BAYLOR ENGINEERING AND COMPUTER SCIENCE (ECS) BUILDING EXPANSION EXECUTIVE SUMMARY:

Synergy. A very "new" word with a very "old" application. Synergy refers to the phenomenon in which two or more parts acting together create an effect greater that predicted by knowing only the separate effect of the actions. *In short, the whole is greater than the sum of the parts.* Synergy is today's word to describe what expanding Baylor's School of Engineering and Computer Science facilities will accomplish….

Current Facility + New Facility = Synergy Unleashed

Excellence Now:

Baylor ECS enjoys the highest national ranking of any Baylor school/college, the highest pass rate in Texas on the engineering senior exam, and the highest student qualifications outside the Honors College. Baylor ECS research and development recently designed new equipment for nationally known Curves International and are among the first to explore the new discrete/continuous concept of time scales. Baylor ECS students regularly study abroad in Maastricht and Shanghai and serve populations in Kenya and Honduras through discipline-specific appropriate technology applications. Academic excellence and Christian commitment and community are producing Baylor-molded, bright, well-rounded ECS leaders with a Christian worldview.

Current Challenges:

Baylor ECS has only 7 (!) classrooms. These classes are at 80% capacity during preferred hours. Demand exceeds supply regarding student enrollment, laboratory space, faculty research space, and students available for internships and employment in a world hungering for more ECS skill and talent. Some designs and features of the current 1988 ECS building are limited, outdated, and obsolete. Baylor's impact and influence on the world through ECS students is limited to our current size and output.

Exciting Opportunities:

Baylor ECS is maximizing what we have and working closely with our valued campus partners. Our Living Learning Center is the model for campus in providing students engagement, deeper relationships within their discipline peers, and community. The Baylor-managed ACM International Collegiate Programming Contest is the largest and most prestigious computing event in the world. The world and state economy is healthy and in need of more technology-related expertise as produced by the Engineering and Computer Science area such as mechanical engineering, electrical engineering, computer engineering, computer science, avionics, entertainment simulations, bioinformatics, biomedical engineering, and appropriate technology.

Tangible Benefits:

Expanded facilities add depth and breadth via more classrooms, research areas, labs to practice and experience hands-on applications, curriculum offerings, staff offices, and student ambiance areas. A new building provides cutting-edge technology and a facility design that meets the needs of today's environment. Expansion provides quantity.

Intangible Benefits:
Expanded facilities mean more prestige, loftier reputation, better perception from students, donors, and faculty, more resources from outside sources, user-friendly class schedules and options. Perception becomes reality and positive momentum is created. Quality of faculty, student, and experience increases. Expansion provides quality. Quality prospers alongside quantity….**synergy**.

Competition and Timing:
Empirical data suggests Baylor ECS is excelling despite trailing in many comparable areas with peer institutions. Baylor ECS's percentage of students is 4.3% of Baylor students while peer institutions average about 15%. Research space is less than 50% on average at Baylor versus peer institutions. In an exploding technological age, it is essential to have vision that prepares and leads instead of reacts and follows.

How does the plan help us reach 2012?
Expansion allows ECS the opportunity to compete toe-to-toe with peer institutions on certain minimum measurements such as size of student enrollment, diversity of subject matter, and research projects. This gets us in the "game". What makes us the best is when the distinctive Baylor Christian influence is integrated into the mix. Baylor ECS has the right ingredients in place. What is lacking is a depth and breadth of curriculum and experience which is achieved through expansion of the physical facilities.

Competition is the way of the world. To be the best, we must compete with the best.

Are these statements about the athletic department or the ECS academic unit? Perception and reality both play a part in today's world whether it is an athletic program competing for the best student athletes, a computer manufacturer competing to offer the best hardware and service, or an academic unit competing for the best and brightest students to position themselves better for top academic rankings, the best faculty, and transformational financial support.

An expansion of Baylor's Engineering and Computer Science building amplifies the opportunity for Baylor excellence to impact the world for generations to come.

Engineering and Computer Science Facilities Expansion

We shape our buildings; thereafter they shape us. (Winston Churchill)

STATEMENT OF NEED: *Expansion of Baylor's Engineering and Computer Science (ECS) Facilities by 80,000 ft^2*

- Reaching goals of Vision 2012

The expansion allows greater depth and breadth of instruction, research and experience, and amplifies Baylor's influence on students and in turn the world. The limited facilities of the current ECS building throttle the scope and impact of contributions. Existing ECS facilities (Rogers ECS Building) are operating at overcapacity with respect to student enrollment, faculty research, and co-curricular activities. These factors are intensified by:

- Increases in student quality requiring implementation of more dynamic and responsive learning and co-curricular programming,

- Growth in the undergraduate and graduate student populations that require greater classroom and laboratory facilities,
- Expanding faculty/student research and project activities that necessitate significantly more laboratory, equipment, and computing capacity.

Indicators point strongly toward continued upward trends in student quality, student enrollment, and faculty research. ECS continues to play a prominent role in pursuit of Baylor 2012.

Figure 2: ECS Entering Freshmen

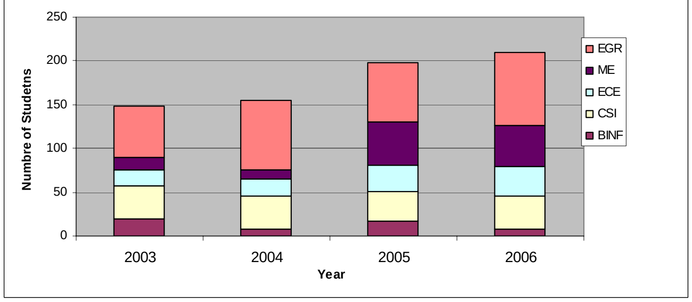

Figure 1: ECS BS & BU Fall FT Frosh SAT

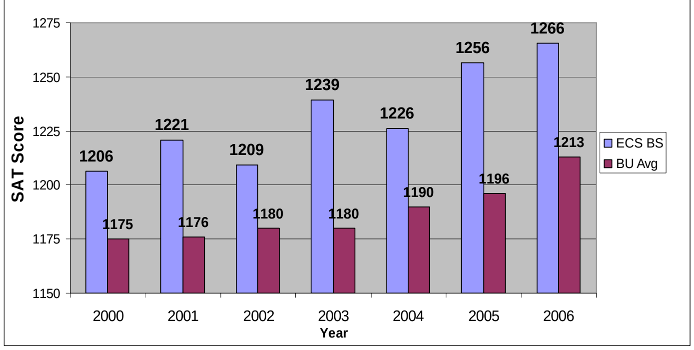

Table I: 2004 ECS Enrollment Comparisons[1]		
Group	**Institutions**	**~% ECS**
Baylor	Baylor	4.3
Aspiration	Duke, Northwestern, Notre Dame, Vanderbilt	16.9
US News Peer	Bucknell, Gonzaga, Lafayette, Villanova	17.1
Faith Based	Mercer, Notre Dame, Valparaiso, Villanova	12.5
Big XII	UT, Colo, KU, OU, …	13.4
Texas Big XII	UT, A&M, Texas Tech	14.7

