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An EPICS Journey: Combining Service Learning and MultiDisciplinary Engineering Projects

Abstract: For the past two years, UW-Madison has been involved in EPICS (Engineering Projects in Community Service), a for-credit academic design program housed in the College of Engineering. One focus of the larger EPICS program has been on Information Systems, which houses 30-60 students a semester. Student teams work with local non-profits to develop websites, active server pages, and database solutions for identified agency problems. Teams are created from majors across campus, including students from engineering, business, art, communication, journalism, political science, and so forth. This panel segment or paper will discuss the complex structure needed to have effective, productive, socially aware, and creative teams while maintaining an administrative and pedagogical structure that is flexible enough to accommodate "real world" realities of changing schedules, client needs, and technology challenges. Currently, students teams are working for agencies concerned with environmental sustainability, community neighborhood development, homelessness, prison education, and technology in the junior high and high schools for minority students. Examples will be brought from these specific projects in order to illustrate triumphs and challenges in developing deliverables for these clients over the several semesters required to finish a project.

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An EPICS Journey: Combining Service Learning and MultiDisciplinary Engineering Projects

'Tis true... there's magic in the web of it.

from Shakespeare's Othello (III.iv.69)

In 1995, a new program called "EPICS" (Engineering Projects in Community Service) began on the Purdue campus, supported by a National Science Foundation grant. The working idea behind this program is to combine the service learning efforts of students in engineering *and* other disciplines with local and national projects of non-profit or not-for-profit agencies. Part of Purdue's mission was to extend this program beyond its campus, and to date, there are at least eight campuses active in EPICS and many more considering its implementation.

In 1999, the University of Wisconsin-Madison began an EPICS chapter. With a faculty team of about eight members, planning for implementation began with a small gift from the Purdue project. Now, in 2002, the EPICS program at Madison has served over 400 students; those student have come from all of the engineering disciplines, business, journalism, technical communication, art, sociology, political science, and other disciplines.

I would like to speak generally about the difference between service learning and volunteerism first, then speak to the University of Wisconsin (UW) efforts, and finally

move specifically to the segment of the UW program called "Information Systems," where I am a co-advisor/instructor with Dr. Fred Bradley of Material Science Engineering. By using the Information Systems (IS) EPICS teams as examples, I would like to explore some of the complexities of designing a class and project that serves such a multiplicity of needs, both for students, clients, and instructors.

Service Learning Vs. Volunteerism

The idea of service learning is often confused with volunteerism or community service. While the concepts and activities are often related, service learning specifically means that work is provided to meet community needs (often for non-profits) while combined with theoretical constructs and pedagogical practices of the classroom. Thus, students commit to projects, and those projects are constructed to enhance the learning from the classroom.

This differs in practice from volunteerism or community service because service learning often is a for-credit endeavor. And while all of these kinds of community-based activities enhance the academic and civic experience of those involved, service learning has that extra component that takes the theory of the classroom into "real" life. Not even well-crafted case studies can bring such reality-based complexities for student (and instructor) consideration.

UW's General EPICS Program

EPICS at the UW provides engineering and design deliverables in a community/client-based atmosphere. Based in the College of Engineering, EPICS places teams of undergraduate and graduate engineering students, as well as students from across campus, into a partnership with local community service agencies. Through this interaction, teams design and develop long-term engineering projects that meet identified agency needs.

EPICS has proven to be an asset beyond the classroom or design project level (more on that later). At the college level, EPICS has provided avenues for meeting identified College of Engineering *and* ABET criteria, including community service, design experience, leadership, and so forth. In the university's strategic plan released in 2001, a goal is articulated to for "expanding opportunities for undergraduates to conduct original research and creative endeavors, provide support for interdisciplinary learning, and infusing curricula with service learning." EPICS, as a program, focuses on providing the following:

> Start-to-finish design experience
> Deliverable designs to nonprofit clients
> Communication experience
> Multidisciplinary team experience
> Leadership opportunities
> Interplay between projects and courses
> Engineering in societal context
> Civic engagement

