

A. JAMES CLARK SCHOOL OF ENGINEERING
STRATEGIC PLAN
2009-2014



A. JAMES CLARK
SCHOOL OF ENGINEERING

COVER IMAGE

In 2009 a Clark School team of graduate and undergraduate students designed, built and launched a super-sized, helium-filled balloon, carrying a GPS receiver and radio, that rose to 128,379 feet before bursting. In doing so they set the new Amateur Radio High-Altitude Ballooning Record, surpassing the previous record by nearly 3,200 feet.

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A VISION SHARED

The A. James Clark School of Engineering has been a powerful driver of the University of Maryland’s remarkable rise over the past two decades, and both shares and helps shape the university’s vision. In the Clark School’s Strategic Plan 2009-2014, we have assembled a rich set of ideas for our continued progress, using the University of Maryland’s Strategic Plan 2008-2018 as a model. The university’s plan states the following values and principles, which the Clark School enthusiastically endorses:

- *Build an Inclusive Community* that is enriched by differences, brings together people from the widest array of backgrounds and perspectives, and recognizes that excellence cannot be achieved without diversity.
- *Embrace the Power of Technology* to ensure the highest quality instruction, research, scholarship, and outreach to our alumni and the larger community.
- *Act with Entrepreneurial Spirit* in tackling big issues, seizing opportunities and adapting quickly to changing circumstances; partner with others—locally and globally—to extend the quality, breadth, and impact of the university’s programs.
- *Take Responsibility for the Future*, enhancing the quality of life of all people, sustaining the natural environment, and reinforcing the capacity of Maryland’s citizens to thrive and prosper in a diverse, ever-changing, globally competitive environment.

We appreciate your interest in our plan, and encourage you to review it and participate in the implementation process that will follow publication of the plan.

THE CLARK SCHOOL: A PROFILE

The Clark School today is recognized as a leading engineering institution whose programs yield:

- New knowledge and technologies
- New engineers prepared to contribute to society by applying technological approaches to the opportunities and challenges before us

- New Maryland enterprises that bring technological products and services into the marketplace
- And service activities that engage and inspire students and deliver value to people in Maryland and the United States and around the world.

Engineering at the University of Maryland began in 1894, and its history is marked by distinguished graduates who have served as leading engineers, public servants and business people. Our first female engineering graduate, Ms. Evelyn “Evie” Barstow Harrison, earned a B.S. degree in civil engineering in 1932. After a successful engineering career, she went on to work with former first lady Eleanor Roosevelt on the first Presidential Commission on the Status of Women in 1961 under President John F. Kennedy. The list of distinguished graduates in public service includes Gordon England, ’61, former Deputy Secretary of Defense, and Michael Griffin, ’77, former Administrator of the National Aeronautics and Space Administration.

A pair of alumni, Edward Miller, ’50, and James Plummer, ’53, won the Charles Stark Draper Prize for their contributions to the development of satellite reconnaissance during the Cold War; they and many other pioneering alumni, faculty members, and closely associated engineers are members of the Clark School’s Innovation Hall of Fame (see below). A core group of friends and alumni have enjoyed significant successes

as inventors and business leaders; in turn they have become major donors and helped to establish the Clark School and its signature programs. Glenn L. Martin, founder of the original Martin Aircraft Company that later became part of Lockheed Martin, was an early supporter in 1949, followed most prominently by alumnus and construction magnate A. James Clark, for whom the school was named in 1994. Robert E. Fischell and his family have given gifts that established the school’s Fischell Department of Bioengineering and Robert E. Fischell Institute for Biomedical Devices. Alumnus Jeong H. Kim provided funding that enabled the construction of the Jeong H. Kim Engineering Building, and alumnus Brian Hinman supports the Hinman Campus Entrepreneurship Opportunities (CEOs) program. Many other individuals and corporations have contributed over the years, and all remain key factors in the school’s continued success.



[RESEARCH AND INNOVATION]

Members of our Innovation Hall of Fame—Clark School alumni, faculty and other closely associated engineers—are responsible for the development of:

- The electric/gasoline hybrid power train used in Toyota vehicles
- Pulse Doppler radar
- The universal product code
- The flexible coronary artery stent and implantable insulin pump
- The first successful satellite reconnaissance system
- Audio, video and data conferencing solutions
- Retractable landing gear

and many other major contributions to society. See www.eng.umd.edu/ihof for more information.

