting, the names of all members involved, any red flags (i.e., critical problems that may change the direction of the overall project, such as the loss of a client or a team leader). Also, in the WSR the team leader describes any other technical and/or nontechnical issues such as the need for some specialized software or expertise. Finally, the WSR entails a list of dated project accomplishments during the past week as well as a brief description of the action items and goals for the upcoming week. So far, the WSR has proved to be a very simple and practical tool that helps everyone involved to stay focused. Both our clients and students have provided positive comments about the effectiveness of this practice.

Occasionally, during the first weekly class meeting various external or internal speakers may be invited (e.g., experts on a specific technology), technical workshops might be held (e.g., a jump-start workshop on smart-phone apps development), and/or other related educational activities can take place. On the other hand, during the second weekly meeting, the team leader is in charge and works directly with the team. He/she is responsible to keep the team focused and ensure that everyone is on task and making progress on their work. At all times, of course, the instructor is also available for answering any questions or to provide assistance if needed. That gives an opportunity for the team leader(s) to exercise their management and leadership skills. The author has also allocated separate time outside the classroom in order to mentor the team leaders on an as-needed basis.

Most of our EPICS projects follow the typical start-to-finish software development life-cycle process (i.e., planning, gathering requirements, designing, implementing, and testing, or providing maintenance to an existing software system). Depending on the nature of each specific project, the team (in consultation with its supervisors) selects the most appropriate software development process model. In particular, the students who have taken SE361 (our introductory software engineering course) have already been exposed to and have used agile software development methodologies such as Scrum©. More specifically, they are familiar with modeling tools and languages such as the UML (Unified Modeling Language), Use-case diagrams, and so on. Typically, these students undertake the technical lead of the project and

teach others the necessary tools and related processes. They also understand the incremental and iterative nature of the software development process and apply it effectively to their project. Normally, the team starts by selecting a small subset (usually about 10%) of the agreed-upon requirements, proceeds to the design and implementation of such a subset of requirements, and then demonstrates a prototype implementation to the client for feedback. The team also designs and executes various test cases to detect and fix any defects before the first incremental release of the software system. This whole process is repeated in increments until all requirements are implemented.

Throughout the semester, every EPICS team is expected to produce various project artifacts and deliverables. Depending on the type of project and its stage, various related deliverables may include a requirements specification document, architectural/design diagrams, prototypes, code, test cases, project plans, timelines, project display posters, presentation slides, videos, and websites. Most of these deliverables are uploaded on our CMS (Content Management System), which is implemented on our EPICS website as they are produced. Every registered user to our CMS may access such artifacts and use them. This practice has proved to be an effective mechanism for project continuity. For example, when new team members are joining an ongoing project they can find and download any project-related items from our website. This way we avoid reinventing the wheel every time a new team undertakes an ongoing project.

Every EPICS group also prepares and submits a comprehensive report at the end of each semester, along with a final presentation given to the client and any other interested stakeholders. The expected content and format of the final report and the presentation are given to the students at the beginning of each semester. The report (or dossier) typically entails the problem statement; detailed requirements specifications; both short-term (i.e., for the semester) and long-term project goals; a project plan with timeline and milestones; any design, implementation and testing artifacts; and various technical manuals, tutorials, and other related documentation. In addition, the dossier describes each member's role, goals, and accomplishments for that semester. Also, it contains copies of all weekly status reports with individual member's detailed contributions, and a copy of the final PowerPoint presentation.

In addition, all teams are typically expected to prepare and give two separate presentations at the end of each semester: one for the client team (usually nontechnical) and another (which is technical in nature) for the faculty advisor. In some cases, both presentations are combined into a single one (when the client has the necessary technical background).

Finally, all EPICS teams are required to create a signature poster that includes information about the client, all team members, and a brief description of the project (it also includes pictures, photographs, and/or various

graphic images). All of these posters are prominently displayed (along with project dossiers) in our computer teaching lab. This becomes our EPICS showcase for anyone who visits our department (e.g., prospective students and their families, potential clients, sponsors, and so on). Such displays have been an effective marketing tool for attracting new students and/or new clients to our EPICS program.

3.2.3 Grading

All students enrolled in an EPICS course receive a final letter grade (like any other CSSE course). Again, the grading scheme depends on the particular instructor who teaches EPICS that semester. The author (when he teaches EPICS) typically calculates such grades based on a formula that entails the following criteria: peer reviews, the client's performance evaluation of the team, all project deliverables produced, and, of course, the instructor's ratings. More specifically, during the peer review process every member of the team is expected to evaluate everyone's contribution, including their own, their leaders, and the performance of the team as a whole.

Such a grading approach strives for a balance between the amount of progress made on a task and the degree of learning new technologies. In particular, the author's grading scheme takes into consideration the importance of peer and mentor evaluations to assess the quality of the student's work and his/her overall performance (as in real life). So far, the students have responded positively to such a grading model (note that other EPICS supervisors may use a slightly different grading scheme).

It is the author's experience that students like the idea of peer reviews and see them as opportunities for them to provide constructive feedback to help their fellow team members (and the team as a whole) improve their performance (especially their leader). They also appreciate the fact that they are expected to participate in the performance assessment process. The following is an example of a student's midsemester peer evaluation comments about the team leader's performance.

> Our leader] does a really good job letting people know what their jobs are, and what tasks are needed to be done, but doesn't motivate everyone on completing their jobs. Our group is progressing, but if the team leader would motivate everyone we could have a much more productive semester.

The author has made some interesting observations when it came to students' self-evaluation (the hardest part of peer evaluations). Typically, some students tend to be hard on judging themselves, whereas others tend to glorify their work and a few provide several excuses for not performing well. Below are some quotes from such self-evaluation reports.

> I feel I have brought a lot to the group this semester, compared to the last. I have completed most of the GUI's and updated the last one from the previous semester. I am learning a lot of JavaScript, which is becoming very useful with all of the GUI's. I hope to bring more to this project, but its taking some time to learn some of the material.
>
> I feel that while I have been successful in keeping the team focused on their work, I have been less than successful in guiding the direction of the project. Once version 1.0 of the software system is finished, however, I am confident that the project's future will become that much clearer to me.

Also, below you can read some comments from students evaluating their own team as a whole.

> This semester we have made huge strides. We all have come together to advance together. Some haven't brought enough to the group, but the others have picked up the slack and have really made some huge progress with the project. Hopefully, this semester will make a huge impact with the client and show them that we are getting a lot done.
>
> We have a lot of intelligent minds, just not the organization to truly develop software in both an effective and rapid manner. As a new member, I find it's easy to not get as much done as I maybe could, because there's not much sense that leadership holds the team accountable for holding the group up or not delivering. If there were more of a culture of daily forward progress, more of the team might be compelled to kick start their performance, myself included.

During the middle of the semester, the EPICS instructor calculates an "estimate grade" for all students (based on the midsemester peer and client review process). The midsemester grade has proved to be useful in the sense that it gives the students an idea where they are standing with respect to their grade. Along with such an estimate grade, the instructor also recommends a list of areas for improvement so that the students know what they need to do in order to secure a better grade. (An example of a midsemester trial-grade and accompanying recommendations is included in Appendix E.)