As indicative of improving ECS student quality, Figure 1 shows that the average SAT score of ECS freshman has increased an average of ten points per year over the last six years. This trend is expected to persist as Baylor continues to increase student quality and sculpt the freshman class to better meet enrollment-management objectives. Table I shows that the percentage of ECS students at aspiration, peer, faith-based, Big XII, and Texas Big XII institutions is from three to four times as great as that at Baylor. {Prestigious schools such as Rice, MIT, and Carnegie Mellon were not used for this comparison because they are not comprehensive universities and thus their percentages of ECS students are disproportionately high, being over 30%.} These figures suggest that as Baylor pursues Vision 2012, ECS enrollments should trend toward a higher percentage of overall Baylor enrollments. Figure 2 shows that over the last few years that ECS freshman enrollments have increased each year. Table II shows that inquiries about and applications to Baylor ECS programs are approximately 10% and 20% higher for Fall 2007 when

TABLE II: Baylor and ECS Prospective Data from 2003→2006						
Year: Fall	**Inquiries**		**Applications**		**Gross Deposits**	
	BU	**ECS**	**BU**	**ECS**	**BU**	**ECS**
2003	88,369	5,498	8,934	657	3,227	203
2004	91,535	4,292	10,938	799	3,383	204
2005	98,915	3,701	15,477	1,036	3,973	235
2006	115,586	4,607	21,449	1,662	3,970	260
2007- thru 12-1-06	122,613	5,150	13,614	1,057	--	--

compared to Baylor as a whole. These increases suggest that student demand for Baylor ECS programs continues to grow. A new admission process being employed on a pilot basis is also aimed at increasing student retention whereby the steady increase in ECS enrollment should continue.[2]

For the Fall 2006 semester, Baylor ECS enrolled 557 undergraduate students and 36 graduate students. An undergraduate enrollment simulation model based on historical retention rates suggests that the minimum optimal enrollment from a faculty efficiency perspective is 822. Extrapolation of a conservative value of twelve percent from TABLE I suggests an undergraduate ECS enrollment around 1,400.

ECS faculty/student research and programs also continue to grow. 2006 externally-funded research awards include Dr. Erich Baker's studies in bioinformatics, Dr. Russ Duren's work in avionics, Dr. Newberry's writings in engineering ethics, Dr. Gravagne's exploration of time scales, Dr. Bradley's developments in alternative fuels, and Dr. Poucher's project on competitive learning. Likewise, publications by and citations of ECS faculty continues to increase.

The Rogers ECS Building contains only seven classrooms. An analysis of the most popular class periods (9:00 a.m.-2:00 p.m.) from Fall 2005-Spring 2007 shows an 80% utilization rate (178/224) with over 100 offerings outside of these periods. All but one faculty/staff office is currently utilized and most faculty research areas are shared by multiple faculty members. The current median faculty research space is considerably less than the minimum identified as the national norm for new faculty (250 ft^2).[3]

During Fall 2005, a faculty/staff committee conducted a study and submitted a report entitled *Current and Future Space Needs for Engineering and Computer Science*[4] (Appendix I). This study, in addition to input from Baylor Facility Services and the ECS Board of Advocates, identified the ECS space needs listed in Table III. Combined, the amount of space needs determined through this process is approximately 80,000 ft^2.

Table III: ECS Facilities Space Needs

Function	**Space, ft^2**
Classrooms	3,500
Offices & Research Space	15,250
Teaching/Research Labs	17,500
Other Miscellaneous	7,500
Shell/Future[5]	20,000
Common/Community	15,950
Total	**79,700**

- Supports and Conforms to Baylor's Mission

The mission of Baylor's School of Engineering and Computer Science is to provide a superior education through instruction, scholarship, and service that prepares graduates for professional practice and responsible leadership with a Christian worldview.

The goals of Baylor's ECS are:

- To foster and educational environment that promotes success and learning.
- To support faculty and staff members' commitment for achievement in teaching, scholarly pursuits, professional development and service contributions.
- To promote Christian values and community.
- To be nationally recognized for quality engineering and computer science programs.

Each of these goals maps directly to Baylor's mission, goals, and vision. Moreover, programs are currently in place or envisioned that will assist in the greater attainment of ECS's mission and goals. Facilities limitations currently limit full pursuit.

On several fronts, ECS faculty and staff are deliberate about the application of faith within the Baylor context, and the result are gratifying. For example, ECS students have a choice of three different faculty-led discipline-specific experiences for Summer 2007. Previous experiences include projects in Kenya, Paupa New Guinea, Vietnam, Iraq, and Belize.[6,7] And students have coordinated a new student organization, *Engineers with a Mission*, as a co-curricular vehicle to apply their faith.

ENVIRONMENTAL ASSESSMENT: ***Years of thorough analysis and broad input indicate that Baylor ECS expansion is a key element for success.***

- Internal Strengths

Input, research, and expertise have been utilized over the course of the last 5-10 years as future expansion has been considered. These include a faculty committee report finding dated 2005[4] (see appendix), earlier architectural sketches, previous Regents' statements,[8] designation on the Baylor campus master plan, ABET report language for more space,[9] Advocate Board comments about critical mass, and consultation with previous Baylor facilities personnel. The goal for expansion is to employ a dynamic, collaborative, and creative planning process.[10]

Furthermore, many ECS efforts for excellence involve and require close working partnerships with other elements of Baylor. Such partnerships have helped ECS achieve a series of outstanding successes such as a Science, Math, Engineering, and Technology (STEM) Career Fair, Baylor's first Living-Learning Center,[11] ECS specific honors tracks, an ECS/business study-abroad program, and discipline-specific missions.[12] **Positive outcomes include Baylor's highest ranked college/school, the highest pass rate in Texas on the engineering senior exam, the highest student qualifications outside of the Honors College,** and others highlighted in Table 4**.** Further evidence of the fruitfulness of these partnerships is displayed in the several strategic-initiative proposals being submitted for very exciting projects. These relationships benefit ECS and our partners, and expanded ECS facilities will do the same.