And while EPICS helps the College of Engineering meet benchmarks in its strategic planning and addresses the Wisconsin Idea[1], that is not where the impetus for the project comes from. Indeed, the energy, the drive, and the inspiration for the projects and philosophy for the program comes from the dedicated instructors that keep the program alive semester to semester. That is, EPICS was not created to meet benchmarks. EPICS

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[1] See the beginnings of the Wisconsin Idea at the Wisconsin Electronic Idea: http://www.library.wisc.edu/etext/WIReader/Contents/Idea.html. Basically, the Wisconsin Idea is "the idealistic and humane concern that knowledge could and should have practical impact on the needs, problems and aspirations of the people."

began as the right thing to do; it just happened to also meet institutional goals once it was in place.

At the UW, EPICS is made of faculty and staff members (usually 7-9 people). These instructors come from all areas of engineering and technical communication. Some are tenured or tenure track people, some are not, and some are retired faculty. Sometimes we have a chair or program manager, and sometimes not (we like to experiment). For those with a teaching component to our contract, we work on getting EPICS as part of our regular teaching load. For any others, we try to secure funding through NSF, Purdue, the College of Engineering, or other sources. This team of instructors meets weekly to discuss the vision of the program, funding, pedagogical approaches, and to do strategic planning. Generally, we each have teams of students that we advise; we regard each other's projects as independent classes, but with the goals of the EPICS philosophy always guiding those projects.

Projects for the EPICS UW program have included the following (also on handout):

Biomedical Engineering Projects:
Moo-v-ability Projects (Movement Assistance, several projects) serving individuals from the community with severe movement related disabilities: Advisor, Frank J. Fronczak, ME, BME.
Voice Improvement Projects serving the Department of Communicative Disorders: Advisor (several projects): Willis Tompkins, BME.
Rehabilitation Medicine Dept. Projects serving the Department of Rehabilitation Medicine: Advisor (several projects): Jay Martin, ME and Jennifer Kushner, WEEL.
Biofeedback/stress Management serving the Department of Medicine: Advisor: John Webster, BME.
Information Systems Projects:
Campus Sustainability Projects serving Environmental Management and Sustain Dane: Profiling Resource Flows and Atlas of the Biosphere: Advisors: Fred J. Bradley, MS&E and Traci Kelly, Engineering Professional Development (EPD).
Madison Homelessness Prevention Network serving Madison Community Development Block Grant Office and MMSD Transitional Educational Program: Advisors: Fred J. Bradley, MS&E and Traci Kelly, EPD.
South Metropolitan Planning Council serving South Metropolitan Planning Council and Real World Research: Advisors: Fred Bradley, MS&E and Traci Kelly, EPD.
Task Force on Money, Education and Prisons, Inc. (MEP) serving Task Force on Money, Education and Prisons, Inc. and Wisconsin Council on Children & Families: Advisors: Fred Bradley, MS&E and Traci Kelly, EPD.
Information Technology Academy (via DoIT at the UW): Advisors: Fred Bradley, MS&E and Traci Kelly, Engineering Professional Development EPICS IS team, serving the specific database, active server page, and web design needs for Dr. Bradley and Dr. Kelly to deliver to other teams.
Other Projects:
Habitat for Humanity serving Habitat for Humanity: Advisor: John Mitchell, ME.

These projects can change from semester to semester, and each project is assumed to be a multi-semester project. The challenge, then, is to make progress, maintain consistency, and enhance mature projects while allowing for the new influx of new projects into the EPICS rotation. It is a symbiotic relationship; service organizations are increasingly relying upon technology for the coordination, delivery, accounting and improvement of

their services, while students are looking for opportunities to enhance their learning experience by working in projects that give them a feel of the world outside academics.

EPICS UW Information Systems: A Closer Look

One of the larger sub-sections of the EPICS UW project is the "Information Systems" (IS) segment. Overall, anywhere from 40-60 students from a multitude of disciplines register for Information Systems. Those students are then broken into smaller project teams that focus on a specific project for a specific client. In EPICS Information Systems (IS) teams, we focus on developing quality web pages that integrate active server pages, database application, and web-based tools to solve specific information needs for our non-profit clients. Since I am co-advisor to these IS teams, I feel best qualified to speak of our particular practices.