Finally, it is important to mention the EPICS University website, an excellent source of various practical pedagogical tools (e.g., a repository of forms, questionnaires, evaluation surveys, assessment criteria and so on) [3]. These tools are available and they can be customized and used by any other EPICS site. Occasionally, we have borrowed, customized, and used such templates in our EPICS courses (and we are thankful to the EPICS University for their generosity). For example, the author has used such guidelines and questionnaires for conducting student peer reviews and for soliciting evaluation feedback from clients (see Appendices B and C, respectively). It

is worth mentioning that during the process of customizing and fine-tuning the peer evaluation criteria, the author has found that it is important to involve the team leaders and take their input into consideration (see Appendix B). Below, is an example of such a partial questionnaire used to solicit feedback from one of our EPICS clients.

> Did working with the EPICS team enable you to improve your business process? If yes, how? *"While the process seems to be moving slowly at times, the end product should be stronger thanks to the thorough work. The final product will likely be something we are all proud of!"*
>
> What would you like the students to know about your organization? *"We are grateful for the work being done by the EPICS team and are looking forward to continuing the partnership."*
>
> What three things could be done to improve the team and their project? *"The team is doing a great job of taking client input and applying it to the project. Since we come to the classes and are pretty open and informal, it may seem strange to say it would be a good idea for the students to dress nicely when they are making their presentations, especially the final one. They'll be glad to have heard this from a 'test' client versus in an actual job setting. Since we are not the "typical" client it would be good practice for them to step back and see how the team does when they are communicating with the nontechnical parts of the client team."*
>
> What would you like the class instructor to know? *"I personally appreciate the fact that he is in touch with the project and can act as liaison between the client and the team. He helps manage the expectations for all of the players."*

Finally, the author typically shares and discusses such comments (using discretion) with all EPICS team members as constructive feedback from the clients.

3.2.4 Signature Features

This section describes some of the unique characteristics of the EPICS program at Butler University. Most of these features are inherited (and customized to our CS and SE majors) from the national EPICS program [3].

First, EPICS entails student-focused and student-driven team projects under faculty supervision and client mentorship. In other words, our students wish to engage with EPICS because they expect to experience something different from the typical lecture-based classroom model. More specifically, they want to have the freedom to choose and drive their own learning experiences by selecting, owning, and managing their preferred projects, clients, and teams. To accomplish that, at the beginning of every semester, we go through a matching process that allows the students to engage with a project of their choice. We have seen that such freedom makes our EPICS students

more self-motivated and they tend to learn on their own and from others. In a later section, we provide some assessment data that supports such claims.

In real life, the duration of software engineering projects tend to span a few months to a few years. Our EPICS projects typically provide an opportunity for our students to engage in similar multiple-semester projects. This is a valuable experience for our students because they become familiar with various project management issues such as the moving target problem (i.e., continuously changing requirements) as well as project continuity issues (e.g. nonreturning team members, poor team leadership, change of mentors or supervisors, and so on) At the end of the day, everyone involved in EPICS benefits from interacting with actual clients, conducting real projects, meeting strict expectations, and facing rigid constraints.

Our EPICS teams are vertically integrated to include second-semester freshmen to seniors. They earn required (or elective) academic credit that counts toward their graduation. Such teams are also multidisciplinary and are open to students in any major. Although typical CSSE students tend to work and eventually learn on their own, we have observed that EPICS provides a platform that promotes and facilitates learning from each other.

In addition, EPICS appears to be an effective vehicle for attracting underrepresented groups (e.g., women in CSSE). It is worthwhile mentioning that our first EPICS student team at Butler consisted of five females and one African-American male.

Another signature feature of EPICS is that it promotes a project-focused learning model in which the type of selected project drives the educational content of the course. For instance, some EPICS projects may require our students to learn how to use a specific technology. Moreover, the EPICS model entails various self-motivated, engaging, and self-directed learning activities. For example, we have observed our EPICS students becoming resourceful and learning from various sources. Specifically, they might be learning new things on their own, from their instructor, an industry mentor, other students within vertical teams, other faculty members, or from taking other courses. On one occasion, the author had a student who located and took a course outside the CSSE department in order to learn how to use Macromedia Flash© to develop game animations for an EPICS project. Another example would be for students to take short courses on how to develop applications for smart phones (e.g., iPhone© or Android© apps), which are typically not offered by the CSSE department as regular courses.

Although our EPICS program is interdisciplinary, it is autonomous and managed solely by the CSSE department. It maintains its own website wherein anyone interested can find related information. The EPICS program has also been institutionalized within Butler University. More specifically, all EPICS courses are endorsed by Butler's Center for Citizenship and Com-

munity (CCC), and they are annotated by the Service-Learning (SL) course indicator [7]. Finally, some of the non-CSSE students who have taken EPICS courses so far include foreign-language and society and technology majors. They usually take the courses in order to satisfy elective credit for their major.

All students and instructors involved with EPICS are expected to engage in various external activities such as participating in conferences, competitions, and other related professional events. For instance, they have participated in and given various presentations and poster displays in several academic conferences and related workshops, including the National EPICS Conference [8], the Frontiers in Education Conference [9], the SENCER Summer Institute [10], the SIGCSE Conference [11], and the Computing Conference for Small Colleges [12]. In addition, EPICS teams have participated in various student competitions such as the ASEE Idea2Product competition [13]. Also, our EPICS teams have visited various centers and universities such as the Virtual Reality Center at IUPUI [14], the Electronic Visualization Lab at the UI–Chicago [15], and, of course, Purdue University, where they attended various EPICS projects presentations [3].

Finally, our EPICS teams have also been awarded various monetary (and nonmonetary) prizes due to their participation to various competitions, including the I2P 2004–2005 and the ISSAC 2002 [16]. Such awards earned by our EPICS teams have had an important impact on our students' self-esteem and professional development as well as their personal growth. Also, our EPICS program has been endowed by a generous gift from the Sallie Mae Corporation [17].

3.3 COMMUNITY PARTNERSHIPS

During the past ten years, our EPICS program has established numerous partnerships with various not-for-profit organizations in the Indianapolis Metropolitan area. Some of these collaborations have been more successful than others. One of the lessons we learned is that maintaining such healthy partnerships requires a serious commitment from all parties involved, which is key to the success of EPICS.

Typically, in order for an organization to qualify as a viable EPICS client, it has to be strictly a not-for-profit organization. To date, we use a simple process for selecting promising clients for our EPICS program. Most of the times, we receive calls and/or visits from various interested organizations from the local community. We first meet with them in order to understand their needs and see if there is a good match with our EPICS program at Butler. If indeed there is such a match, we ask them to write up a brief descrip-

tion of any possible projects for our EPICS students. These descriptions are then discussed with all teams and their advisors. As a result, the appropriate matching of students with the right project is accomplished. Although initially there was a concern about how we would attract and sustain EPICS clients, it quickly became apparent that the demand for engaging with our EPICS program was (and still is) much greater than its capacity. Today, we maintain a waiting list of interested potential EPICS clients.