Table 4: ECS Facts and Figures[13]

16	ECS students per faculty member
32	Full-time ECS faculty
20	Industry executive who make up the ECS Board of Advocates
2	University Distinguished Professors among the ECS faculty
25	Ranked in the Top 25 for more than five years in a row
98	Percent of graduates who pass the Fundamentals of Engineering exam
8	ECS Student organization
1300	Average SAT score for freshman in the ECS Living-Learning Center
12	Patents owned by ECS professors

Additionally, the role of engineering and computer science in Texas's and the nation's economy is a predominate driving force. The payroll for technology companies in Texas is $31.5 billion a year. Demand for ECS graduates exceeds the supply.[14] The National Academies published a study of the effects of STEM on American competitiveness and prosperity that indicated the need for attracting and educating a greater number of ECS students[15]. The authors of this report summarized the needs as:

> *"In a world where advanced knowledge is widespread and low-cost labor is readily available, U.S. advantages in the marketplace and in science and technology have begun to erode. A comprehensive and coordinated federal effort is urgently needed to bolster U.S. competitiveness and pre-eminence in these areas."*

Baylor ECS has responded to this calling not only through a strong partnership with the Office of Enrollment Management, but also through three grants, including two through the Texas Engineering and Technical Consortium authorized by 2001 SB 353 *Technology Workforce Development Act*[16] (Appendix III). This funding was further leveraged for a $500,000 NSF grant awarded in 2006 to attract to Baylor diverse ECS transfer students from Texas community/junior colleges and four-year faith-based colleges and universities.

Furthermore, research indicates that "facilities pull" often is as influential as "reputation pull" on students' choice of where to attend college.[17] It is expected that this facilities expansion will require some modification to the existing Rogers Building, including the possibility of more efficient utilization of the basement. Though there have been preliminary discussions with two architects, the precise location and design of the new facility has not been determined. An opportunity exists to "connect" architecturally to the Baylor Science Building to form a technology corridor, utilize the existing the Wiethorn Visitors Centers (if it is to be relocated), and connect programmatically with the ECS Living-Learning Center in the North Village Residential Community. The architectural design firm will assist in tying these elements and others into the project.

- External Opportunities and Threats

Expanded ECS facilities create the capacity necessary to conduct meaningful research across several disciplines in an academic setting that doesn't currently exist. Enrollment demand is relieved and curriculum offerings strengthened with expanded facilities.

There are funding prospects for research projects, endowment, professorships, chairs, corporate partnerships, etc. that are created by expansion and transformed-perception opportunities of Baylor as a major player in the top tier of American universities.

Without expansion, Baylor ECS is lacking sufficient space to compete in key areas with peer institutions.

<u>Undergraduate and Graduate Instruction / Learning / Community Needs</u>

- Educational Laboratories
- Classrooms
- Project Space
- Study Space
- Resource / Information Center
- Community space

Faculty Needs:
- Offices
- Smaller / Individual research projects
- Larger / group research projects
- Specialty Research Space and Laboratories (i.e., vibration free, exhaust, wet labs, etc.)

Staff Needs:
- Offices
- Working / Project Space
- Student Career & Interview
- Programming Space

Other Needs:
- Graduate Offices
- Student organizations
- Seminar / Conference Space
- Equipment and Office Storage

The threat of a worldwide or national recession could adversely affect the benefits gained through expanded facilities by reducing the demand for education as a result of a softer economy. The current environment of exploding technological innovation is a threat to any physical expansion that could implement technology that becomes obsolete before the end of the useful life of the new improvements. Nevertheless, it is evident that the type of technological innovations ECS students study are integral parts of our quality of life and are essential in securing Texas' and the U.S. position for "improving the pace and success of the global marketplace."[18]

- Competitors, Peers, and Aspirants

An expansion of space for ECS is a proper and necessary response to the changes in our field and in the larger world. Baylor ECS facilities lag behind all the schools listed in Table I with perhaps the exception of Valparaiso. Mercer is nearing the completion of their second ECS building.[19] All of the other institutions listed in Table I maintain facilities that are at least several times the size of Baylor ECS facilities. Less than five percent of top tier universities do not have Ph.D. program in engineering and computer science. Under currently facility limitations it is not feasible for ECS to envision growing top flight ECS Ph.D. programs

GOALS AND ASSESSMENT: ***Measuring and assessing goals provides tangible tools to track progress in meaningful ways.***

- Measurable Goals

The primary measurable goal will be the amount of money raised to construct expanded facilities. Proper due diligence will be conducted to design a modern, cutting-edge facility and to assess the cost to build such a structure.

Other goals for the expanded facilities will include parameters relating to availability of classroom space during peak hours, sufficient number of faculty and staff offices, faculty research space compared to national norms and levels of funding, and percent of student/community space comparable to the Baylor Science Building.

- Goal Assessment

It is a reasonable goal to raise an expected $20-$25,000,000 in approximately 5 years. Other measurable points through that time frame will be taken to evaluate progress. It is expected that quarterly reviews will be sufficient.

Assessment of classroom, laboratory, research, and office space will be measured based on the percentage of documented need that is met.

ACTION PLAN: *With needs identified and goals in place, ECS is poised to pursue the resources for and design of a functionally useful and architectural striking facility.*

- Implementation of the Action Plan

A series of steps will be taken once the project is approved. One first step will include naming an ECS fundraising committee comprised of faculty, students, staff, Board of Advocates members, loyal supporters, and ECS's best financial and influential supporters. Other early steps will be the engagement of an architect and contractor and a series of input opportunities from Baylor ECS faculty, staff, students, and Board of Advocates, etc.

- Responsibility

The ultimate responsibility shall be a partnership between the Dean of ECS, the Office of University Development, and the Office of Design and Construction Services. A review of processes, responsibilities, etc. used for the Baylor Science Building will be used as a model.

