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EPICS: Service Learning by Design, Engineering Projects in Community Service

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EPICS: Service Learning by Design

Engineering Projects in Community Service[1]

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Abstract:

Engineering Projects in Community Service — EPICS — is a service learning program that was initiated at Purdue University in the Fall of 1995. Under this program, undergraduate students in engineering earn academic credit for long-term team projects that solve technology based problems for local community service organizations.

The service goals of the EPICS Program include: developing and delivering systems which address the organizations' current technical problems; working closely with the organizations to determine how to best utilize technology to improve their services or enable new services; and providing reliable, long-term technical assistance for community service organizations.

The educational goals of the EPICS Program include: providing students with multi-year, team-based project experience; teaching students, by direct experience, how to interact with each other and with customers to specify, design, develop and deploy systems that solve real problems; and showing engineering students how their expertise can directly benefit even the most disadvantaged members of their community.

1 Introduction

Undergraduate students in engineering face a future in which they need more than just a solid technical

background [1, 2, 3]. In setting the goals for any system they are asked to design, they will be expected to communicate and work effectively with people of widely varying social and educational backgrounds. They will then be expected to work with people of many different technical backgrounds to achieve these goals. They thus need educational experiences that can help them develop these skills.

Community service agencies face a future in which they must rely to a great extent upon technology for the delivery, coordination, accounting, and improvement of the services they provide. They often possess neither the expertise to use nor the budget to design and acquire a technological solution that is suited to their mission. They thus need the help of people with strong technical backgrounds.

The Engineering Projects in Community Service (EPICS) program provides a service-learning structure that enables these two groups to work together and thereby satisfy each others' needs. This structure supports long-term projects in which teams of undergraduates in engineering are matched with community service agencies that request technical assistance. Under the guidance of faculty in engineering, the EPICS project teams work closely over many years with their partner community service agencies to define, design, build, and deploy the systems the agencies need. The results are systems that have a significant, lasting impact on the community service agencies and the people they serve.

2 The Origin and Design of the EPICS Program

The EPICS Program [4, 5] was initiated at Purdue in the Fall of 1995 to fulfill the complementary needs, described in the introduction, of engineering undergraduates and community service organizations. It established a structured service-learning environment in which students experience realistic engineering design as a long-term, start-to-finish process. In the context of this experience, the students develop the communication, teaming, and design skills that are now essential in the workplace. The EPICS Program is thus well-aligned with ABET 2000 criteria that reaffirm the importance of a broad view of what constitutes an engineering education.

The community service aspects of the EPICS Program contribute significantly to the success of the EPICS Program. They not only broaden the students' perspectives on and experience of society, they provide the students with "customers" who truly want and will use the systems the students develop.

In the next three subsections we provide a broader discussion of the goals of the program, describe the unique ways in which it achieves these goals, and explain how it fits within the engineering curriculum at Purdue.

2.1 Goals and Unique Features of EPICS

Many of the goals of the EPICS Program required the development of unique approaches to teaching design. These goals and the approaches they inspired are:

- *Emphasis on long-term design experience:* The EPICS track of courses spans the freshman through senior year, with freshmen and sophomores registering for 1 credit per semester and

juniors and seniors registering for 1 or 2 credits each semester. Projects can thus last for many years and each student may participate in a project for up to seven semesters. This allows problems of significant scope and impact to be addressed. It also provides the students with sufficient time and a stable environment in which to develop critical non-technical skills, such as teaming and communication skills.