Among others, some of our current or former EPICS customers and community partners include schools such as Crispus Attucks Middle School and the Oaks Academy [18], the Indianapolis Legal Aid Society [19], the POLIS Center [20], the Butler Undergraduate Research Office and Conference [21], the Crohn's and Colitis Foundation [22], WFYI Radio/TV Station [23], the Association for Software Testing (AST) [24], the Center for Urban Ecology at Butler [25], Lutheran Child and Family Services [26], and the nuAfrica Water–Education–Life Organization [27].

Some of these partnerships have resulted in projects such as the "Language-In-Action" (LIA) project with Crispus Attucks Middle School of Indianapolis. The LIA project started in 2001 and entails a Web-based suite of educational software for teaching Spanish and Greek (extendable to other languages) to middle school students. One interesting component of LIA is the "QuickDrop" software application, which helps students with practicing their Spanish and Greek vocabulary by playing fun animated computer games while they are doing their homework. Appropriate implementation technologies used during that project include Macromedia Flash© for its Web interface and animation as well as mySQL and php for the database back-end support. The LIA project is actually the inaugural EPICS project at Butler University. The author was the first faculty supervisor of LIA and the team consisted of six motivated CSSE students—five women and one African American male.

It is the author's opinion that LIA still represents one of the most successful EPICS projects he can remember. During that project, the EPICS team conducted many visits at Crirpus Attacks Middle School, helping students and Spanish teachers incorporate the LIA software into their curriculum successfully. The author remembers the students of the first LIA–EPICS team being extremely excited and self-motivated. They used to spend numerous late-night hours in the computer lab working on their project. Because of that, at that time, the author had introduced (with humor) the term "EPICS addiction." Among others, the LIA team won our first EPICS award in the Indiana Student Software Awards Competition (ISSAC) in 2002 (more about LIA can be found in [4 and 5]).

Another example of a long-term and successful partnership is our collaboration with the POLIS center at IUPUI in Indianapolis, which started in

2002 [20]. This effort resulted in work accomplished for the SAVI (Social Assets and Vulnerability Indicators) project [28,29]. SAVI is a dynamic community information system hosted by POLIS. During that partnership, our EPICS students were involved in the development of a .NET Web application that facilitates the process of searching the SAVI database. More specifically, the team developed a prototype query-builder back-end that parsed any textual user-entered string (like any search engine) and converted that string to a meaningful SQL query. That query was then compiled and executed on the SAVI database in order to locate and display the desired information. During that project, our EPICS students benefited tremendously from working with experienced SAVI personnel and learned the .NET platform. It is also worth mentioning that after that project, the author incorporated the .NET platform in his software engineering courses as a vehicle to introduce object-oriented design concepts and techniques (more details about this EPICS project are described in [5]).

More recently, in 2010, we have started an ongoing EPICS project aimed at the development of a set of smart-phone native applications called IndianApps for the Urban Ecology Center at Butler University [30]. More specifically, our EPICS team was tasked to develop a GPS-based pilot smart-phone application that would enable the citizens of Indianapolis to report and track environmental data such as information about injured birds, sick trees, rain barrels, and so on. In particular, the rain barrels are scattered all over the city, and citizens may enter their locations and their water volume using smart-phones (or other mobile devices) connected to the Internet. The initial high-level architecture of IndianApps designed by our EPICS team is shown in Figure 3.1.

As you can see in Figure 3.1, The GUI layer was developed using Dream Weaver©, the application algorithms used JavaScript and php, the database connectivity was done using phpAdmin, and the database used MySQL. The data then was exported into a spreadsheet and then geocoded (i.e., translated coordinates) so that they could be represented on a map. For more information on the IndianApps project see [25].

Finally, the WFYI Assets Management System (AMS) represents the result of another recent partnership with the WFYI Public Radio/TV Station in Indianapolis [31]. During that project, our students were engaged with various activities that spanned the complete software development life cycle. We will describe this project in the next section in more detail as an example of a successful EPICS project.

3.3.1 WFYI–EPICS Partnership

This section describes our partnership with the Indianapolis WFYI Public Radio/TV Station [23]. We believe that this particular EPICS project repre-

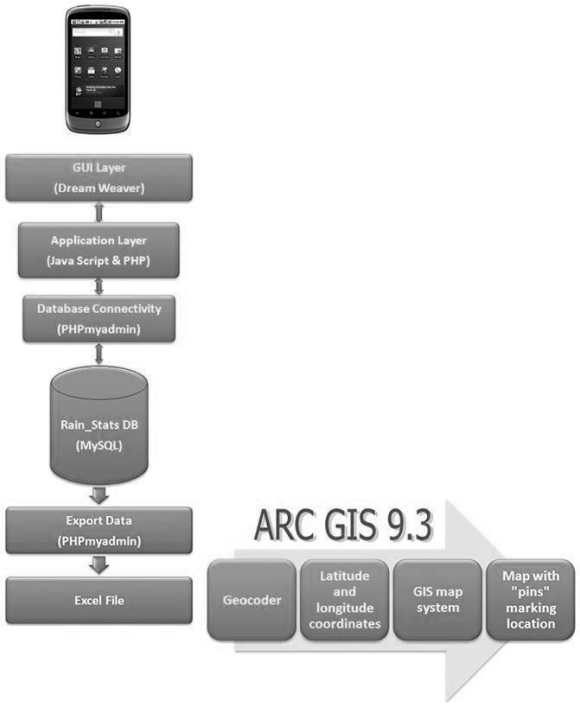

Figure 3.1. High-level architecture of the IndianApps system.

sents an example of a very successful partnership with a not-for-profit organization that has provided a positive learning experience for our students.

The rest of this section starts with an overview of the project and its history. Then it briefly explains its technical landscape, goals, and challenges. In addition, it discusses the contributions of our students to the project and the impact it has had on their education. This section concludes by describing some comments from the technical project manager of WFYI, including some important lessons learned.

The WFYI–EPICS partnership started during the spring of 2008 semester when an upper management team from WFYI visited Butler University to discuss a possible collaboration with our EPICS program. This project ended in 2010 when a beta version was released and installed at the client's site. Three different teams were engaged in this project, which lasted five consecutive semesters. The author of this chapter was the primary faculty supervisor since the inception of the project.

At first, our client expressed the desire to automate the process of storing and managing all their video production elements and related material. Such material included an estimated 4000 tapes containing approximately 2000

hours of video for more than 40 productions over a 10-year period. Based on that, we established an initial list of requirements for crafting an Assets Management System (AMS) for WFYI. It was decided from the beginning that the AMS would need to entail a Web-based interface with a typical relational database back-end. Such a database management system utilizes multiple connected tables to store all related information, which is optimized in order to provide a more effective query facility for searching and retrieving desired data. Figure 3.2 shows the main login Web interface of the AMS.

At the beginning of this project, our students experienced first-hand that gathering requirements can be a lengthy and challenging process (as was the case here). More specifically, the EPICS team conducted several meetings with various people from WFYI and devoted many hours discussing the requirements for the AMS. During such meetings, the EPICS team utilized various modeling tools (e.g., use-case diagrams learned in our software engineering courses) in order to model the system's functionality from the user's perspective. Also, simple use-case scenarios, user stories, and feature lists were found to be practical tools for collecting and specifying the requirements for the AMS. Such requirements started as high-level and evolved to be long, refined, and very detailed.