The Clark School takes advantage of its Washington D.C. location to create extensive partnerships and initiate major research centers with government and corporate partners. Total external research expenditures in 2008 were \$126 million, with an average annual tenured and tenure-track faculty member research productivity of \$630,000.

[EDUCATION]

The Clark School annually delivers engineering education to some 1,600 graduate students and 2,800 undergraduate students. Degrees offered are the Bachelor of Science, Master of Science, Master of Engineering, Professional Master of Engineering, Doctorate of Philosophy, and Engineering Graduate Certificate.

Undergraduate majors are: aerospace engineering, bioengineering, chemical and biomolecular engineering, civil and environmental engineering, electrical engineering, computer engineering, fire protection engineering, materials science and engineering and mechanical engineering.

In 2008, our undergraduate students won prestigious Goldwater and Truman scholarships and our graduate students won prestigious NSF, Zonta, and Sloan fellowships. Four Clark School student teams placed first in society-sponsored engineering competitions, including the TerpsRacing team, Robotics@Maryland team, American Helicopter Society design team and Space Systems design team.

Our innovative Keystone program ensures that our first- and second-year undergraduate engineering courses are taught by some of our best, most inspiring faculty members. Keystone brings beginning engineers an enhanced educational experience, reinforces and recognizes outstanding teaching, and serves a national model for increasing engineering student retention and graduation rates.

Our innovative Future Faculty Fellows program prepares selected Ph.D. candidates for careers in research and teaching in leading institutions.

[ENTREPRENEURSHIP AND ECONOMIC DEVELOPMENT]

The Clark School's Maryland Technology Enterprise Institute (Mtech) is a powerful engine for technology-based economic development. Mtech's extension service has had a \$291 million economic impact on Maryland manufacturers from 2000 to 2008. Its industrial partnerships program awarded \$3.6 million in 2008 to partnerships between Maryland companies and university researchers. Its Hinman CEOs program is a nationally recognized model for living-learning student entrepreneurship education, and has produced numerous student- and alumni-run startup corporations that generate annual revenues in excess of \$8 million.

[SERVICE]

The Clark School's Engineers Without Borders chapter is regarded by many as one of the best in the nation, involving some 150 students in service engineering projects around the world, including Thailand, Peru, Burkina Faso (West Africa), and South America.

Student groups also engage in free evaluation of building energy usage for Maryland businesses, in Habitat for Humanity projects in New Orleans and elsewhere, and in engineering outreach programs to high school and middle school students.

[RANKINGS]

At present (September 2009), the Clark School's graduate programs are ranked 17th in the nation overall, and 9th among public programs (the Clark School is also the top public engineering graduate program in the mid-Atlantic area). The school's undergraduate programs are ranked 23rd overall and 9th among public programs.

NOTE: These and other numbers in the Strategic Plan reflect the situation at the time of writing, and thus will not be updated over time.

INTRODUCTION

THE CLARK SCHOOL STRATEGIC PLAN 2009-2014: A MESSAGE FROM DEAN DARRYLL PINES

The Clark School's five-year strategic plan is comprehensive, action-oriented, and transformational. It is designed to complete the school's ascent into the ranks of the very best engineering programs—our objective is to be second to none and make a positive impact everywhere.

[ORGANIZATION]

The organization of the Clark School plan follows that of the university's:

- Undergraduate Education
- Graduate Education
- Research
- International Collaboration (with a separate section on Partnerships, Outreach and Engagement)

In each section, we propose goals and strategies to expand and enhance our most successful initiatives, and propose new initiatives that will lead to greater opportunities for students and faculty members to excel in their work and contribute to society.