EPICS IS teams combine the talents from computer engineering, electrical engineering, technical communication, computer science, marketing, business, communication, political science, English, art, journalism, human ecology, and other majors. Students can be of any class (frosh through graduate), and can be from any major. Team make-up will consist of skill sets from as many majors as possible in order to assure depth and breadth of experience. Indeed, this program is called *Engineering* Projects in Community Service; however, we find that engineering-only enrollments provide too narrow of a talent pool for the realities of client needs. We also feel strongly that having engineering-only teams for projects such as these does not reflect the actual best-practices in industry today. Thus, Dr. Bradley and I recruit actively from business, technical communication, graphic design, journalism, political science, and other majors to bring balance and perspective to our teams.

The multiplicity of goals and tasks, combined with the mixed-major approach to the IS teams, presented Dr. Bradley and I with quite a challenge. We needed to formulate complex arrangements and team structures to accommodate this myriad of needs. We knew that we had to accomplish many tasks, including

> meeting College of Engineering standards for the courses registered for, which included design courses (define+design+build+test+ deploy+support), business courses, technical communication courses, and so forth
> creating pedagogically sound methodologies introducing theoretical and practical application of information systems
> enhancing student learning with an awareness of civic responsibility tracking assessment at various levels
> recruiting vertically (first-year through graduate levels) and across campus as needed
> establishing contacts and projects in the community
> maintaining our own sanity while dedicating many, many hours to the brainstorming, creating, organizing, teaching, advising, and supervising these several teams–all of which had different goals and needs

To be fair, Dr. Bradley began his journey with the IS projects with Dr. Leah Newman of Industrial Engineering, and then I came on board in the spring semester of 2000. They had begun the journey, and I joined their team. And while Dr. Newman has moved on to another university, Dr. Bradley and I refine our approaches each term, trying something new each time by building on student feedback and our own observations in concert with the clients' responses to our work.

Teams and TeamWork: Project Teams and Functional Groups

So, a complex organization has developed over the last few semesters. In Appendix A, please see the organization chart as it stands for academic year 2001/2. Students begin the course with an introduction to team-building, and then teams are revealed in the second or third week. If we have continuing students from the semester previous, those students remain in their old teams, unless a desire to change is expressed. Because of the mix of students, majors, experience, and talents, we feel it necessary to bring in fresh ideas about team work, leadership, creativity, and connection to one's work. Quite frankly, we model our teams after the highly successful IDEO Corporation (see www.ideo.com). We show a short documentary-style segment from Nightline about the IDEO company, and then we discuss that company's "focused chaos" philosophy of design innovation.

Dr. Bradley and I try to infuse the class with the idea that invention needs to be product of creativity, not just usefulness.   A problem is not solved by just looking for the engineered answer or by simply a good instruction set to a wonderful piece of software. A problem is solved in the best way when you have the best minds from all walks of life examining the issue from as many angles as possible. Multidisciplinary teams make for the widest-applicable solution, so all perspectives are encouraged to investigate the problems and produce a deliverable design.

Project Teams

Students are primarily responsible for a Project Team; that's a team built around a specific client and project. Because students can register for 1-3 credits, much of the work distribution happens in these groups, and students are responsible for taking on the correct amount of work as deemed by their credit hours. (We try to help with time allocation, but there are always 1-credit students who do three credits' worth of work…and vice versa.) Dr. Bradley and I construct the Project Teams by using a matrix built of student-stated project preference, year in school, major, special skills…taking into consideration a balance of gender and ethnic factors, as well. Typically, our teams have 8-10 students each.

Mature projects, at this point, have semester-long notebooks that leave a history for incoming teams. Despite that, we still encourage teams to do their homework about the topic, not only reading the notebooks but also re-interviewing the clients for fresh perspective. We try to combine client desires, insightfulness gained by investigation, technical capability, and creative problem solving to gain a workable solution.