After the establishment of the final requirements, the EPICS team created a high-level architectural design for the AMS. Figure 3.3 depicts such an architectural diagram. As you can see in the diagram, the proposed system had to facilitate the process of online data entry as well as to handle an already existing large amount of related data that was stored in several scattered spreadsheets. In addition, the AMS was expected to provide some functionality for the database administrator (DBA) in order to create and manage new accounts for AMS users.

Figure 3.2. Main login window of the AMS. (The WFYI logo is copyrighted by WFYI Radio/TV of Indianapolis.)

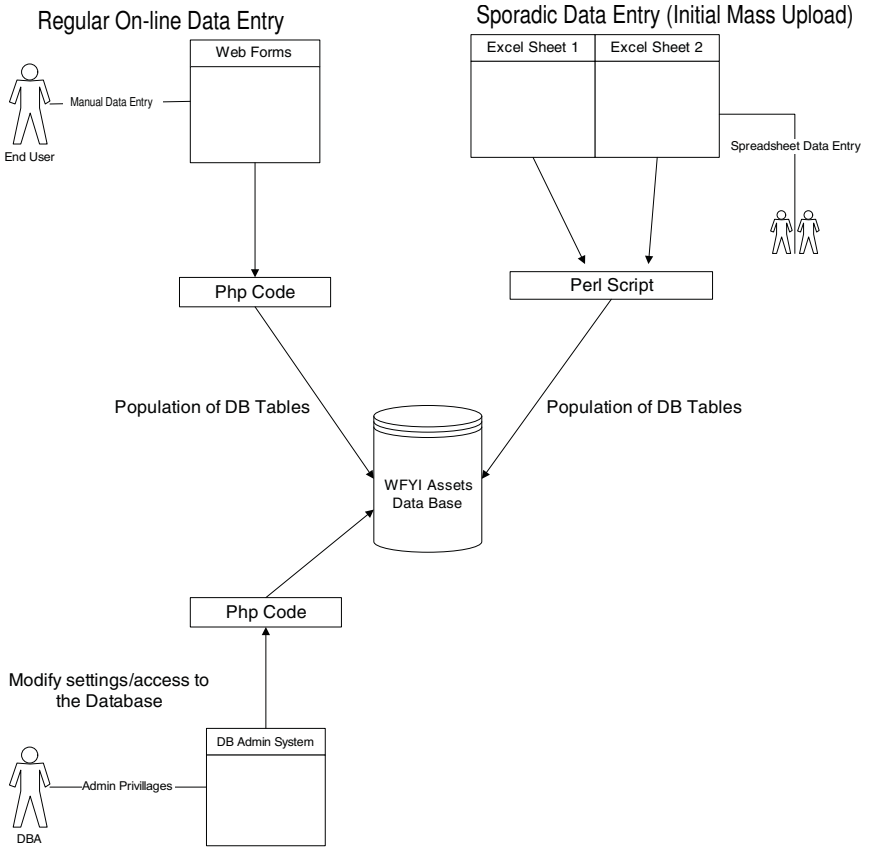

Figure 3.3. High-level architectural design of the AMS.

During the detailed design phase of the project, our EPICS team was divided into three separate focus teams. Each team was tasked with the completion of one of the above-mentioned subsystems of AMS. More specifically, the first focus team was responsible for the automation of the initial mass upload of existing data, the second team focused on the future online data entry and database management features, and the third team aimed at providing the system administrator functionality. Figure 3.4 depicts a simple data-entry form developed by the EPICS team for entering new information online. Figure 3.5 shows the main window implemented for the AMS administrator for creating and managing accounts for new users.

It is the author's experience that decomposing the initially proposed system into separate cohesive units (such as the ones described above) was critical to the overall success of the project. Based on such logical decomposition of the new system, the EPICS team was organized into smaller

Figure 3.4. Online data-entry form of the AMS. (The WFYI logo is copyrighted by WFYI Radio/TV of Indianapolis.)

subteams. Such division was done based on various criteria such as the background of each team member. For instance, the students who were familiar with (or wanted to learn) the Perl scripting language undertook the implementation of the mass-data upload functionality. On the other hand, anyone who wanted to work with php and MySQL technologies worked on the online new-data-entry part. Therefore, it is important to discuss with the students the various options and allow them to choose which part of the sys-

Figure 3.5. System administration main window of the AMS. (The WFYI logo is copyrighted by WFYI Radio/TV of Indianapolis.)

tem they wish to engage with. (The author has found that such an approach has been effective most of the time.)

During the implementation phase, our students had to learn and use typical Web-based software development tools, languages, and platforms, including HTML, CSS, JavaScript, php, phpAdmin, PerlScript, and MySQL (some of these tools are taught in CSSE courses but others are not).

During the final phase, our EPICS team conducted various software testing activities (led by the students who had taken our Software Testing and Quality Assurance course). During that time, our students designed, generated, and executed several test cases. Based on that, some defects were detected and resolved before the final release and delivery of the AMS.

In addition to the technical challenges, our EPICS team learned some unique project management lessons during this project. For instance, it is worth mentioning that the team made an impressive effort to embrace a blind student who participated in this EPICS project for several semesters. With the support of all team members and the faculty supervisor, the blind student eventually played a central role and made an exemplary contribution to the project (mostly on designing and implementing the database back-end of the AMS). Moreover, the team learned how to survive a high turnover of various project constituents such as different team leaders and new members (also multiple users, developers, testers, business people, etc.) Another important lesson our students learned during this project is how to deal with frequently changing requirements. It took the team quite some time in order to understand what needs to be accomplished and eventually help the users/clients to realize what they really wanted (something typical of any real software engineering project).

Another experience worth mentioning is related to computer ethics. Although it was the end of the semester (and student grades were due), the team was reluctant to release the final version of the AMS prematurely (i.e., with known bugs). During a meeting at that time, it was stressed by the team leader that it would be unethical to release a buggy version to the client, which would go against everything that they had learned from our Computer Ethics course. The author (being the supervisor of that team at that time) was impressed by the way the EPICS students handled this situation on their own and made appropriate decisions. This incident represents an example of a case in which our students exhibited the ability to make mature decisions and effectively apply (nontechnical) knowledge (learned from the Computer Ethics course) to a real-life situation.

The rest of this section presents some feedback provided at the conclusion of our project. Such feedback mostly comes from the technical lead of our WFYI client as well as from some of the students involved. All this information was collected during an interview conducted by Butler's public-rela-

tions personnel in order to write a related article published in *Butler Magazine* [31]. The responses from that interview are described below (with permission), followed by the author's comments. It becomes evident from such praise that our EPICS students produced high-quality deliverables and exhibited a remarkable work ethic during that project. In addition, they made a great impression and impact on the WFYI personnel (especially the upper management). Finally, from the students' own comments we can see that they have appreciated such a realistic experience.

3.3.2 Students' Perspective

The overall feedback we received from all our students about their involvement in the WFYI–EPICS project was very positive. Below, we share related comments from some students involved, particularly the ones who worked all five semesters and had completed a summer internship at WFYI working with their personnel on the AMS.

> We got to design the solution. The professor stayed out of the project as much as possible. This removed the crutch that most students rely on, making us grow as developers.