In the *undergraduate education section*, the plan proposes not only higher SAT scores for admitted students, and higher numbers of female and minority students, but also new levels of attention to the quality of teaching and mentoring, greater scholarship funding, new ways to interact with high school students and teachers, a curriculum that better reflects the changing technological world, and a superior educational experience. Major new undergraduate education spending priorities include:

- Creating and offering undergraduate courses for non-engineers to build technological literacy throughout the university
- Creating and administering new student challenge programs (undergraduate and graduate)
- Expanding and enhancing Keystone: The Clark School Academy of Distinguished Professors to address a broader range of courses
- Creating opportunities for students to participate in and contribute to sustainable, environmentally sound engineering development in the state, nation and internationally.



- Establish partnerships and programs to ensure a diverse, well-rounded, undergraduate student body
- Expanding the FLEXUS gender-diversity living-learning program to provide greater resources and offer participation by CMPS students
- Building the foundation of the Fischell Department of Bioengineering.

In the *graduate education section*, the plan proposes improved support for graduate students, better tracking and control of student progress toward degree, new interdisciplinary programs, new diversity targets and career preparation. Major new graduate education spending priorities include:

- Creating and administering new student challenge programs (undergraduate and graduate)
- Creating and administering a new Engineering for Sustainability Program
- Creating a culture of inclusion, scholarly output and positive impact.

The *research section* proposes new research expenditure goals and corresponding increases in both faculty and administrative and technical staff, new guidance for our research program and priorities, school incentive funds and awards, increased multi-year, multidisciplinary centers, greater faculty NAE membership, greater awareness of and funding for our research programs, expanded collaborations with national and international partners (including increased IPA positions), and greater faculty involvement in entrepreneurship and technology transfer. Major new research spending priorities include:

- Strategic faculty hiring to advance nanotechnology, bioengineering, and energy and sustainability research
- Building the foundations of the University of Maryland Energy Research Center
- Creating and administering a new Engineering for Sustainability program
- Expanding the size and scope of the undergraduate research experience
- Creating a Clark School post-doctoral research program.

In *international collaboration* and in *partnerships, outreach and engagement*, the plan calls for greatly increasing the number of students receiving academic credit for foreign study courses and for new staff to support these increases, new international collaboration objectives for each department, expanded involvement with the international community resident in Washington, D.C., and continued strengthening of the programs of the school's Maryland Technology Enterprise Institute. Major new spending priorities include:

- Creating and administering research experiences for high school STEM teachers to learn about engineering
- Ensuring the future of the Engineers Without Borders Program
- Creating and administering pre-college research internships with Clark School faculty members
- Creating and administering summer research internships for students at minority-serving universities
- Creating and administering a summer corporate employment and scholarship program for high school seniors admitted to the Clark School.

The Clark School has requested approximately two thirds of the funding for the proposals listed above in its reallocation proposal to the Provost.

There are also three facilities spending priorities that span all Strategic Plan sections:

- New Robert E. Fischell Institute for Biomedical Devices building
- New University of Maryland Energy Research Center facility
- New Clark School Innovation/Conference Center (an addition to the Jeong H. Kim Engineering Building).

[FEASIBILITY AND COST]

The Clark School Strategic Plan is both ambitious and feasible. While particular proposals may be adjusted and prioritized along the way and obstacles will no doubt be encountered, the plan can be accomplished so long as we obtain a substantial infusion of new resources, reallocate existing funds wisely and constantly improve our efficiency and effectiveness.

We project a total expenditure of about \$100 million (in 2008 dollars) during the five-year implementation period of the plan. The bulk of this amount, approximately \$70 million in capital and start-up costs, will be secured through

private philanthropy and public-private partnerships related to the University of Maryland Energy Research Center, the Robert E. Fischell Institute for Biomedical Devices, the Clark School Innovation Center (see above), and general laboratory renovations and additions to existing infrastructure. About \$30 million over five years will come from enhanced contributions from alumni and friends of the institution, self-generated revenue including research support and entrepreneurial educational initiatives, and highly targeted reallocations of institutional funds specifically to support institutional priorities and excellence.

[FACULTY AFFAIRS/DIVERSITY]

In addition to achieving undergraduate and graduate student diversity goals (spelled out in their respective sections of the plan), the Clark School seeks to achieve diversity among its faculty. We will examine current practices and implement new ones for increasing the diversity of all applicants for faculty positions, consider a mentoring program for new faculty members, and explore helpful family-friendly policies such as teaching relief for faculty members who are new parents.