- *Teams are vertically-integrated:* Each team is a mix of freshmen, sophomores, juniors and seniors. This vertically-integrated composition, when combined with long-term registration of students for the same project, creates significant continuity in team membership from semester to semester and from year to year. As seniors on a team graduate, new freshmen and sophomores are added. Participating students can thus experience the team as new members during their first semester and then have the opportunity to grow into technical and organizational leadership positions by the time they graduate.
- *Projects are multi-disciplinary:* Several current teams include electrical, computer, and mechanical engineering students as well as, in the case of two current teams, Sociology students. Students' disciplines, their academic "age", and their preferences regarding projects are the only data used when assigning them to EPICS teams.
- *Large project teams:* The large scope and long-term nature of these multi-disciplinary projects requires teams of 10 - 15 students. These large teams provide their membership with significant organizational challenges in addition to providing them with the necessary number of minds and hands to complete large-scale projects.
- *Emphasis on start-to-finish experience:* EPICS involves students in a true define - design - build - test - deploy - support experience. The students work with their partner organization to define the projects they will undertake and continue to interact with the organization through the development, testing, deployment, and subsequent support of the fielded project.
- *Existence of a true customer:* Each team is paired with a local community organization to solve real problems. The fact that successful projects will actually be used creates a strong commitment from the individual students, the entire EPICS team, and the partner community service agency.

The above features of the EPICS Program provide an environment in which many critical career skills can be taught. Perhaps most importantly, the students are provided with many opportunities, over an extended period of time, to hone these skills.

- *Communication:* EPICS projects require written reports, oral proposal and progress presentations, oral communications with sponsors and consultants, and intra-team communications.
- *Analytical thinking:* Because the scope and size of an EPICS project is much larger than is possible in traditional courses, students have to apply what they have learned to less well defined problems across a variety of disciplines.
- *Teamwork:* EPICS projects are large, so teamwork is essential. Students learn to divide up a large problem, assign and schedule sub-tasks, and integrate the pieces into a working solution.
- *Resourcefulness:* Vertically integrated projects encourage students to pursue non-traditional educational resources, such as each other, their Project Partner, and academic consultants who have experience related to the projects.
- *Resource management:* Each team will develop a proposal for the equipment and space requirements for the project, and will have to take into account the resources of the sponsor.
- *Professional ethics:* Professional conduct, both in relation to the sponsor and within the team itself, is essential, so students must maintain an awareness of ethical principles while meeting the demands of the project.

2.2 Assessment Procedures

Independent formative and summative evaluation of the EPICS Program has been conducted each semester by Professor J. William Asher of Purdue's Educational Studies Department. In assessing the students' attitudes towards the program, the formative evaluations have been especially useful. A majority of the students cite the opportunity to obtain "practical, real-world experience in engineering design" as their primary reason for participating in the EPICS Program. In every semester, however, a significant number of the students also identify the opportunity to do community service as a major factor in their EPICS participation. Many of the students report that they have done community service in the past, in activities such as tutoring, church work, scouting, soup kitchens, crisis hot-lines, and volunteer work for Habitat for Humanity. To date, none of the students has reported prior experience that combines community service with engineering.

To complement the descriptive evaluations, we have collected evaluation data along the dimensions of the specific program goals. To date we have responses from 153 student evaluations, collected at the end of the Spring 1996, Fall 1996, and Spring 1997 semesters. The students were asked to "Evaluate the impact that EPICS has had for you on each of the following: Your Technical Skills; Your Understanding of the Design Process; Your Communication Skills; Your Ability to Work on a Team; Your Resourcefulness; Your Organizational Skills; Your Awareness of the Community; Your Awareness of the 'Customer' in an Engineering Project; Your Awareness of Ethical Issues." Each aspect was to be graded on a letter-grade scale, with "A=excellent; B=good/above average; C=average; D=marginal/below average; F=poor" with the option for "N/A" for "not applicable". In compiling the data, each "A" grade was assigned 4 points, each "B" 3 points, each "C" 2 points, and each "D" 1 point. Grades of "F" were assigned 0 points. "N/A" responses (a total of 19 out of the 1316 individual grades assigned by the students) were not included in the summary statistics. Table 1 shows the distribution, average, and standard deviation computed over three semesters.