Another, commenting on "soft skills," states:

> I learned] how vital it is to communicate effectively with people that might approach the project or the organization as a whole from a different perspective.

3.3.3 Client's Perspective

The responses below describe the client's viewpoint of the initial project requirements and related logistics (e.g., real constraints and limitations, project duration, number of teams, final deliverables, etc.). As you can see, this represents a real, complex, and challenging project with actual constraints.

> The EPICS team was tasked with creating an Asset Management System to catalog and describe a series of tapes containing various video elements. The video elements were created for many different video productions that WFYI Productions did. These tapes compromise the raw camera footage from locations and the various "takes" created during production of documentaries, TV advertising spots, short information pieces, and television programs. The Asset Management System would store descriptive data called metadata about each tape that would describe the contents, when it was created, who created it, for what client, and the location of the tape among other information.
>
> There was an internal resistance to changing the way things were being done. There existed a varying degree of organization with regard to "raw

> tapes" and that the "system" (used loosely) seemed to be working well enough. Few people were willing to devote time to build something new since they were too busy managing other production-specific projects, often tied to income for the station. There is also a very limited staff with the skill set needed to undertake a software project like this and that staff was already overstretched managing the development and maintenance of four websites.
>
> The project design and implementation took five semesters and had three distinct teams during that time frame. [The students developed] a MySQL- and php-powered tool that WFYI Productions can use to catalog its production tape library. Each time a new tape is created by a videographer, they log the tape into the system and store it in a designated room with organized shelves.

An important accomplishment of this project is that the end-product is in fact utilized by the client (as the response below indicates):

> The system is being used currently as intern and staff time is available to "backlog" the extensive preexisting tape inventory. I also believe the system is being used as new material is produced and cataloged.

It is fair to say that other EPICS projects, although developed for real customers, have not been in actual use due to various reasons (mostly nontechnical). On the contrary, the WFYI project is a good example of a project in which students developed a robust prototype application rather than an academic exercise used as a learning playground.

The following responses demonstrate that our EPICS students did impress our client due to their exceptional work ethic and enthusiasm to learn. Therefore, the client has expressed a genuine interest in continuing such collaboration with EPICS (the author is already being discussing such possibility with WFYI personnel).

> I am a computer science graduate myself and understand the difficulties involved in learning the nuances of computer programming. I felt that the Butler students involved with EPICS were intelligent, easy to work with, and eager to learn. Also, given the enormity of this project, I think they were all brave and showed great determination to see the project to completion.
>
> This was WFYI's first collaboration with EPICS, although I was aware of the concept of EPICS from my time at Purdue University. I will likely ask Butler EPICS to assist WFYI with future projects, since there will always be the need for the skills that computer science students possess and WFYI is unable to hire. There is always more work for me than I am able to complete.

Our EPICS students had a great opportunity to spend a summer at WFYI getting their hands dirty and, thus, being able to earn a deeper understanding of the end users real needs (as the response below indicates):

> "When the team came in during the summer of 2009 and shadowed the staff and interns tasked with managing and organizing the tape library, they were able to clarify and refine the design goals of the project to closely match the actual need."

Finally, our EPICS students had an impact even on the WFYI upper management as the following important response indicates:

> "The collaboration was beneficial to many upper management and staff here at WFYI. It forced many to realize that their broad and not clearly defined project requests don't clearly translate into a workable solution. A great deal of work is needed to define and specify the broad ideas and requests into solid foundations for a project to accomplish."

3.4 ASSESSMENT

This section describes how our EPICS service-learning program is being assessed internally. It also explains why we believe it has proved to be successful at Butler. The focus is on the reasons why EPICS has flourished at various levels (i.e., departmental, College, and University levels) within Butler.

First, it becomes evident that our EPICS program has been successful within the CSSE department due to various reasons. One such reason is that with EPICS, throughout the multiple-semester software engineering projects, our students have the opportunity to experience something beyond a typical internship or a capstone project. Moreover, via EPICS they can apply classroom knowledge and skills in a realistic environment by starting early in the curriculum (as mentioned above, EPICS can be taken as early as the second semester of the first year). In addition, they are given the chance to balance their technical and soft skills (dealing with real customers and project management issues). Finally they understand what it means to act as a professional during client meetings. Based on all of the above reasons and the feedback we receive from our students (see survey responses in the next section), it becomes evident that EPICS aligns very well and complements our own CSSE curriculum.

Second, we have watched EPICS flourishing within a liberal arts and sciences (LAS) college (compared to a typical engineering college). Some of the reasons include the fact that LAS students usually come to EPICS with a broader education and a solid understanding of how to be useful citizens and the need to help their community. Therefore, they have a positive attitude toward service-learning. They also know how to think outside the box and appreciate diversity and multiculturalism. Finally, we have seen that many LAS students that take EPICS are double majors (e.g., music and CS). In

other words, a home such as the LAS College appears to be an excellent place for an EPICS program to flourish.

Third, we provide some reasons why we believe that EPICS has been successful as a viable program within a small private university such as Butler. The main reason is that the University's mission statement mentions, and clearly stresses, the importance of community involvement, service-learning, and outreach activities. In addition, Butler has institutionalized service-learning via the CCC (Center for Citizenship and Community), which manages and coordinates all service-learning courses and volunteerism as well as ensures a sense of community awareness and responsibility among students [7]. Finally, it is worth mentioning "The Butler Way" mentality that characterizes the spirit of Butler University, namely, a family-oriented environment with small-size classes where students receive (and expect) personal attention and, therefore, develop a caring behavior for others and their community. So it is the author's opinion that this justifies the success of EPICS at the University level.

3.4.1 Qualitative Data

During the past few years, the CSSE department has been collecting assessment data from our students regarding their experiences with EPICS. Such data are typically collected using surveys and they are depicted in Appendices G and F. As you can see from those surveys, the students are given two separate groups of questions: one related to learning new technologies on their own and the second about team work. Below are some students' responses regarding their ability to learn new technologies on their own (for more details see Appendix F).

> I have been able to become very familiar with php and SQL. Something else that has been a great learning experience is dealing with clients that don't know exactly what they need, but they know what they want to be able to do. This gave me the opportunity of coming up with multiple ways to solve a problem, and presenting them with their options. This helped embrace that there is always more than one way to solve a problem.

From the overall comments shown in Appendix F, we can clearly see that most students indicate that they have been able to learn new technologies on their own and apply them to their project successfully. Also, some students claim that they feel confident enough (with what they have learned) so that they can teach it to other incoming EPICS students (i.e., they feel that they have mastered such new knowledge).

Regarding project management experiences, most students state that their teamwork skills have improved greatly and some feel ready to lead their

own teams (again, a more detailed description can be found in Appendix G). Here is an example of such comments:

> Although there were some issues with communication within the team, this was a great learning experience since not all groups will have good communication. I learned a lot about how to work with the conditions, as well as how to adapt to them. This was a very stressful semester, however. I learned far more than I have in previous semesters.

Finally, it is worthwhile pointing out some particular comments mentioned in Appendix G of a student admitting that he/she has regretted the fact that he/she was disconnected from the rest of the team. Another student also is confessing that he/she was not very happy with the work accomplished as a leader of the team and wanted to gain more experience.