- Timing

A systematic flowchart of responsibilities, timing, and other duties will be incorporated into the process of designing, fundraising for, and building the improvements. This project will be a part of the upcoming comprehensive fund-raising campaign. Construction will begin following Baylor practices and after fund raising is assured. As indicated in the budget schedule in Appendix II, it is perceived that fund raising will begin during the 2007-08 academic year, construction will begin during the 20011-12 academic year, and occupancy will occur during the 2012-13 academic year.

BUDGET NARRATIVE: ***Baylor ECS faculty, staff, students, and friends give of their time, talents, and resources largely for ideas that align with their belief, stewardship, mission, and vision.***

- Funding Necessary

A new addition of 80,000 square feet is expected to cost in the neighborhood of $200/square foot. This will equate to a construction cost of approximately $16,000,000. As called for by Baylor practice/policy, a 10% endowment for utilities/maintenance[20] will be included with the project, estimated at $1,600,000. A reasonable amount for furniture and fixtures will be included as part of the project. It is estimated that these items would add approximately 30% of the cost of the building,[21] say around $4,800,000. Rogers Building basement storage and space repurposing is estimated at 10% of the construction cost; $1,600,000. The total estimated cost is approximately $24,000,000 for improvements, furniture and fixtures, and maintenance endowment.

- External Funding:

The plan is to raise the funding costs associated with the construction segment of the project through external sources that will include individuals, corporate, and foundation donors. Naming opportunities (for the building and smaller elements within), steering committee relationships, other Baylor relationships and ECS alumni and friends will be vigorously pursued. High priority will be give to securing a lead gift.

- Budget Allocations:

Initial funding to engage an architectural firm to produce designs, illustrations and models, and conduct due diligence, is necessary. It is estimated that approximately $250,000 is to be budgeted for such preliminary planning initiatives as described. The remainder will be raised a part of the upcoming fundraising campaign. A preliminary budget schedule is included in Appendix II.

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Current and future space needs for Engineering and Computer Science

William Jordan, Leigh Ann Marshall, Peter M Maurer, Ashley Thornton
Fall 2005

Introduction

Over the Fall semester, 2005, the ECS expansion initiatives committee has met to determine the current and future space needs for the Baylor School of Engineering and Computer Science. This report does not deal with absolute minimums, because in a sense, there is no such thing. Engineers and Computer Scientists are clever people. The Engineering and Computer Science faculty are more than capable of taking whatever resources they are given and making the best of them. However, insuring that our students are well versed in the latest technology and well prepared to enter a highly competitive marketplace requires a vision that goes far beyond the bare minimum. Providing a nurturing environment that is pleasant and rewarding for both teacher and student requires much more than the absolute minimum.

Even though the current space allotment has increased significantly in the recent past, there are still serious problems. One of the biggest problems suffered by both departments in the school is lack of sufficient faculty to maintain current teaching obligations. This problem was not directly addressed by the committee, except in terms of office-space needs, but it is also a problem that cannot be ignored. The second problem is seriously inadequate laboratory space for either research or teaching. The third problem is inadequate classroom space.

A number of important assumptions have been made in calculating our future needs, the most important of which is the assumption that there will be approximately 20 graduates per term, per program. This number was chosen to meet with the faculty/student ratios projected for Vision 2012. Twenty graduates per term implies class sizes of around 20 in the upper division courses with larger classes in the lower division. The second assumption is that programs will grow as follows.

Computer Science
- a. Bioinformatics will continue to expand.
- b. A Software Engineering option will be offered in the near future.
  - c. A Gaming option will be offered in the near future.

Electrical and Computer Engineering

A Biomedical Engineering option will be offered at the undergraduate level

Mechanical Engineering

Mechanical Engineering will continue to grow.

Thus we are expecting 20 Bioinformatics, 20 Computer Science, and 20 Software engineering graduates in Computer Science, 20 EE/CE and 20 Biomedical graduates in Electrical and Computer Engineering, and 20 graduates in Mechanical Engineering.

We also expect reasonable growth in the graduate programs, with an additional ten graduate students each in Computer Science, Electrical Engineering, and Mechanical Engineering.

Faculty office space has been computed at 150 square feet per office. An additional 300 square feet for research space has been added for each new faculty member, unless the respective departments provided different information. Graduate student office space has been computed at half the Faculty office space, or 75 square feet per graduate student.

New classroom space

To accommodate larger classes at the freshmen and sophomore level, it is necessary to have at least two classrooms that will hold up to 60 students. Other than 109, there are no classrooms of this size in the Rogers Engineering Building. To accommodate freshmen engineering classes, it is necessary to have two classrooms that will hold up to 200 students each. In addition, the need for new courses and new sections of existing courses, three new classrooms will be required. (28 new sections for ME, 4-8 new sections for Software Engineering, 4-6 new sections for the CS gaming option, 4 new sections CS graduate level, plus new sections for Biomedical Engineering and for graduate-level engineering courses.) One classroom can support 14 sections per term if it is fully utilized between the hours of 8:00 AM and 5:00 PM five days a week. The totals are given below. These classrooms are *in addition* to existing classrooms. No replacements are planned.

60 Student classroom:	750 sq ft
60-student classroom	750 sq ft
100 student classroom-	1,000 sq ft
100 student classroom-	1,000 sq ft
Total 3,500 sq ft	

Office and Research Space

The breakdown of the new faculty needs is as follows. Note that these needs are *over and above* existing positions, including those that are currently being advertised but are not filled.

Computer Science (Not including currently advertised position)

	Type	Office	Research Space
1.	Regular 1	0	300
2.	Regular 2	0	300
3.	Gaming	150	300
4.	Bioinformatics	150	300
5.	Software Engineering 1	150	300
6.	Software Engineering 2	150	300

Electrical/Computer Engineering		
1. EE/CE 1	150	500
2. EE/CE 2	150	500
3. EE/CE 3	150	500
4. EE/CE 4	150	500
5. Biomed 1	150	400
6. Biomed 2	150	400
7 Biomed 3	150	400
Mechanical Engineering		
1. Regular 1	150	400
2. Regular 2	150	400
3. Regular 3	150	400
4. Regular 4	150	400
5. Regular 5	150	400
6. Regular 6	150	400
7. Regular 7	150	400
8. Regular 8	150	400
9. Regular 9	150	400

Other needs are as follows.