In all aspects except Technical Skills, the students' average rating exceeded 3.0, which corresponds to a "B". Since the emphasis in the early stages of a project is on problem definition and brainstorming of possible solutions rather than on implementation, it is not surprising that the impact on technical skills is rated lower than the other dimensions. Ability to Work in a Team and Understanding of the Design Process received the highest scores. Community Awareness received an average rating of 3.2.

	A(4)	B(3)	C(2)	D(1)	F(0)	avg
Technical skills	25	80	34	6	4	2.78
Understanding of the design process	58	44	6	0	1	3.45
Communication skills	71	66	14	1	0	3.36
Ability to work in a team	95	46	9	2	0	3.54
Resourcefulness	63	72	17	0	0	3.30
Organizational skills	47	81	21	3	0	3.13
Community awareness	63	56	28	3	0	3.19
Awareness of customer	81	53	14	1	1	3.41
Awareness of ethical issues	41	62	37	1	0	3.01

Table 1. Student evaluation in response the following: *Evaluate the impact that EPICS has had for you on* _____. Evaluation is on a 4-point scale with a rating of *A* corresponding to a 4.0.

2.3 EPICS in the Curriculum

The implementation of EPICS in the engineering curriculum is still evolving. It currently consists of a vertically-integrated track of three courses in the School of Electrical and Computer Engineering. These courses have the permanent numbers EE-290, EE-390, and EE-490; for EPICS participation by sophomores, juniors and seniors, respectively. In the Spring of 1998, freshmen will be participating in most EPICS teams, thus completing the vertical integration of the EPICS Program. The freshmen will be registered for ENGR-195B because all undergraduates in engineering at Purdue have a common first year in Freshman Engineering.

ENGR-195B's primary goal is to provide second-semester freshmen with what is often their first glimpse of a real engineering project. They will attend all team meetings and all meetings between the team and its project partners. They are expected to learn their team's mission, become familiar with the nature and goals of the community service organization that is their team's project partner, and begin contributing to the team in any way they can. Because they are freshmen, they often – but not always – have limited technical skills. Their initial contributions will thus usually take the form of assisting with the writing and editing of team reports and web pages, participating in brainstorming sessions, testing projects in the lab, providing support for projects that have been deployed in the field, and aiding in searches for resources for the team. Freshmen can register for ENGR-195B for one credit during their second semester as freshmen.

EE-290's objective is to give sophomores further insight into the specific EPICS project they have joined and, more generally, into the design and development process. They, like the freshmen, will attend planning and reporting meetings with the customer and will be expected to attend all team meetings. Under the direction of the team's juniors and seniors, they will perform and report upon tasks consistent with their level of technical expertise. If they had joined the team as freshmen, they should already have learned enough – either on their own, or under the guidance of other team members – to begin making technical contributions. Sophomores can register in EE-290 for a total of two credits – one credit each semester of their sophomore year.

EE-390: The responsibilities of the juniors in EE-390 includes assisting the seniors in the planning and organization of the project, the solution of technical problems, meeting with the customer, and the supervision of sophomores and freshmen. They will have principal responsibility for finding sources of information or technical expertise needed for the project. Each semester, a Junior can register for either one or two credits of EE-390, with the number of credits being their choice.

EE-490: The seniors enrolled in EE-490 are generally responsible for the management tasks of planning and organizing their team's project activity and interacting with the faculty advisors and customer representatives. Their technical responsibilities will include system design, solving technical problems, and training, monitoring, and directing the other team members in the tasks of system design, construction, testing, and deployment.

Students interested in EPICS are urged to enroll for at least two semesters in a row; otherwise, there is not sufficient time for them to fit into their team and make significant contributions. The goal is for students to join the program as early in their academic careers as possible and then continue with the program – on the same project each semester – until they graduate. The results have been very gratifying: of those students who can return each semester (i.e., they are not graduating, going on coop, etc.), 74% do so.