Functional Groups

Not only do students belong to Project Teams, but they have responsibility to these Functional Groups, as well. These skills-based groups addresses the needs of the entire group by working on databases, web functionality, communications, design, leadership, and civic responsibility. Students can self-select into these teams, either going where they already have skills *or* going to an area where they wish to develop a talent.

This fall, functional teams will be taught in the classroom by a myriad of experts from across the campus. For example, George Pasdirtz of our Division of Information Technology will be working with students in the web functionality team to develop navigation models, organization of sites, client needs assessment, and so forth. We have people donating time from the Office of Quality Improvement to work with the leadership/teamwork team, and so forth. These experts bring pedagogically sound perspectives to the students, teaching them the theory

and practice of the topic at hand. Then, students take this knowledge back to their Project Teams and implement it, teaching their team members as the project progresses.

Client Interaction
Each semester, the student on Project Teams meet multiple times with their clients in order to interview, inform, and investigate the needs of the specific project. Typically, clients are invited to special days planned for their attendance. These meetings are essential to understanding the changing needs of the non-profit, to gain approval for certain routes of development, and to share data needed for populating the databases created by the students for the client.
At least twice a semester, students present progress formally to the clients in a presentations setting. This takes place in a large lecture hall, and usually PowerPoint is used in combination with the active website for demonstration, contributing to the ever-important skill of communication with peers and clients.

Examples
At the time of this paper's delivery, current examples of the projects that students are working on will be showcased. The website is here: <http://zeus.msae.wisc.edu> or here: <http://zeus.msae.wisc.edu/epicsis/about/index.asp> .

Our Deliverable to the Student: Independent Work
As students come to realize that this is an unconventional course, and as they come to realize that the problems are real and that the needs are complicated, many become extremely uncomfortable. There are no back-of-the-book answers here…not for the students or the clients or even the advisors. While Dr. Bradley and I (along with support and input from TA's) struggle with sequencing of information, teaching moments, tracking of team progress, and ways to guide our students towards the best answers, it often becomes apparent to the students that they will have to create a solution that does not exist yet. That is, the advisors don't have a specific desired outcome, other than "it should work."
Especially for engineering students, sometimes the ambiguity, the chaos, the uncertainty, the debate, and the critical thinking of this sort is extremely uncomfortable at first. We try to nurture that, because we cannot afford to have a student shut down out of fear of the unfamiliar. As advisors in such a complex endeavor, we "own up" to the fact that we are learning too, and we articulate the need for constant exploration, professional behavior, creative endeavor, and academic and community responsibility. Interestingly enough, we created an organizational model for our class structure that closely represents the model used by the Hewlitt-Packard company; we were told this after the fact by the HP philantrhopic reprsentatives that assist our teams.
Dr. Bradley and I hold close the idea that our students will come up with good solutions, give the time, freedom, skills, and chance to do so. Have we been disappointed in the past? Sometimes…but only for a while. When we review projects and assess student evaluations, we troubleshoot and try to bring more advice and guidance to a group. But we do not teach them a specific solution. That is for them to discover.
What do we get in return? Once students embrace the idea and understand that such projects are more "real" than cocooned case studies, they find great satisfaction in their work. In past semesters, students have not only committed to creating the best deliverables they can as a team, but they also volunteer as teams (one team worked at a soup kitchen, and the other assisted a community neighborhood project). There is true investment in the issue, and student gain perspective about their skills and how those skills can come to enhance the community as a whole, not just their GPAs.