3.4.2 Key Challenges

Although we have collected promising qualitative data that demonstrate the success of EPICS, it is the author's opinion that there is still room for improvement and fine-tuning of our EPICS program at Butler University. The main key challenges can be classified in the following categories: project management, assessment of learning, faculty involvement, and sustained funding. Below the author discusses each of these categories separately.

Managing vertically integrated and multidisciplinary teams is an ongoing challenge. Helping students to form and manage effective teams, selecting their leaders, and assigning appropriate roles to each team member are not easy tasks (especially in an academic environment). In the past, the author has tried to assign to each team member typical and specific roles (e.g., technical lead, customer liaison, recorder, historian, etc.) but has found that such roles do not always work (the students tend to prefer to create their own roles within each team, which make sense most of the time).

The author believes that we need to strive for a better mechanism that ensures balanced team structures and effective conflict management among team members. Moreover, we must look for better ways to deal with the team fragmentation phenomenon. For instance, some students tend to disconnect themselves from their team, preferring to work alone and/or with someone they know and trust, thus resulting in fragmented teams due to personality issues.

In addition, we need to improve our long-term project continuity mechanism. Such a mechanism may include an effective way of introducing smoothly new students in an ongoing project, to select and match appropriate software engineering projects with the right teams, and to synchronize in-class and on-the-job learning. Also, we have learned that it is important to know when it is a good time to bring a project to closure (e.g., a milestone has been

reached and there is a consensus that this project must be brought to closure). Within that context, the author has observed that there is a difference between managing long-term projects (e.g., with a secure client commitment) versus short-term projects (e.g., with nonreturning or inattentive clients). For instance, the author had to terminate some projects in the past due to inadequate attention and lack of commitment from a client. Another reason for closing a project has been the lack of interest and motivation from the students.

Also, a key challenge is how to provide a good balance between ensuring student progress on a project while learning something new. For instance, in some cases, lack of progress can be due to a steep learning curve on a specific project. However, students need to understand that in real life you are expected to do both (i.e., learn new things and demonstrate satisfactory progress at the same time). Also, we must take a closer and more careful look at what we should evaluate and how (e.g., Do we measure how much students learn? What progress they accomplish? How happy have they made their customers?) In other words, it is solely the author's opinion that we still need a better way to measure service-learning effectively (at least within our own EPICS program).

Another important issue with EPICS is faculty engagement. More specifically, it is essential that any faculty member who wishes to teach EPICS courses receive credit equivalent to teaching any regular course. In general, teaching a service-learning course such as EPICS should provide credit that can be counted towards academic tenure and/or promotion. We have found at Butler that supervising two or three (sometimes more) EPICS projects is equivalent to teaching a regular semester course. Moreover, faculty members who are expected to teach EPICS courses should be given the opportunity for professional development. For instance, travel funds should be made available to them on a regular basis. Such support will allow faculty members to attend related professional events for preparing to teach service-learning courses as well as to keep up to date (e.g., the EPICS annual conference, SENCER summer institute, etc.).

Finally, although we have established an endowment for our EPICS program at Butler, we still believe that it is essential to continue seeking funding from various sources (both internal and external). Such sources may include the university, corporate sponsors and alumni as well as various community foundations.

3.5 A ROAD MAP

This section is intended to provide some assistance to anyone who wishes to create a new EPICS program at their institution. It describes a plan and pro-

poses a road map that entails a sequence of path points to be visited in order to craft such a program.

Path Point 1: Viability Study

The goal here is to assess the overall feasibility of establishing an EPICS program at your institution. You can begin by asking some fundamental questions such as: What is Service Learning (SL)? What does SL mean to you? Can EPICS be an actual implementation vehicle of SL? How can EPICS be implemented at various levels within your university (e.g. college, department) effectively? How would it affect your program? How can you integrate it in your curriculum? How would your students and your faculty benefit?

The above questions will hopefully provide a better understanding of EPICS and how it can be incorporated into your institution. At the same time, you may gather common goals from all stakeholders involved and define the future desirable state of your EPICS program. Then specify all necessary steps to get to that state. With this in mind, you can create and include a project plan of the overall effort. Finally, this viability study will entail a cost/benefit analysis in order to determine all necessary resources required to create a service-learning program and its long-term benefit to your institution.

Path Point 2: Establish Awareness

Here, the goal is to socialize the concept of EPICS at your institution. Begin by communicating your short- and long-term goals effectively to everyone involved (including students). At the same time, make sure you establish internal and external visibility of your efforts. Some recommended ways to accomplish that may include the formation of a service-learning committee within your department and/or college. Also, you may create an advisory board with members from your community and alumni. Such board will not only advocate for your EPICS service-learning program but it will also be able to help you secure some external funding. Moreover, at this point it is crucial that a level of some commitment is secured from your institution's upper management or administration.

Finally, you will need to start devising an effective mechanism for creating (and sustaining) meaningful partnerships with not-for-profit organizations in your community. You can start by asking for help from anyone inside your institution who works closely with your community. For instance, many universities have an office that coordinates student volunteerism, service-learning, and/or other similar outreach activities (at Butler we have the

CCC [7]). It is the author's experience that sustaining such healthy relationships with community partnerships is essential for the success of your EPICS program and it requires some effort from everyone involved. For instance, during the first few years of our EPICS program we organized an annual dinner and appreciation evening, and invited all of our community partners and students at the end of every semester. Such a social event gave everyone an opportunity to get to know each other at a personal level and eventually created a sense of bonding. This dinner usually took place at an outside restaurant or inside our department.

Path Point 3: Incorporate EPICS into Your Curriculum

Now you can start creating a course (or a sequence of courses as we did at Butler) that count toward your major. Since it is common at academic institutions to engage with a lengthy process for approving new courses, we recommend that you begin by using your special-topics course to offer a section on EPICS (until the formal course is approved) for any interested students (so you do not lose momentum). Also, remember to allow for flexibility in the number of credit hours that students can take. As mentioned in an earlier section, at Butler we found that our students sometimes prefer to take fewer credit hours to fill up their schedule in a particular semester (or to simply graduate). In addition, your course structure should be vertical in nature, allowing for freshman, sophomore, junior, and senior students to register for different courses (e.g., 200-level course for freshmen/sophomores, 300-level for juniors, and 400-level for seniors).

Finally, you may allow your students to register for EPICS over several semesters for additional credit. At Butler, students are required to register for the 200-level EPICS course during their first year (second semester). If they wish to continue taking the EPICS class (which they do most of the time), they register for the 300-level course, and, finally, during their senior year they may register for the 400-level EPICS course. Every semester when they complete an EPICS course, they earn additional credit. For the 300- and 400-level courses, we usually count such credit towards our upper division elective courses. Overall, we have seen many students repeating EPICS two or three times (especially the ones motivated to become the leaders of their teams) during their studies at Butler.