[MOVING FORWARD WITH YOUR SUPPORT]

The Clark School Strategic Plan reflects the university's 10-year plan, "Transforming Maryland: Higher Expectations," and at the same time the Clark School's unique opportunities and challenges. Our plan was formulated by committees comprised of Clark School faculty and staff members, and incorporates their insights. All stakeholders—faculty, staff, students, alumni, Board of Visitors members—have contributed to the development of this plan.

The plan is significant not only in the ideas it proposes, but also in the process of implementation to which it leads. This process will ultimately be of equal importance to the formulation of the plan, and all Clark School stakeholders will have the ability to recommend specific ways to put the plan in practice at a level of detail not attempted in the plan itself.

The Clark School encourages all to continue to read and discuss the plan, commit to it as our guiding document for the next five years, and participate in the implementation process. Your ideas, spirit, and hard work have moved the Clark School to its current position as an excellent educational and research institution. With your continued support and enthusiasm, we can complete our journey to join the ranks of the very best.

VISION

The A. James Clark School of Engineering will offer its undergraduate students an outstanding and rigorous educational experience, and an environment and programs to support their social and intellectual growth. The school will provide a range of educational opportunities that reflect the academic breadth and depth appropriate to a comprehensive research university. Upon graduation, our students will have experienced an atmosphere of intellectual ferment and inquiry; participated in a diverse and inclusive community with significant engagement in different cultures and global issues; had the opportunity for involvement in cutting-edge research, community service, public service and the business world; and worked toward the solution of critical state, national and global problems. We will encourage our students to complete their education successfully in a timely manner in keeping with our emphasis on rigor, international experiences, co-op opportunities, internships and research experiences.

Our students will graduate with the knowledge, skills, habits of thought and experiences that will enable them to continue to grow and thrive as global citizens, and will possess the creativity and entrepreneurial spirit to respond responsibly and imaginatively to the challenges of the 21st century. They will be highly competitive candidates for challenging, rewarding and prestigious career opportunities. Those choosing to continue their education will be successful in gaining admission to advanced degree and professional programs of their choice.

The school will attract and enroll highly talented students from Maryland, the nation and the world whose academic achievements and life experiences will contribute to the learning environment for their fellow students. The school will be a place where the state's most talented students can fully achieve their educational goals in an accessible state-supported institution. The school will help to stem the outflow of talented state high school graduates to out-of-state institutions, increasing the chance that these students will continue to live in and advance the progress and well-being of Maryland and the region.

The school will control its undergraduate enrollment as necessary to ensure that available resources are sufficient to provide an outstanding educational experience to our undergraduates. We will increase our activities to achieve true diversity in our student body and faculty, in both of which we must increase the number of African-Americans, Native Americans, Hispanic-Americans and women to reflect more accurately our state's demographics. In keeping with this vision, we outline the following five-year goals.

GOAL 1.1: The Clark School will implement new initiatives, and strengthen existing ones, to improve further the quality of its undergraduate education. We will provide programs that are comprehensive and challenging, match or exceed students' learning goals and serve as a foundation for success in the workplace or advanced study and for a more fulfilling life.

FIVE-YEAR GOALS FOR UNDERGRADUATE EDUCATION

	PROPOSED	CURRENT		PROPOSED	CURRENT
Undergraduate enrollment	3100 (+/- 100)	2759	Student retention	75% after 3 years 80% after 2 years	62.7% 73.7%
Admitted student SAT scores			Student graduation	50% after 4 years 70% after 5 years 75% after 6 years	40.0% 58.3% 64.5%
75 th percentile	1460	1435	BS productivity	700 degrees/year	551 (673 in 2006)
25 th percentile	1310	1270			
Student diversity	25% women 15% minorities	18.8% 11.5 %			
Degrees granted	25% women 18% minorities	22.2% 7.9%			

[STRATEGIES]

A. Aggressively build up Keystone: The Clark School Academy of Distinguished Professors so as to improve the quality of the first two years of engineering courses. By doing so, improve our retention rate and better prepare students for their last two years within their majors. Increase the number of Keystone professors from the current nine to a total of 25 over the next five years. Continue to identify courses from around the school that should come under Keystone auspices. Aggressively pursue funding—from private benefactors, the campus, school and industry—to expand this program.