Within the School of Electrical and Computer Engineering, 3 credits of EPICS in the senior year fulfill the senior design requirement for the BSEE degree or can be counted as one of the senior technical electives for the BSCmpE degree. An additional six EPICS credits can count toward the 46 required credits of ECE courses for the BSEE or BSCmpE degree. An unlimited number of EPICS credits can be counted as unrestricted electives. Engineering students from schools other than Electrical and Computer Engineering also register for EPICS by signing up for EE-290, 390 or 490. These courses count in their curriculum as technical electives.

In the near future, we hope to have EPICS courses established within each School of Engineering at Purdue. We expect this to occur first within the School of Mechanical Engineering because approximately one-quarter of EPICS students are Mechanical Engineers. The remaining two-thirds are mostly students from Electrical and Computer Engineering, with a few students from Aeronautical, Chemical and Civil Engineering.

Each student in the EPICS Program attends the weekly two-hour meeting of his/her team in the EPICS laboratory and the common one-hour lecture given each week for all EPICS students. These scheduled class and lab times ensure that students will have a common time to meet. Additional meeting and work times are to be scheduled by the project team members.

The weekly one-hour lectures are usually given by guest experts, and have covered a wide range of topics. The Executive Director of United Way of Tippecanoe County has met with the EPICS students. Lectures on communications and reporting have included topics such as proposal writing, technical presentations, collaborative report writing, creating World Wide Web documents, and visual design. Faculty members from the Krannert School of Management at Purdue have given presentations on project management, team dynamics, and a series of six lectures (two per semester) on ethics. The students have participated in a "diversity workshop" run by Purdue's Office of Diversity and Multicultural Affairs. A series of lectures on entrepreneurship has brought in speakers from local start-up companies and the founder of a national engineering company, as well as speakers from the Krannert School of Management, Purdue's Office of Industrial Relations and Office of Technology Transfer, the Director of the local Business and Industrial Development Center, and the city attorney for the City of Lafayette. Purdue Engineering faculty and staff have made presentations on the design process and product safety, as well as on technical topics relevant to several of the teams.

3 Implementing EPICS: Projects and Project Partners

Each EPICS project involves a team of ten to fifteen undergraduates, one or more community service agencies, and a faculty advisor. Each team is vertically integrated, consisting of a mix of sophomores, juniors and seniors. Each team is constituted for several years — from initial project definition through final deployment — with students participating for several semesters. This structure enables long-term projects. Over time, each project has five phases: Finding Project Partners, Assembling a Project Team,

Project Proposal, System Design and Development, and System Deployment and Support.

Phase 1 - Finding Project Partners: Each EPICS project addresses the technology-based problems of one or more community service organizations in the local community. Agencies with appropriate problems must therefore be found.

When planning for the EPICS Program started in the Fall of 1994, we were able to contact many different service agencies at the same time by making a presentation about the program and its goals at the monthly meeting of the directors of all local United Way agencies. This single presentation led to many discussions with individual agencies and a long list of potential projects.

From this list of potential projects, those best suited for the EPICS Program were selected. Projects are selected based on their:

- *Significance:* There are a large number of potential EPICS projects within a city the size of Greater Lafayette, IN, which has a population of approximately 100,000. It is not possible for us to pursue all of them, so those that should provide the greatest benefit to the community are selected.

- *Level of Technology:* Projects must be challenging to, but within the capabilities of, undergraduates in engineering.

- *Expected Duration:* Although projects may have components that can be completed in a semester or less, each project must be long-term, requiring two or more years of effort from a team of ten to fifteen undergraduates.

Since the first round of projects grew out of the presentation at United Way, the source of new projects has been varied. Some projects have been initiated by faculty; others have been suggested by students. As the program has become known in the community, several projects have been proposed by local community service organizations.

Each year, new projects are selected by the EPICS faculty, using the significance, level of technology, and expected duration criteria. From five initial projects in Fall 1995, the program has grown to seven projects in Fall 1996, and to twelve in Fall 1997. The twelve 1997-98 projects are summarized below.