Path Point 4: Secure Resources

At this point, you are ready to launch your program. The key to success here is to identify the right faculty member(s) to teach your new EPICS course(s). The selected individual(s) must be enthusiastic about service-learning and

have a genuine interest in engaging with the community and helping others in need. Typically, such enthusiasm and excitement is passed to the students who eventually will be advocating for EPICS and suggesting it to other motivated students. Also, based on the author's experience, the faculty member(s) who are about to teach EPICS need to understand that this is not a typical lecture-based course but is student-driven (i.e., students develop a sense of project ownership). Therefore, EPICS supervisors need to demonstrate some flexibility and act more in a mentor/coach role rather than as a traditional instructor.

During the first year, it is also recommended that you advertise your new EPICS classes to all your students. At Butler, at the beginning of every semester, our EPICS students visit other courses in order to attract interested students to join their own projects (i.e. students recruiting other students appears to work well for us). Also, at Butler University we offer various EPICS related scholarships and awards. For instance, we have established an annual EPICS-honorary award (i.e., an EPICS pin and pen) for senior students who have exhibited exceptional leadership during EPICS. Also, during 2001–2005 our EPICS students were eligible to receive an NSF scholarship for continuing their studies in computer science or software engineering. Such honors and awards can typically help you to attract, recruit, reward, and retain motivated and hard-working students for your EPICS program.

Finally, during the first year you will hopefully receive positive feedback from the first group of students that took your EPICS courses and you will start generating momentum. This is a great time to look for some seed money from your administration. Since you can demonstrate some early signs of success, hopefully you will be eligible for some financial support.

ACKNOWLEDGMENT

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APPENDIX A

WEEKLY STATUS REPORT (WSR)
Monday, April 6th, 2009

TO: All team members, advisors, mentors etc.
FROM: The EPICS-WFYI team leader
SUBJECT: Status of the Asset Management System (AMS)

I. RED FLAGS: None.

II. ISSUES: None.

III. ACCOMPLISHMENTS:

March 30th, 2009

- Based on the discussion from the March 23rd meeting with WFYI, the EPICS team continued to make improvements on their data model in order to better understand how the AMS operates with different asset types.

April 1st, 2009

- The EPICS team finished the latest version of their data model. This model will be used to create the new version of the AMS that the team will present to WFYI at their next meeting.

IV. PLANNED ACCOMPLISHMENTS (4/15/09 to 4/27/09):

Future meetings will be planned as follows:

- The EPICS team will meet with WFYI on April 13th to update them on the progress they have made on the AMS.
- Depending on how much progress is made before their April 13th meeting, the EPICS team will meet with WFYI on April 20th and/or April 22nd.
- On April 27th, the EPICS-WFYI team will have their last meeting of the semester. At the meeting, the EPICS team will follow their presentation of the AMS with a Q&A session. Pending approval from their faculty advisor, the EPICS team may also invite other students and faculty from the Computer Science department to watch their presentation.

APPENDIX B

EPICS Peer Evaluation Form

Please rate the performance of your team and its members including yourself by using a number between 1 and 5. For this evaluation, you can use the assessment criteria described at the bottom of this form. Please e-mail this completed form to your instructor no later than (due date goes here).

INDIVIDUAL TEAM MEMBER RANKING

1. NAME of team member: _____ Rate (1–5): _____
COMMENTS: please use the space below to provide some helpful suggestions and constructive comments on what this person needs to do to improve his/her performance this semester.

2. NAME of team member: _____ Rate (1–5): _____

3. NAME of team member: _____ Rate (1–5): _____

4. NAME of team member: _____Rate (1–5): _____

5. NAME of team member: _____Rate (1–5): _____

TEAM RANKING

Rate the overall performance of your team so far this semester (1–5): _____
COMMENTS: please use the space below to provide some helpful suggestions and constructive comments on what your team needs to do to improve its performance this semester.

PEER EVALUATION RATING SCHEME

1—Unsatisfactory

- Team member does not recognize his/her role in the team
- Functioning below what is expected
- Minimal or no initiative shown
- Often misses meetings
- He/she makes no commitments and/or sets no goals

2—Needs development

- Team member understands his/her role
- Has difficultly setting goals for him/herself
- Needs help identifying future tasks and stay focused
- Occasionally takes initiative
- This person is not as effective as other team members

3—Meets expectations

- Team member has a good understanding of his/her goals
- He/she schedules tasks to meet established goals
- Apply basic knowledge/experiences to accomplish his/her tasks
- Takes initiative sometimes
- Follows instructions and completes his/her tasks

4—Exceeds expectations

- Sets his/her own goals and demonstrates significant progress toward those goals
- Analyzes and tests options, questions actions when appropriate
- Provides constructive feedback to the team when necessary
- Regularly takes initiative and is very dependable
- Does at least his/her share for the team

5—Outstanding

- A key member of the team
- Consistently shows initiative
- He/she has a clear understanding of the team's long-term goals
- Makes consistent progress toward his/her own goals
- Takes responsibility for a major share of the team's work
- Helps the whole team make significant progress
- Assesses options, advocates for the most effective solutions

TEAM EVALUATION RATING SCHEME

1—Unsatisfactory

- Team does not have a well-defined goal
- It does not have a well-defined team structure

- Functioning below what is expected
- Shows no progress

2—Needs development
- Team understands its goal
- Team needs help identifying future tasks and staying focused
- Team structure needs improvement
- Team needs better coordination

3—Meets expectations
- Team has a good understanding of its goals
- Team schedules tasks to meet established goals
- Team demonstrates satisfactory progress
- Team structure is well defined and works well

4—Exceeds expectations
- Team demonstrates consistent progress toward its goals
- Team structure is well defined and very effective
- Team has a well-thought-out plan
- Team conducts regular meetings to discuss progress and future action items

5—Outstanding
- Team shows exceptional progress toward its goals
- Team has an excellent team structure and works effectively
- Team conducts additional meetings outside the regular class meetings
- Team assesses options, follows the most effective solutions
- Team is exceptionally productive

APPENDIX C

Project Evaluation Questionnaire (for EPICS Clients)

Please provide some feedback about your work with the Butler EPICS team. You may respond to the following questions by writing your answers in the spaces below.

- Name of your organization or agency _____
- Semester and year of working on this project _____
- Please rate the degree to which you are satisfied with the following:

	Very Satisfied		*Neutral*		*Very Dissatisfied*
a. Communication with student team	*1*	*2*	*3*	*4*	*5*
b. Responsiveness of team to customer's needs and interests	*1*	*2*	*3*	*4*	*5*
c. Professionalism of the team	*1*	*2*	*3*	*4*	*5*
d. Amount of time required to manage the team	*1*	*2*	*3*	*4*	*5*
e. Skill level of team	*1*	*2*	*3*	*4*	*5*
f. Quality of the work	*1*	*2*	*3*	*4*	*5*
g. Overall experience with Butler students	*1*	*2*	*3*	*4*	*5*

1. Did working with the team help you to improve your business process? If yes, how?
2. What 1–3 things could be done to improve the team and their project?
3. What would you like the students to know about your organization?
4. What would you like the EPICS faculty supervisor to know?