Computer Tech	150
Computer Tech Assistant	150

Additional Staff

Mechanical 1	150
Mechanical 2	150

CS 150
EE/CE 150

Grants & Contracts	150
Graduate Students CS (10)	750
Graduate Students EE/CE (10)	750
Graduate Students ME (10)	750
Bioinformatics Post-Doc	150

Total 6,450	8,800	15,250

Teaching/Research Laboratories

The following laboratories will be primarily oriented toward teaching, but may serve some research functions as well. Please note, that these needs are *in addition* to any space already devoted to the listed functions.

Computer Science	
Robotics	300
Gaming/Security/GPS/Parallel	750
Simulated Living Room (Gaming)	300
Senior Design Lab (CS/SE)	2,000
Competitive Learning	400
Teaching Lab	1,500
Electrical/Computer Engineering	
Instructional Labs	1,000
Biomed Lab 1	600
Biomed Lab 2	600
Mechanical Engineering	
Machining	300
Testing1,400	
Fabrication/Materials	400
Design Fab 1	400
Design Fab 2	400
Computer	400

Total 10,750

Other Needs

In addition to the needs specified above, the following "Quality of life" additions would significantly enhance the academic environment. Again this space is over and above any existing space devoted to these functions.

Conference Room CS	350
Conference Room EE/CE	350
Conference Room ME	350
Faculty reading room	300
Visitor's lounge	350
Student Study Space	2,000
Total	3,700

Conclusion

The totals from the previous sections are as follows.

New Classrooms	3,500
Offices and Research Space	15,250
Teaching/Research Labs	17,500
Other	3,700
Total	39,950

To put this space requirement into perspective, the Rogers Building is approximately 60,000 square feet, including hallways bathrooms, closets, elevator shaft, stairwells and other overhead. “Squaring off” the building would have produced an additional 35,000 usable square feet.

At present, no further meetings of the committee are planned. Please let us know if there is anything further we need to do.

APPENDIX II
Preliminary Budget Schedule

ECS Facilities Expansion Cost/Endowment Estimate											
AY- Academic Year	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	
fiscal year designation	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	
	Current	Next-begin	full swing	↔	↔	full swing	wind down		enter bolded items, all else calculated		
							occupy 1/2	occupy	occupy	occupy	
Facility construction cost	sq ft	cost/sq ft			util-maint endowment	% util-maint endowment	% for furnishings	Rogers %			
$16,000,000	**80,000**	**$200**			$1,600,000	**10%**	**30%**	**10%**			
% raised each year		**10%**	**20%**	**20%**	**20%**	**20%**	**10%**				
Raised for construction		$1,600,000	$3,200,000	$3,200,000	$3,200,000	$3,200,000	$1,600,000				$16,000,000
Raised for furnishings		$480,000	$960,000	$960,000	$960,000	$960,000	$480,000				$4,800,000
Raised for util-maint endowment		$160,000	$320,000	$320,000	$320,000	$320,000	$160,000				$1,600,000
Rogers recofig/basement		$160,000	$320,000	$320,000	$320,000	$320,000	$160,000				$1,600,000
Totals to be raised		$2,400,000	$4,800,000	$4,800,000	$4,800,000	$4,800,000	$2,400,000				$24,000,000
Preliminary architectural & planning		$125,000	$125,000								
							50%	**50%**			
Construction etc. costs							$11,200,000	$11,200,000			
											Total
Funds brought in/raised		$2,400,000	$4,800,000	$4,800,000	$4,800,000	$4,800,000	$2,400,000	$0	$0	$0	$24,000,000
Funds used for construction		$0	$0	$0	$0	$0	$11,200,000	$11,200,000	$0	$0	$22,400,000
Funds used for architect & planning		$125,000	$125,000	$0	$0	$0	$0	$0	$0	$0	$250,000
Funds expended		$125,000	$125,000	$0	$0	$0	$11,200,000	$11,200,000	$0	$0	$22,650,000


ASEE
PRISM
AMERICAN SOCIETY FOR ENGINEERING EDUCATION
SEPTEMBER 2006
Turned On In Texas
Academia, industry and government join forces to beef up the engineering workforce.
TEXAS
Welcome Engineers!