Summary of Fall 1997 EPICS Projects

1. **Title:** Children's Clinic at Wabash Center - ECE Emphasis.

   Project Partner: The Wabash Center Children's Services.

   Facts: Begun in Fall 1995; 7 ECEs, 1 IDE, and 3 MEs on Fall 97 team.

Tasks: Develop computer-controlled toys for children with physical disabilities. Develop an artificial sensory environment to provide multi-sensory stimulation and a sense of control to children with physical disabilities.

Technologies: Motors, electronics, computer controls.

Impact: Expanded capabilities and control of their environment for children with physical disabilities.

2. **Title:** Children's Clinic at Wabash Center - ME Emphasis.

Project Partner: The Wabash Center Children's Services.

Facts: Begun in Fall 1996; 3 ECEs, 5 MEs, and 1 MSE on Fall 97 team.

Tasks: Develop electro-mechanical toys and play areas for children with physical disabilities. Provide ways for physically disabled children to control their motion and to play with their peers.

Technologies: Structures, actuators, ergonomics, safety.

Impact: Improved methods for encouraging physically disabled children to develop socially and to develop their sense of motion.

3. **Title:** Habitat for Humanity.

Project Partner: The Greater Lafayette Chapter of Habitat for Humanity.

Facts: Begun in Fall 1996; 7 ECEs, 1 CE, 1 ChE, 1 IE and 2 MEs on Fall 97 team.

Tasks: Design systems and structures to minimize home construction and energy costs. Develop new construction techniques and investigate new construction materials..

Technologies: Power electronics, solar cells, heat flow, materials, energy efficient structures.

Impact: Lower-cost houses and lower home operating expenses for the working poor.

4. **Title:** Home Healthcare Services.

Project Partner: The Visiting Nurse Home Health Service.

Facts: Begun in Fall 1995; 10 ECEs on Fall 97 team.

Tasks: Develop software to manage nurse scheduling and point of care service. Design and build RF-controlled locks and appliance controls to enable home- and bed-bound patients to control their houses.

Technologies: Scheduling algorithms, databases, wireless remote control, electro-mechanical systems.

Impact: More efficient use of agency personnel; new capabilities to help patients.

5. **Title:** Homelessness Prevention Network.

   Project Partner: Eight Agencies of the Tippecanoe County Homelessness Prevention Network.

   Facts: Begun in Fall 1995; 11 ECEs and 3 Sociologists on Fall 97 team.

   Tasks: Design and implement a centralized database that allows the agencies to coordinate their services, track their clients, and assemble accurate reports without violating clients' confidentiality.

   Technologies: Databases, cryptography, communication, software.

   Impact: Improved coordination of agencies serving the homeless; more accurate understanding and reporting of the scope of homelessness in Tippecanoe County, Indiana.

6. **Title:** Imagination Station/Burtsfield Elementary School.

   Project Partner: Imagination Station (an interactive science and space museum) and Burtsfield Elementary School.

   Facts: Begun in Fall 1997; 5 ECEs and 5 MEs on Fall 97 team.

   Tasks: Develop systems to aid in science, mathematics and technology education.

   Technologies: Networked multi-media systems, human-computer interfaces, video technology.

   Impact: Improved educational resources for the community.

7. **Title:** Indiana Division of Families and Children.

   Project Partner: The four service agencies comprising Alternative Community- Based Services.

   Facts: Begun in Fall 1997; 10 ECEs, 1 ME, and 2 Sociologists on Fall 97 team.

   Tasks: Develop a centralized database to help the four service agencies coordinate their activities and share information. Develop custom palm-top software to aid service personnel visiting families.

   Technologies: Databases, cryptography, communication, software.

Impact: Improved and less-expensive social services for at-risk children and their families.

8. **Title:** Klondike Elementary School.

   Project Partner: Klondike Elementary School.

   Facts: Begun in Fall 1997; 9 ECEs and 3 MEs on Fall 97 team.

   Tasks: Design of custom educational software, sound systems, and multimedia tools for education.