B. In cooperation with the College of Computer, Mathematical and Physical Sciences and the College of Chemical and Life Sciences, closely monitor content, grade distribution and teaching evaluations in mathematics, physics, chemistry and biology classes to ensure that Clark School students receive high quality instruction in those support courses. Establish a group of faculty members (perhaps Keystone professors) to perform monitoring.

C. Motivate all Clark School faculty members to achieve excellence in classroom instruction, and provide helpful monitoring, evaluation and training to make this more likely. Consider creating a Dean's List of Excellent Teachers whose members achieve at the highest level based on teacher performance criteria and student evaluations. Use the list to recognize and reward members and thus improve further the academic culture of the school. Working from the list's criteria, establish standards to evaluate the efforts and abilities of all teachers. Determine which teachers need to take their teaching duties more seriously, and provide teaching training to improve performance. Make the list available to aid students in selection of instructors.

D. Further expand Clark School undergraduate entrepreneurship courses and programs to equip technology creators with the skills to launch and manage successful new ventures. Develop courses and programs to provide engineering students, and non-engineering students with interests in technology commercialization, with the entrepreneurial mindset, functional skill sets, and personal relationships to



succeed in technology startups and within corporate ventures. Consider introducing a technology entrepreneurship minor, based on student demand and available resources.

E. In cooperation with the new Honors College, develop a new Entrepreneurship and Innovation Program and begin in the fall of 2010 to provide freshmen and sophomores from all majors the opportunity to learn and live entrepreneurship and innovation. Help students in the program develop the characteristics described in I.1.D above. Through experiential learning, dynamic courses, seminars, workshops, competi-

tions, and volunteerism, deliver a world-class education in entrepreneurship and innovation. Enable all student teams, in collaboration with faculty and mentors who have successfully launched new ventures, to develop an innovative idea and write a product plan. Accommodate up to 150 students in steady state. Utilize the program as a major factor in attracting outstanding students to the university and the Clark School in particular.

GOAL 1.2: The Clark School will attract a larger pool of academically talented applicants, enroll an increasingly stronger group of freshmen and transfer students overall and more students from under-represented groups, and become the school of choice for more of the highest achieving students from high schools in Maryland and around the world.

[STRATEGIES]

A. Offer ample scholarships to the most highly qualified applicants so that we may compete for them not only on the basis of the quality of our programs but also financially. We have reached a point at which we can equal in many cases the very best schools in terms of academic quality and enrichment programs. We must now increase our scholarship offerings to improve further our competitive profile and capture more of the top students in Maryland, the nation and the world.

B. Devise and hold a competitive challenge for high school students to increase their awareness of the Clark School and engage them in activities that demonstrate the school's rigor and spirit and their own knowledge and creativity.

UNDERGRADUATE EDUCATION

Offer the challenge on a regional basis at first, then expand to become nationwide. Consider creating our own challenge, perhaps associated with the current ENES100 autonomously controlled hovercraft project. Participants might develop their designs at their own schools, then build their hovercrafts at the Clark School using materials we provide, and compete against other high schools or against Clark School students. Also consider the existing For Inspiration and Recognition of Science and Technology (FIRST) competition or a home-grown “junkyard wars” competition.

C. “Adopt” the top 25 high-tech Maryland high schools to increase applications from and enrollment by their students. Participating Clark School faculty members, staff members and students will visit these schools to demonstrate Clark School faculty and student research, make presentations on student programs such as Engineers Without Borders, interest students in Clark School public lectures and events and possibly serve as advisors and helpers in high school projects. Launch the adoption program with five schools and add five schools per year. Set expectations for faculty involvement and provide appropriate support for a successful ongoing activity.

D. Do more to impress upon potential applicants the value of a Clark School degree, especially the opportunities available to our graduates. Consider involving young alumni in presenting their own success stories to prospective students via high school visits and the Clark School website, and involving our Corporate Partners (perhaps via the “adoption” program described above) to show the likelihood of obtaining a challenging and rewarding position upon graduating with a solid Clark School GPA and degree.