APPENDIX D

EPICS Final Project Report (Format and Content)

Cover page (course name, team name, team members, semester, project name, etc.)
Table of contents
Summary/Abstract
Chapter 1: Introduction

- Problem statement and objectives
- Motivation and rationale
- Description of the customer and developers

- Your overall approach and process model
- Glossary and terminology
- Organization of the report

Chapter 2: Requirements Specifications

- Description of functional (e.g., features) and nonfunctional requirements (e.g., performance)
- Assumptions and constraints

Chapter 3: Architecture

- Overview of high-level system architecture to include:
  - System services and/or features
  - System structure (logical components and their relationships)
  - System communication (interaction between components)
  - System functionality (responsibilities of each component)
- Architectural decomposition and style (client/server, Web-based, three-tier, etc.)
- System platforms (hardware and software)

Chapter 4: Design

- Description of the user interface (include screen shots)
- Features/operations
- Layout and aesthetics
- Organization of window displays, dialog boxes, and menus
- Print out report formats
- Navigation and browsing options
- Error message dialogs
- Data model

Chapter 5: Implementation

- Selection of implementation language(s)
- Coding standards and comments used
- Implementation process and distribution of work
- Organization of the code base (e.g., directories, files, packages, classes, etc.)

Chapter 6: Quality Assurance and Testing

- Describe the selection of your testing objectives
- Explain your basic testing approach and method(s) used
- Describe related checklists and/or templates used for testing purposes
- Explain your defect detection, reporting, and management process
- Include some documented sample runs of the code (using several test-data cases, a list of defects detected, and how they were fixed)

Chapter 7: Project Organization and Management

- Describe your team's organizational structure
- Explain the role and detailed contribution of each member in the team

- Clearly describe how the overall work was divided and carried out by different members
- Describe your project's management process (e.g., conducting meetings, scheduling, communication, planning, reporting, conflict resolution, etc.)
- Describe any related technologies and tools selection and use
- Include all Weekly Status Reports (WSR)
- Provide a detailed user's manual (e.g., instructions on how to operate your system)

References/bibliography (include all references and/or websites you used)

Appendices (complete source code, presentation slides, customer and peer evaluation forms, etc.)

APPENDIX E

Mid-Semester "Trial" Grade and Evaluation Feedback (Example Letter)

Team member name,

After calculating the averages of the peer evaluations data collected, the client's feedback as well as my own assessment, I am sending you an estimated grade so far for you and your team.

I am also including some brief recommendations on how to further improve your work during the rest of the semester.

Your grade: B plus (score received 3.6/5.0)
Overall team grade: A minus (score received 4.4/5.0)

RECOMMENDATIONS:

I can see that your team has accomplished a lot of work with establishing a solid connection with the customer, already selected an enabling technology (Joomla), and are getting to a point where you can start using it to develop the website.

Here are some recommendations on how to further improve your work during the rest of the semester:

1) Document well all the mini specs and features-list agreed upon
2) Finalize the design of the website and start implementation as soon as possible
3) Engage with your customer in regular meetings as frequently as possible

Other than that, keep the good work up!

Best,
Your EPICS instructor

APPENDIX F

EPICS survey (student responses)
Learning New Technologies

<u>Question 1:</u> While taking EPICS, did you learn and use any new technologies for your project (i.e., something you have not been taught in other CSSE classes)? Please briefly explain.

"I have been able to become very familiar with php and SQL. Something else that has been a great learning experience is dealing with clients that don't know exactly what they need, but they know what they want to be able to do. This gave me the opportunity of coming up with multiple ways to solve a problem, and presenting them with their options. This helped embrace that there is always more than one way to solve a problem."

"Actionscript III, Flash 9, some Photoshop."

"I learned to use Flash so as to create a game for the CCFA. Admittedly it was rather brief but I did get to learn about the technology. "

"I learned about Joomla, a little php, and some SQL. I also learned more in depth about perl. It helped doing this because I was able to learn how to connect outside programming languages into an SQL database (perl to sql)."

"No. Our project required that I deal primarily in developing the back end of a database-driven Web application. It was great practice, to be sure, but I already had significant experience with these technologies prior to Epics."

"I learned Macromedia Flash and Actionscript for making the game."

"I worked with database design that I haven't had to work with before.

Yes, I learned several new technologies that have been integral to the success of my project. Those technologies are Joomla, MySQL, and php. I used the first to help update my project's website while using the second and third for contributing to its development."

"I learned how to use php, myadmin, and how to create databases. I also learned how to program in perl script and connect perl code to sql tables and fill them."

"I was familiar with all the technologies I worked with (PHP, SQL, Apache, and PHPMyAdmin) but I certainly know them better now because of doing this work with them than I did before."

"Joomla, little php, myAdmin/php."

"Well if you consider Chief Architect new then yes. However, I used the software last semester for the same project."

"I learned how to use Actionscript. I have never used this program before, so it took quite a bit of time to learn on my own. I have become familiar with creating and editing graphics, movie clips, and buttons. I also have a brief understanding of how the computer coding is handled."

"Learned how to create a website using Joomla 1.5"

"I learned a lot about php and got a lot of firsthand experience in Dreamweaver."

"Yes, I have gotten some experience with Joomla."

"With this project, we learned Joomla, which is a content management system for designing websites. Once set up, it allows for easy updating of the content, as well as management."

"Joomla is a dynamic CMS. It's a very nice system that has high potential."

"For this project, I learned how to use Microsoft Visio to create use-case and entity-relationship diagrams. As software engineering is the field that I would like to gain some experience in, this is an application that I will be using well in the future."

Question 2: To what extend do you feel that you have successfully learned this new technology? Rate using the scale 1–5 (1 means not successful and 5 means very successful)

"Though I have learned much regarding the aforementioned technologies, there is still a lot that I would like to know. These include designing a custom template in Joomla, adding user privileges to a website using php, and creating sophisticated databases using MySQL."

AVERAGE (5-point scale): 3.95

Question 3: How confident do you feel about helping new incoming EPICS students learn this new technology? Rate using the scale 1–5 (1 means not confident and 5 means very confident)

"I am certain that between now and the fall 2009 semester that I will have learned so much regarding the aforementioned technologies that I can help any new EPICS student learn a technology that they can use in their project."

AVERAGE (5-point scale): 3.89

APPENDIX G

EPICS Survey (Student Responses)
Team Work

Question 1: Do you feel that your group worked as a team effectively? Rate using the scale 1–5 (1 means not effectively and 5 means very effectively)

AVERAGE (5-point scale): 3.52

"Although my team worked effectively as a group, there is still much for them to learn about collaborating on a technical project."

Question 2: How actively did you participate and engage with the team? Rate using the scale 1–5 (1 means not actively and 5 means very actively)

AVERAGE (5-point scale): 4.02

"Though I actively participated with my team, I did not engage them as much as I should have. This is one of the mistakes that I hope to correct next semester as well as in the future with other projects."

Question 3: How much do you think you have benefited from working as part of a team? Rate using the scale 1–5 (1 means not benefited and 5 means very benefited)

AVERAGE (5-point scale): 4.15

"Although I benefited from working as part of a team, I did not benefit as much from leading it. I still have much to learn about what it means to be an effective leader in EPICS as well as other capacities."

"Although there were some issues with communication within the team, this was a great learning experience since not all groups will have good communication. I learned a lot about how to work with the conditions, as well as how to adapt to them. This was a very stressful semester, however, I learned far more than I have in previous semesters."