   Technologies: Acoustics, electronics, software.

   Impact: Improved educational environment.

9. **Title:** Lafayette Crisis Center.

   Project Partner: Lafayette Crisis Center.

   Facts: Begun in Fall 1995; 8 ECEs and 2 MEs on Fall 97 team.

   Tasks: Design stand-alone kiosks that will provide information about community services to people in need of assistance. Incorporate means of contacting appropriate agencies.

   Technologies: Databases, human-computer interfaces, weather-proof enclosures, touch-screens.

   Impact: Improved access to community services.

10. **Title:** Office of the Dean of Students.

    Project Partner: Purdue University's Office of the Dean of Students.

    Facts: Begun in Fall 1997; 4 ECEs and 8 MEs on Fall 97 team.

    Tasks: Design classroom furniture for physically handicapped college students; develop closed-captioning systems for deaf and hard-of-hearing college students.

    Technologies: Structures, closed-captioning systems, ergonomics, mechanics.

    Impact: Improved access to education for physically disabled and hard-of-hearing students.

11. **Title:** Speech-Language and Audiology Clinics.

    Project Partner: The M. D. Steer Audiology and Speech-Language Center.

Facts: Begun in Fall 1995; 7 ECEs and 2 MEs on Fall 97 team.

Tasks: Automate calculation of speech rate for clinical sessions. Design specialized speech recognition systems. Design directional microphone system for hearing aids.

Technologies: Speech synthesis and recognition, human-computer interfaces.

Impact: New services for the clinic's clients; improved feedback on effects of therapy.

12. **Title:** Tippecanoe County Historical Association.

Project Partner: The Tippecanoe County Historical Association.

Facts: Begun in Fall 1997; 9 ECEs and 2 MEs on Fall 97 team.

Tasks: Develop multi-media and electro-mechanical systems for on-line storage and interactive presentation of historical information.

Technologies: Video/image processing, image database management, virtual reality.

Impact: Enhanced access to and use of historical archives and sites.

Once a project has been selected for the EPICS Program, the service agency that will be directly involved is designated the *Project Partner.*

Phase 2 - Assembling a Project Team: Once a project and Project Partner have been identified, a student team is organized. This is done by advertising the project in undergraduate classes and on the World Wide Web. Ten to fifteen students are chosen for each Project Team. Depending on the needs of the Project Partner, teams may reflect a single engineering discipline or may be multidisciplinary, including students from two or more engineering fields.

The team must be vertically integrated: it must be a mix of freshmen, sophomores, juniors and seniors. Each student is requested to participate in the project for as many semesters as possible. The combination of a vertically integrated team and long-term student participation ensures continuity in projects from semester to semester and year to year. Projects can thus last many years if new students, especially freshmen and sophomores, are recruited for the project as team members graduate.

Phase 3 - The Project Proposal: During the first semester of a project, the Project Team meets several times with its Project Partner and the EPICS faculty to define the project and determine its goals. During this phase the Project Team learns about the mission, needs, and priorities of the Project Partner. A key aspect of this phase is identifying projects that satisfy three criteria: they are needed by the Project Partner, they require engineering design, and they are a reasonable match to the team's capabilities. Also, to ensure that the students build confidence and the Project Partners see progress, the teams are encouraged to pursue a mix of long-term and short-term projects. Short-term projects generally require only one or two semesters to complete; long-term projects take two or more years. This process of project definition culminates in a written proposal and presentation in the fourth week of the semester. The proposal is critiqued during a lab session, with detailed feedback provided in the areas of organization, content, technical approach, and writing. The proposal must be approved by the EPICS faculty and then be accepted by the Project Partner.