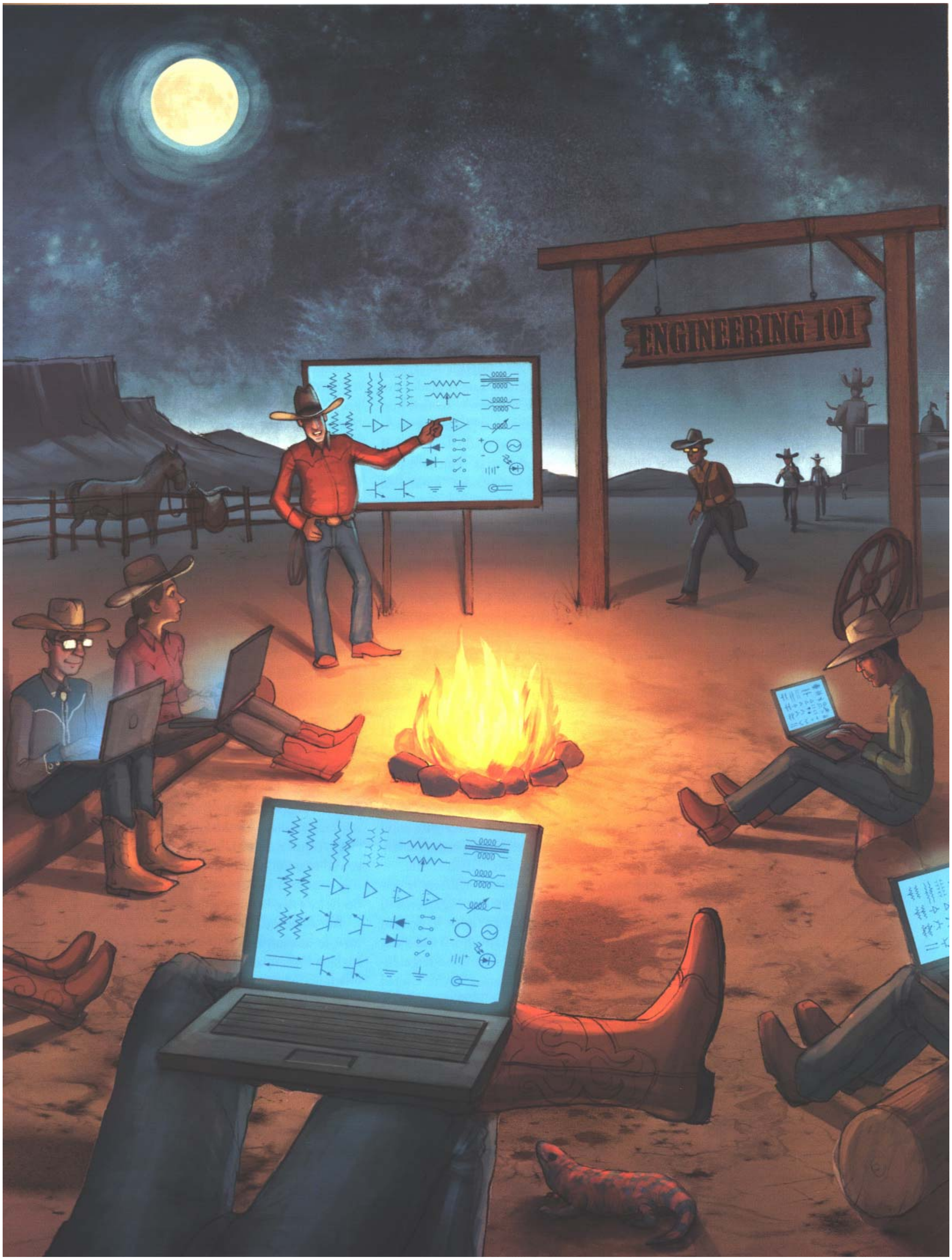
BY THOMAS K. GROSE

TEXAS IS NOT GOING TO GET CAUGHT SHORT WHEN IT COMES TO ELECTRICAL ENGINEERS. TOP LEVELS OF GOVERNMENT, INDUSTRY AND ACADEMIA ARE WORKING TOGETHER TO ATTRACT MORE YOUNG PEOPLE TO THE FIELD.

Booting Up

ILLUSTRATION BY JON KEEGAN

APPENDIX II
Preliminary Budget Schedule



Andres Lugo
2006 graduate
Electrical Engineering
University of Texas-Pan American

The TETC program has had a very positive effect on my career as an electrical engineer. As a freshman I struggled, juggling homework and a job. I heard about a TETC program allowing students to work on campus in the engineering building. One of the conditions was that I could only work 10 hours a week and could not hold an outside job. In my senior year, I was awarded Outstanding Student of the Year by the electrical engineering faculty. The TETC program gave me the time and finances to stay focused and excel at my studies. I recently began a job at Raytheon.

AS A FRESHMAN electrical engineering student at the University of Texas-Pan American in 2002, Andres Lugo struggled. UT Pan Am is a commuter school with a large Hispanic population in Texas' Rio Grande Valley, and most students work off-campus jobs. Lugo was no exception. But the 20 hours a week he worked at Ticketmaster greatly interfered with his studies. Then he joined a unique program at UT Pan Am that gives students part-time jobs in the electrical engineering department to keep them on campus and focused on the demanding curriculum. Lugo's grades improved. In his senior year, the faculty named him "Outstanding Student of the Year." He's now working for Raytheon and starting graduate school at the University of Texas at Dallas. The jobs program, he says, was key to his success. "I was able to keep school as my top priority," Lugo explains. Moreover, it allowed him to spend more time with other students and faculty, and that "helped me feel comfortable in that environment."

Lugo, 23, is just one of many success stories spawned by the UT Pan Am jobs program (see story, page 31). And it exists only because of an enterprising consortium comprising industry, academia and government that funds novel approaches to boost graduation rates in electrical engineering and computer science. The Texas Engineering and Technical Consortium (TETC) raises money from industry donations and federal government sources, and those dollars are then matched by the state legislature. TETC (commonly pronounced "T-tech") then awards Technology Workforce Development (TWD) grants as seed money to schools that come up with solid proposals for increasing graduation rates, mainly by improving recruitment or retention efforts.

The need to graduate more engineers is certainly acute. The number of jobs for engineers and computer scientists is expected to grow 36 percent through 2010 in the United States. But it will likely be tough to fill them. The number of undergraduate engineering degrees conferred in the United States peaked in 1985, and by 2004 the number had dwindled by 20 percent. In electrical engineering, undergraduate degrees peaked in 1987 at 25,000; last year it was half that amount. Enrollment for computer science degrees fell a whopping 60 percent from 2000 to 2004. Of the 1.1 million high school kids who took the ACT college entrance exam in 2005, only 5 percent planned to seek an engineering degree. Sadly, most of them won't finish. The national retention rate for freshman engineering students is 48 percent. Last year, America graduated more sports-exercise majors than electrical engineers. That unfortunate stat prompted General Electric CEO Jeffrey Immelt to quip in a speech this year: "If you want to be the massage capital of the world, you're on your way."

If we can't meet our need for engineers in the future, it would undoubtedly be bad for the national economy. But it could particularly whack Texas, whose economy is strongly underpinned by the high-tech industry. Texas' technology industry, second only to California's, employs 446,000 people. That represents a $30.4 billion payroll. The industry accounts for 30 percent of the state's exports. Stats like those have earned Texas silicon-plated bragging rights. But the state's high-flying tech industry could find itself grounded if it can't recruit needed talent. So six years ago Texas vowed to double the annual number of engineering, computer science, math and physical science bachelor's degrees it awards to 36,000 by 2010.

Beyond its goal of increasing engineering graduation rates, TETC has two other missions: to increase diversity among those students and to encourage more collaboration between industry and higher education.

An ambitious, worthy goal, to be sure. But how to accomplish it? That's when a group of high-tech companies, led by Texas Instruments, championed a recommendation from a government study and in 2001 persuaded state lawmakers to create TETC. Beyond its goal of increasing engineering graduation rates, TETC has two other missions: to increase diversity among those students and to encourage more collaboration between industry and higher education.