E. Establish a task force to assess opportunities for targeting departing members of the military as potential applicants to the Clark School’s undergraduate and graduate programs.

F. Participate in national compacts and collaboratives, and partner with the top 10 STEM community colleges, to increase applications from women and under-represented minorities.

GOAL I.3: The Clark School will set high expectations for undergraduate student success in the first year, and provide resources to ensure that students meet their educational responsibilities from the beginning and continue on to their upper class courses and graduation.

[STRATEGIES]

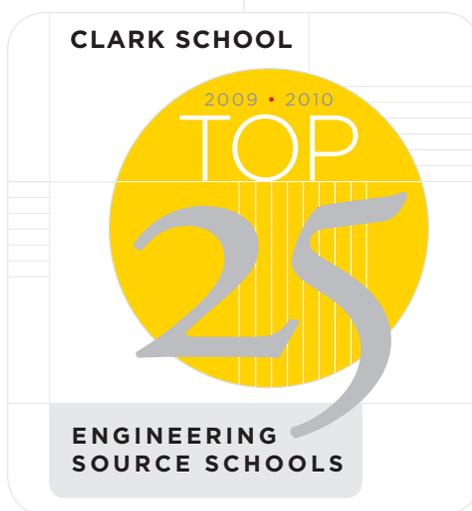
A. Identify at-risk first-year students in the first weeks of the semester and engage them in a mentoring program, involving faculty members, staff members and other students, to ensure their attendance in class, completion of reading assignments and homework, and proper preparation for first exams. We will do everything in our power to get students off to the right start, including monitoring their success in large chemistry, math, physics and biology classes in which attendance is not taken and instructors are often not perceived

as concerned with student success (see I.1.B. above). Consider creating an “at-risk student checklist for success” for use by mentors to increase retention and measure progress.

B. Establish a tutoring office to assist first-year students in learning class content. Consider extending the availability of Keystone professors and assistants to staff the office. Chemistry, physics, and math courses have help clinics, but we offer no additional help for our students in those courses or for many engineering courses.

C. Foster a culture and environment in which faculty, staff and students help first-year students understand that we expect them to attend class, prepare for class and study. Consider creating areas where students are always welcome to study and bond; these will be open late and perhaps staffed by upper class undergraduates or graduate students who can provide help with course work. Consider training first-year course instructors in the special needs of freshman students.

GOAL I.4: The Clark School, in recognition of rapid changes and new directions within technology and especially product development, will further develop its curriculum to prepare students to excel in the world they will inhabit and help to lead.



[STRATEGIES]

A. Develop a new three-credit *Biology for Engineers* course in conjunction with the Department of Biology (College of Chemical and Life Sciences), and encourage all Clark School departments to enable their students to take the course as part of their undergraduate degrees. Some Clark School departments may add the new course by reducing the number of physics credits they require and restructuring physics course content in conjunction with the Department of Physics (College of Computer, Mathematical and Physical Sciences).

B. Work with the Department of Psychology (College of Behavioral and Social Sciences) to develop a new *Psychology for Engineering Design* course and with the Department of Economics (College of Behavioral and Social Sciences) to develop a new *Economics in Engineering Design* course, both to be offered through the CORE course requirements.

C. Develop a new junior/senior year, cross-disciplinary design course (in effect a high-level ENES100) in which faculty members from several departments assist students in their designs; it would not be a lecture course. Consider giving credit for the Technical Elective within the program and possibly for the capstone design course. Also consider requiring a one-credit seminar course to present detailed information of use in design. Projects might focus on high-level challenges requiring integration of several disciplines to achieve an optimal solution; for example, in autonomous control of vehicles, 50 to 100 students would be involved in various projects.

GOAL 1.5: The Clark School will do more to ensure that our students are better prepared to face the challenges immediately presented to them upon obtaining their bachelor's degrees and entering the professional world.

[STRATEGIES]

A. Establish a Writing/Presentation Center within the Clark School to improve students' professional communication skills. The center will assist professors in incorporating a significant writing component in their classes, assist students in managing such components within engineering and all classes, and help to incorporate ENGL393 (Technical Writing) more effectively into the overall undergraduate program.