These projects put engineering (and other work) into context. Engineers learn how to work with business folks, graphics design people learn to work with technology developers, database experts learn to work with writers…everybody crosses everybody else's path. This isn't just interdisciplinary work within engineering; this is *true* interdisciplinary work with an emphasis on engineering solutions. All team members have an equal say in the development and deployment of projects, should they choose.
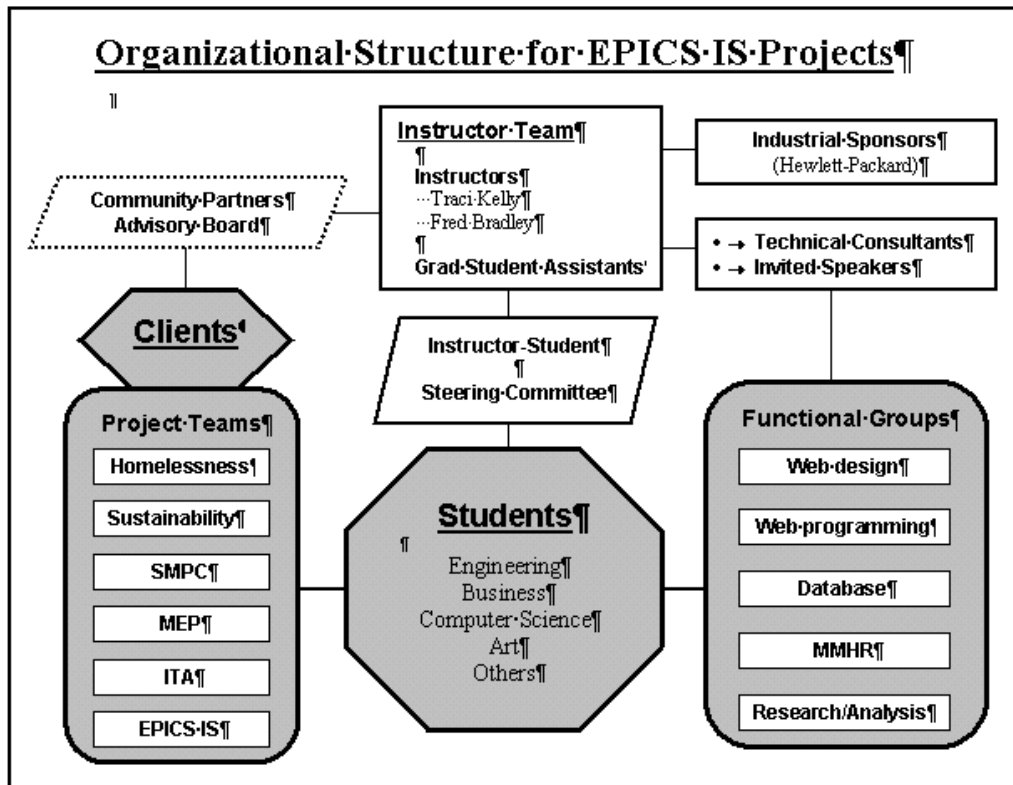
Conclusion

In this shrinking world, we cannot escape the confluence of globalization, citizenship, community, and civic duty; the concept of professional responsibility necessarily involves a concern with the social dimension and impacts of professional activity. The instructors try to impart a sense of ethics encompassing the idea that one's professional work is located within a larger sphere of personal ethical responsibility.

The concept of "service" as a valid and important goal of science and technology education has been endorsed in an International Association of University Presidents' Policy Statement on Technology And Higher Education, stressing "the tremendous potential and critical implications of technology in support of higher education in the service of society as we move into the twenty-first century."

As we all know, employers seek to hire individuals who understand and appreciate the value of diversity and have the critical thinking and interpersonal skills to deal effectively with ambiguity and complexity in a highly technical and rapidly changing world. The EPICS program is being designed to provide the interdisciplinary, broadly-based service-learning experiences. And while we hope that students learn well and learn deeply so to better function in their careers, we also hope that the EPICS journey starts them on a parallel path of civic responsibility, too.

Organizational·Structure·for·EPICS·IS·Projects¶

Instructor·Team¶

Instructors¶
···Traci·Kelly¶
···Fred·Bradley¶

Grad·Student·Assistants'

Industrial·Sponsors¶
(Hewlett-Packard)¶

- → Technical·Consultants¶
- → Invited·Speakers¶

Community·Partners¶ Advisory·Board¶

Clients'

Instructor-Student¶

Steering·Committee¶

Project·Teams¶
- Homelessness¶
- Sustainability¶
- SMPC¶
- MEP¶
- ITA¶
- EPICS·IS¶

Students¶
Engineering¶
Business¶
Computer·Science¶
Art¶
Others¶

Functional·Groups¶
- Web·design¶
- Web·programming¶
- Database¶
- MMHR¶
- Research/Analysis¶

Appendix B: Draft EPICS Fall 2002 Schedule
(This is provided in order to demonstrate the complex scheduling needed for such large teams with multiple focuses.)