Phase 4 - System Design and Development: Starting from week five of the first semester of a project, the Project Team's goal is to produce a prototype of the hardware/software systems discussed in the proposal. Interaction with the Project Partner continues in order to ensure that the systems being designed and developed are as desired. The formal portion of this interaction takes the form of a written progress report and an oral presentation delivered by the Project Team to the EPICS faculty and the Project Partner at the middle and end of each semester. The progress reports must meet the same standards as the proposals. The Project Team demonstrates the current state of their systems to a team of EPICS faculty every five weeks for the duration of the project.

This phase of a project lasts as many semesters as necessary for the team to complete the project to the satisfaction of the Project Partner.

Phase 5 - System Deployment and Support: The ultimate goal of each Project Team is to deliver a system to the Project Partner. After fielding a prototype, the team must train representatives of the partner in the use of the system, collect feedback, and make any reasonable changes requested by the partner. One of the hallmarks of the EPICS Program is that the systems designed and built by the students are deployed in the field, where they provide real, needed service to the community.

Once an EPICS team has deployed a system it has been working on, and provided sufficient training for agency staff that will use the system, the project is conceivably over. We have yet to see this occur, though, because the EPICS teams are often working on several different systems at any one time, and ideas for additional systems or improvements of currently deployed systems are constantly being generated. We do not envision any of the twelve current EPICS projects ending in the next few years. Thus the, EPICS teams exhibit a key characteristic of corporations – they continue to generate new or improved projects, and to branch out into new "markets".

4 Results

The seven EPICS Project Teams that have been in operation for a year or longer have already deployed a substantial number of systems to, or provided substantive services for, the community service organizations that are their project partners. A detailed description of these systems and services is not possible because of lack of space. We thus provide an abbreviated list below and ask the interested reader to consult the EPICS web pages (http:///www.ecn.purdue.edu/epics) for the associated project team to see more details.

Systems Delivered and Services Provided by EPICS Teams

- **Children's Clinic at Wabash Center – ECE Emphasis:** Doll house kitchen with electronically controlled refrigerator door, lights, and kitchen sounds that are activated by a child via a large, easy to use touch pad.
- **Children's Clinic at Wabash Center – ME Emphasis:** A four button phone adapted for physically disabled children. The structure and controls of a commercially available electric car were modified to allow safe use indoors and to provide better back support.
- **Habitat for Humanity:** New design for construction of corners that minimizes air leakage; brochure for home owners describing ways to save energy through proper choice of light bulbs and how to compute the expected savings; thermal imaging of houses to determine their energy efficiency and the effectiveness of construction techniques.
- **Home Healthcare Services:** Several improvements, including email and automated file backup, made to the agency's computer network; designed system to enable network-wide access to the agency's printer; field-tested first prototype of nurse scheduling software with much improved second version nearly complete.
- **Homelessness Prevention Network:** Delivered computers with stand-alone databases to six agencies for their use over the last six months. Central server and its software have been developed and are currently being tested in the lab. March '98 is the target for deployment of the server and the linking of all client machines.
- **Lafayette Crisis Center:** First prototype of kiosk was developed and field-tested; second prototype is nearly finished. Kiosk automatically updates its local database each night from the official database at the Lafayette Crisis Center. Kiosk can connect users to any community service organization via an automatically dialed phone.
- **Speech-Language and Audiology Clinics:** Software for counting the number of syllables in spoken dialogue is complete and tested; real-time implementation on special purpose hardware is under way. Infrared-controlled lock installed at local middle school for a physically disabled student. Tracheal model to assist laryngectomy patients in use. Several versions of voice interactive children's software in use.

All EPICS projects are very ambitious in scale, and hence require substantial time to produce systems that can be delivered to the field. The deliverables described above were all produced since the Fall of 1995; in other words, in less than two years.

One of the delivered systems – the remote control lock that is custom designed for school lockers – has commercial potential. An EPICS student has formed a small company to make the thirty locks that have been ordered by Greater Lafayette Area Special Services to aid the students it serves in several schools in Lafayette. This type of remote-controlled lock may one day be available for disabled students at all schools throughout the country. This is an excellent example of the impact that the EPICS Program can have.

Endnote

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