B. Establish short, not-for-credit courses throughout the undergraduate program to assist students in learning tools such as Matlab, Labview and CAD for the modern-day practice of engineering. We use these tools in our teaching today, but provide little support to help students learn them. Consider providing tutorial support for such tools through workshops and "open lab" hours, possibly organized through the Clark School information technology department.

C. Encourage students to take the Engineers in Training/Fundamentals of Engineering examination (offered by state governments) as the first step toward becoming a registered professional engineer.

D. Convene a panel of industry experts to define Clark School course requirements pertinent to current industry needs in a variety of fields.

GOAL 1.6: The Clark School will further promote its national and international reputation and the pride of its students and alumni.

[STRATEGIES]

A. Foster a sense of pride and unity among Clark School freshmen by creating and presenting a bonding experience for them prior to the start of the fall semester. Consider establishing a Clark School Challenge that begins with a brief inspirational talk by a famous alumnus or other engineer about the value of the discipline and the role of engineers in improving life, followed by a day-long competition in which small teams solve technical problems in locations across campus, thus learning about each other, the Clark School and the university and earning prizes (perhaps textbook vouchers) for speed, creativity and accuracy. Upperclassmen would develop and administer the challenges, evaluate the teams' performance and award prizes. A set of records would be established for each year's teams to surpass.

B. Create and distribute at graduation a branded Clark School item to symbolize their continuing relationship with the school and their accomplishment in successfully completing the school's degree program. Consider a well-designed and high quality Clark School ring, desk ornament or other object that arouses the curiosity of observers, perhaps has an engineering "double meaning" and at the same time identifies a Clark School alumnus or alumna. It would be kept constant over a long period to build a sense of tradition.

UNDERGRADUATE EDUCATION

c. To engage students in national and social value issues, develop and publicize a Clark School engineering grand challenge program that organizes students to find solutions to one or more major opportunities or problems (referencing the National Academy of Engineering's Grand Challenges program). Consider presenting student solutions in an annual exhibit and selecting the best solution for an award. Consider establishing separate undergraduate and graduate challenge programs.

GOAL 1.7: The Clark School will provide non-engineering students at the university the opportunity to explore technological issues from the perspective of the engineer.



[STRATEGY]

A. Develop a set of five to eight courses on topics of interest to non-engineering and non-science majors. The courses will be at the 100-200 level and meet the requirements of the new General Education program being formulated by the university. The courses will integrate the ideas underlying the concepts of “Pathways to Knowledge and Creativity” and “2020 Perspectives and Ways of Thinking” as outlined in the university strategic plan. Each of the courses will have an eventual steady-state enrollment of 100-200 students and will utilize the school’s most engaging faculty members for instruction. In total the courses will offer approximately 1000 seats per year (500 per semester) to help build technological literacy in the undergraduate student body. All students graduating from the University of Maryland should have a minimum level of technological literacy to succeed as members of the global workforce and potential leaders in their fields of endeavor.

VISION

The A. James Clark School of Engineering will provide graduate education programs in which talented young engineers from Maryland, the nation and the world, guided by renowned and dedicated faculty mentors, can participate in highly productive research programs, develop new disciplinary and cross-disciplinary knowledge, take advantage of opportunities presented by Washington-area industry and government laboratories, successfully fulfill teaching assistantships and serve as mentors to undergraduate students, attend major conferences, publish significant papers, and prepare for and launch careers as leaders in their fields.

Our programs will place the Clark School among the best colleges of engineering nationally and internationally. We will compete successfully to enroll a diverse body of top students (see five-year diversity goals below), and provide a friendly environment and support so as to improve students' enjoyment of their work and social lives and increase the likelihood that they will make their careers and homes in our state. The school will control graduate enrollment to ensure the availability of appropriate resources for our programs.

The vast majority of enrolled doctoral students will complete their degrees in four to six years and publish significant work by graduation. Students who intend to pursue academic careers will engage in mentored teaching experiences and learn how to obtain grants. Our Master of Science and Master of Engineering students will receive training that enables them to flourish in careers in the public and private sectors.