Traci Kelly (kelly@epd.engr.wisc.edu)
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Wednesdays, 4:30 – 7:00 pm, MS&E 265

Week	Date	Topics, Assignments, Due Dates
1	Sep 4 1610 EH	4:30 - 7:00 **Course overview**, Social Change model, Myers-Briggs, photos, ice breakers, IDEO design team video
2	Sep 11 1610 EH	4:30 - 7:00 **Course Details:** Instructor expectations, grading, course structure: project teams versus functional groups, activities: poster session, panel discussion, …; course website, strategic web objectives, navigation model, document briefs, client websites, guidelines for client interaction, Software Training for Students schedule, … **Team formation –** creativity exercise, introductions, update of current project status from former team member(s), access to SWO, navigation model, document brief and final report from last term **Assignment 1: Revise or Create Strategic Web Objective, Navigation Model, and Client Brief Documents,** (see http://axle.doit.wisc.edu/~gwp/WEB.html)
3	Sep 18	4:30 - 5:00 **Stress Management I** (Rob Sepich) 5:00 – 6:00 **Planning and Preparation for Initial Client Meeting** –George Pasdirtz, Strategic Consultant, DoIT 6:00 – 7:00 **Team meetings:** plan for client meeting **Assignment 2: Report on Team Preparation for Initial Client Meeting**, due ?
		Assignment 2 due on Sunday at noon
4	Sep 25	4:30 – 5:45 **Functional Group Meetings I:** Quality Improvement Project Management Web Design Databases Web programming Technology, Society and Citizenship 6:00 – 7:00 **Team Meeting with Client(s)** – Project review presentation to client or initial client interview, project discussion, determine semester goals **Assignment 3: Term Goals and Objectives with Timeline**, due Sunday, February 24 at noon
5	Oct 2	4:30 – 5:45 **Functional Group Meetings II** 6:00 – 7:00 **Team meeting:**

6	Oct 9	4:30 – 5:45 **Functional Group Meetings III** 6:00 - 7:00 **Team meeting**
		Assignment 3 due Sunday at noon
7	Oct 16	4:30 – 5:00 **Stress Management II** (Rob Sepich) 5:00 – 6:00 **Functional Group Meetings IV** 6:00 – 7:00 **Team meetings**
	Mar 10	*Assignment 1 due Sunday at noon*
8	Oct 23 1610 EH	4:30 - 6:00 **Project Progress Report Presentations** (10 minute PowerPoint presentations to large group, invite clients) 6:00 – 7:00 **Team meeting with clients** **Midterm self-peer-team evaluation and formative course assessment**
9	Oct 30	4:30 – 5:45 **Functional Group Meetings V** 6:00 – 7:00 **Team meeting**
10	Nov 6	4:30 – 6:00 **EPICS Poster Presentation in Engineering Hall** 6:00 – 7:00 **Team meeting**
11	Nov 13	4:30 – 5:00 **Stress Management III** (Rob Sepich) 5:00 – 6:00 **Functional Group Meetings VI** 6:00 – 7:00 **Team Meeting -** Send preliminary copy of Term Report to instructor
12	Nov 20 1610 EH	4:30 – 6:00 **Contemporary Issues in Community Service: Panel Discussion** – student organized panel discussion: 6:00 – 7:00 **Team Meeting**
13	Nov 27	4:30 – 6:00 TBA 6:00 – 7:00 **Team Meeting -** Send preliminary copy of Term Report to client
		Thanksgiving
14	Dec 4	4:30 – 6:00 **Contemporary Issues in Community Service: Issues Research** Presentations by teams on project themes 6:00 – 7:00 **Team meeting –** final report team presentation to client
15	Dec11	4:30 - 6:00 **Final Report Presentations to Instructors** (large group) 6:00 – 7:00 **Course evaluations** Final version of Team Term Report due Updated client needs assessment due Self-Peer-Team Assessment due