While it's early days yet, and it's also clear that one relatively small program alone can't solve a problem of such magnitude, TETC has certainly done itself and Texas proud. It's raised $16.8 million and awarded $14.6 million in 47 separate grants to 23 schools. And there are indications it's having an effect. At TETC-funded schools, electrical engineering graduation rates are up 36.2 percent; computer science rates are up 24.7 percent. Moreover, the rate of the decline in computer science enrollments at those schools slowed to 40 percent between 2001 and 2004, compared with the national slide of 60 percent. "I could make the case for you that TETC is the reason" for those improvements, says Ray Almgren, the TETC chairman who is also vice president of product marketing and academic relations at National Instruments, based in Austin, Texas. His predecessor as TETC chairman agrees. "It has made a difference," says Tegwin Pulley, vice president of Texas Instruments. TETC has also impressed disinterested experts. A team of outside evaluators concluded in January 2005 that TETC is "an outstanding concept" run by highly motivated individuals. "In short," they raved, "this is an excellent program." Moreover, several other states, including West Virginia, may use TETC as a model for their own programs.

TETC is overseen by an advisory board of industry and academic leaders. The program is administered by the Texas Higher Education Coordinating Board. Grants are allocated on a competitive bid basis. Winning proposals are funded for two years because Texas runs on a biennial budget. Thirty-four schools are involved in TETC. They range from large universities like the University of Texas at Austin, the University of Houston, Southern Methodist University and Rice University, to small ones, including Lamar University, Tarleton State University and West Texas A&M University. Corporations pay a $100,000 membership fee, and seven companies are currently involved: Texas Instruments, National Instruments, Intel, Hewlett-Packard, AT&T, Lockheed Martin and AMD.

Texas' high-tech industry has a decidedly vested, long-term interest in seeing the state's schools churn out greater numbers of engineers and other tech-savvy college graduates. "For our industry to grow, we're going to have to have the talent," Pulley says. Texas Instruments employs 13,000 in Texas, and 58 percent of them require some sort of technical training. It's already finding it "very difficult" to fill positions in-state and regularly looks out-of-state, as well as out of the country, for new hires. And it will likely get worse as the need for tech talent increases, she adds. "We'll be battling for engineers with cosmetic companies, computer companies and everybody else." Brad Beavers is site director of Intel's Austin design center, which employs 800 people, 95 percent of whom are engineers. (Even members of the center's legal team have engineering degrees.) Beavers, who is also TETC's secretary, says Intel's Texas operation hasn't had trouble hiring top people—yet. But, Beavers says, "the long-term hiring of the best and the brightest is very much a concern."

Setting Aside Self Interest

To be sure, corporate funding of academic programs and scholarships is nothing new. What makes TETC unique is that companies are putting their dollars into a cash pool they have no influence over. Also, participating companies are putting aside their usual corporate rivalries to work for a common good. "It's an altruistic program," says Reinold R. Cornelius, program director. Industrial members say it's a matter of corporate citizenship. "There are some things you can't put a specific return on investment on," says National Instruments' Almgren, especially if a company is part the fabric of the state. National Instruments has a worldwide workforce of 3,800, but 2,400 of them live and work in the Austin area.

Participating schools also had to squelch their competitive inclinations to hoard good ideas for themselves. A big part of TETC's success is establishing "best practices"—and sharing them. Last January, the program held a two-day Best Practices Conference at Southern Methodist University to highlight successful projects that could perhaps be replicated at other schools. "If you have come up with a good program that works, this is not something that should be kept secret," Cornelius explains. Almgren says it is also a matter of bigger schools helping smaller ones. That's important, he says, because if the talent pool is to be increased, much of the intake will have to come from smaller schools, which have more room to grow.

That's also why diversity is important to TETC. Many smaller schools are in areas with large populations of minorities, where students come from families who have little, if any, experience with higher education. Texas, for instance, has a large Hispanic population, but only 5 percent of its engineering students are Hispanic. That's an untapped resource, Pulley says. "And, really, we have got to look into that opportunity." The program's goal to increase cooperation between industry and

Katie Moreland
2006 graduate
Computer Science
University of Texas at Dallas

Last summer I interned as a computer programmer. Although I excelled in the classroom, I was somewhat unprepared for the workplace. Suddenly I was given real-life problems to solve—not from a textbook—and I had to collaborate with other people. It is imperative that the curriculum be altered to better prepare engineering and computer science students for the transition to the workplace. The TETC consortium strives to achieve these goals by improving freshman curriculums and placing computer science and engineering students in summer internship positions where they learn valuable skills required for success in the classroom and also in the workplace.

Joel Quintana
2006 graduate
Electrical Engineering
University of Texas at El Paso

My first career choice was culinary arts, but for economic reasons I couldn't leave home for training. I decided to pursue electrical engineering at UTEP. The transition was difficult. My first in-depth electrical engineering class was overwhelming, and my performance was discouraging. I began attending TETC-funded "Saturday Sessions," where we reviewed class topics. Not only did I earn an A in the course, which encouraged me to continue studying electrical engineering, but I acquired the skills to become a successful student. As a senior, I became a teaching assistant. We helped the students pass the class and instilled communication, team and leadership skills.

higher education is also being met. "It's all about collaboration—no part of TETC is not collaborative," Intel's Beavers says. The problem is so huge, he says, that industry, the schools and government can't solve it on their own. Pulley agrees. "It's bigger than any one company," she says. Beavers has also been impressed that participation in TETC has not only remained consistent, but the people involved continue to be top-level officials, not delegated underlings.

Although TETC has raised and spent a fairly impressive amount of money, it's had to leap over some steep financial hurdles. The year it was created was also the year of the dotcom bust. That not only tightened purse strings; it hurt computer science recruitment efforts. "Just when the program started, computer science numbers especially took a hit," Cornelius recalls. The state was also hit hard by hurricanes Katrina and Rita. And in the wake of Katrina, it was inundated by refugees from even harder hit New Orleans. "There were times," Almgren says, "we thought the money would be there and it wasn't. It's a complicated process, running a state, and other things can happen to change priorities." Still, the legislature made good on its pledge to fund the program with matching dollars in the 2002-03 and 2004-05 budget cycles. But it opted not to fund it in the current two-year budget—in large part because it's spending huge sums to overhaul funding for the state's K-12 education system after the old formula was declared unconstitutional by the Texas high court. All's not lost, however. The governor's office secured a four-year, $10 million U.S. Department of Labor grant to continue TETC's funding. It gets $1 million this year, $2 million next year, then $3 million and $4 million, respectively, in 2008 and 2009. TETC will use the first $3 million to fund 10 programs over two years, giving each $95,000 this year and $190,000 in 2007.

TETC initially focused on electrical engineering and computer science, largely because it was the high-tech industry that helped midwife it into existence. As a result, the state's huge aerospace and petroleum industries, which also employ large numbers of engineers, have largely remained on the sidelines. But now, in part to encourage other industries to get involved, it's broadening its remit to include all engineering disciplines and will fund a wider variety of projects. Says Pulley: "If we look at all engineering, we're not pulling students from one area to feed another, and it brings more companies to the table."

Broadening the program can also help prove that some of the successful projects it has already funded can work in other disciplines. For instance, Texas A&M University used its TETC grant to overhaul and enhance its core gateway electrical engineering course, ENGR 111. The department was losing half its freshmen within the first two years. The new version of the class places more emphasis on design, and there is more "understanding and applying" than "memorizing and reproducing." There's also more mentoring available. In fall 2001, before the changes, the school had 126 electrical engineering graduates; in fall 2004, the number rose to 204. Now, Texas A&M has received a National Science Foundation grant to enhance entry-level courses in all its engineering departments.

TETC sees itself in the future helping schools find other funding sources and honing their proposal-writing tactics.

While TETC will continue to fund projects, it also wants to evolve into an organization that's primarily a catalyst in reforming science, technology, engineering and math (STEM) education. It sees itself in the future helping schools find other funding sources—both state and federal—and honing their proposal-writing tactics. It also wants to build on its success to continue influencing the legislature so lawmakers won't ignore the problem. "Left to its own devices, there would a waning interest," Almgren says. "But this problem isn't going away—our needs in industry are greater than ever." That also includes ongoing efforts to raise public awareness of the issues and to help Texans understand why STEM education, and the recruitment and retention of engineering students, is important to all of them. Thirty years ago, Almgren notes, National Instruments was just three engineers with an idea. With 2,400 people employed today, the company and its employees are contributing millions of dollars to the state's coffers. "The payback," Almgren says, "is big time."

Thomas K. Grose is a freelance journalist who writes for a number of national publications.

TETC in Action

THE MAIN PURPOSE of the Texas Engineering and Technical Consortium (TETC) is to increase the number of students earning undergraduate degrees in electrical engineering and computer science. So the focus has largely been on improving retention rates for students who enroll in those disciplines, as well as stepping up efforts to recruit more students into those fields in the first place.

Here are snapshots of two successful projects funded by TETC: a retention project created at the electrical engineering department at the University of Texas-Pan American and a recruitment project developed by the electrical and computer engineering department at the Cullen College of Engineering at the University of Houston. A third snapshot looks at a project that introduced a curriculum change at Prairie View A&M University. Curriculum changes can help accomplish both goals, says Ray Almgren, TETC chairman.

UNIVERSITY OF TEXAS-PAN AMERICAN

UT Pan Am, located in Edinburg, Texas, in the Rio Grande Valley, is primarily a commuter school with a large number of Hispanic students, many of whom come from impoverished backgrounds. Accordingly, many students work part-time or full-time jobs. "They need cash, so they take a job with Wal-Mart," explains Heinrich Holtz, professor of electrical engineering. "There's nothing wrong with Wal-Mart, but the manager of Wal-Mart doesn't care if you've got a big exam coming up or are behind schedule on a lab project." The upshot was that only 65 percent of Pan Am's electrical engineering freshmen returned for their sophomore year, and not all who did return remained in electrical engineering. A department scholarship program failed to improve retention. It wasn't just the money. Pan Am's Hispanic students come from a culture that values work, one where they are expected to hold down jobs to prove they're responsible.

So Holtz helped devise a project, funded by TETC, to give students part-time jobs (10 hours a week at $7.50 an hour) within the department. The work ranges from teaching assistants to computer lab monitors to research assistants. The students pledge not to work a second job off campus and must remain full-time electrical engineering majors.

The project succeeded on two levels. The paying job allowed students to meet financial and cultural needs. But it also kept them on campus, allowing them to mingle more with other students and faculty. "We converted them from commuter students to residential students," Holtz says. That not only exposed them more regularly to all things technical, but it helped them to feel more a part of the scholarly community. At midpoint, the project had 46 students enrolled. They all graduated, 96 percent of them as electrical engineering majors. And 93 percent had grade point averages of 2.0 or higher.

GRADE camp

UNIVERSITY OF HOUSTON

Nationally, fewer than 20 percent of engineering degrees are awarded to women.

Houston's electrical engineering department felt that part of the reason is that women are rarely exposed to female engineers. To counter that, the department came up with GRADE Camps (Girls Reaching and Demonstrating Excellence), a series of four, week-long summer camps for high school girls ages 14 to 17 (grades nine to 12).

At the camp, the girls spend the week learning basic electrical engineering skills in the morning, then applying what they've learned in the afternoon, building Lego robots that can autonomously move through a maze. Female faculty members and graduate and undergraduate students act as mentors. "The mentoring is a big part of it," says Frank J. Claydon, a professor of electrical engineering. Moreover, after demonstrating their robots to family and teachers at the week's end, they attend a banquet to hear a speech from a high-profile female engineer (speakers have included top high-tech company executives and astronauts from nearby Johnson Space Center).

More impressive, however, are the results. So far, 225 girls have gone through the GRADE Camps. About a third of them are now in college, and 75 percent of them are pursuing a degree in a STEM field.

The girls must have taken math and science classes appropriate to their grade. Still, old stereotypes and attitudes persist. Claydon has heard from high school teachers that when the program is announced in class, few girls raise their hands to show interest. Instead, they wait to talk to their teachers before or after class. "They don't want the boys to know they're interested." Nevertheless, many do apply, and so far the program's been oversubscribed.

PRAIRIE VIEW A&M UNIVERSITY

Prairie View, a historically black university, was having a problem retaining freshman electrical and computer engineering students. So, using a TETC grant, it introduced an Infinity Project course for first-year students. Developed at Southern Methodist University, the Infinity Project is a science- and math-based initiative geared to K-12 and early-college students that "helps educators deliver a maximum of engineering exposure with a minimum of training, expense and time."

The Prairie View course, ELEG 1022, uses Infinity Project lab kits. The project experiments let students envision, design and test modern electronic systems. After two full years, the freshman retention rate now averages around a very healthy 84 percent. The retention rate for all Prairie View freshmen in 2001 was 69 percent. "Would it have happened without TETC?" Almgren asks. "I don't know. But I do know we were the catalyst." —TG

APPENDIX II

Preliminary Budget Schedule