GOAL II.1: The Clark School will deliver graduate programs of the highest quality, characterized by outstanding student accomplishment, high completion rates, short time to degree, and prestigious career placements upon graduation.

[STRATEGIES]

A. Ensure the presence of an outstanding faculty whose research is of high quality and productivity and who participate actively as mentors, collaborators and role models for their students.

B. Encourage doctoral students to carry a full-time academic load, whatever their sources of funding. Exceptions may include students who are involved with the work of area industry and government research laboratories and who may be granted part-time status so long as they make acceptable progress toward their degrees; and students in programs that employ distance learning (e.g., reliability engineering).

C. For every full-time doctoral student who has passed the qualifying examination and is making acceptable progress, find full support—normally research funding—for the normative time to complete the degree. For every doctoral student who has matriculated and has not yet passed the qualifying exam, find full support through fellowships or teaching assistantships. This will require additional resources from the Graduate School and other sources.

D. Set high expectations for student performance, including: participation in cutting edge research; development of disciplinary and cross-disciplinary knowledge that is broad and deep; publishing of papers in respected journals and/or presentations of work at national and international conferences; development of excellent technical writing and oral presentation skills; and competing for national and international awards.

E. Monitor each doctoral student's progress toward benchmarks and put in place mechanisms for ensuring timely completion. Establish a roadmap to degree for each student that indicates expected time to pass the qualifying examination,

FIVE-YEAR DIVERSITY GOALS FOR GRADUATE EDUCATION

	PROPOSED	CURRENT		PROPOSED	CURRENT
Doctoral student diversity	30% women	21%	Master's (M.S. and M.Eng.) student diversity	30% women	24%
	40% U.S. nationals or permanent residents	27%		60% U.S. nationals or permanent residents	60%
	15% minorities within U.S. nationals or permanent residents	11%		20% minorities within U.S. nationals or permanent residents	13%

advance to candidacy, and complete and publish the dissertation. Identify students who are not making sufficient progress and require from them a plan of action to be developed in consultation with their advisors. The Graduate Studies Committee will approve all such plans and monitor students' progress.

F. Encourage departmental research advisors to achieve excellence in their mentorship of graduate students. Advisors should meet regularly with advisees to discuss progress toward benchmarks, preparation for an annual student review and preparation for highly competitive job opportunities. Evaluate faculty members for promotion merit raises and post-tenure review based on quality of mentoring. Develop a list of best practices for mentoring and conduct annual workshops on effective mentoring.

G. Encourage the development of new interdisciplinary programs, especially at the master's (M.S. and M.Eng.) level, so as to reflect the actual needs of much contemporary research and development. Increase the size and visibility of B.S./M.S. and B.S./M.Eng. programs.

H. Further expand Clark school graduate entrepreneurship courses and programs to equip technology creators with the skills to launch and manage successful new ventures. Develop courses and programs to provide graduate engineering students, and graduate non-engineering students with interests in technology commercialization, with the entrepreneurial mindset, functional skill sets, and personal relationships to succeed in technology startups and within corporate ventures. Collaborate with graduate students to organize and operate a graduate engineering entrepreneurship club as an avenue to uniting and connecting students with these interests. Introduce graduate degree offerings in this area via online courses targeting technology entrepreneurs and innovators.

GOAL II.2: The Clark School will determine the size of each graduate program based on faculty and financial resources.

[STRATEGIES]

A. For doctoral programs with a typical five-year duration, establish the number of students admitted in a research

area based on the availability of research-active faculty members in that area who are willing to serve as advisors and have research funding to support the students. The size of doctoral programs will fluctuate based on the amount of research funding received by faculty members. Short-term fluctuations in the job market will not be used to determine program size.

B. Use the following assumptions in establishing doctoral program size: 0.8 doctoral graduates per year per tenured/tenure-track faculty member; average time to degree of five years; 70% of matriculating doctoral students will graduate.

C. Increase the number of M.Eng. graduates to 150 in five years, approximately a 50% increase.



GOAL II.3: The Clark School will compete with top institutions to enroll a diverse group of outstanding students.

[STRATEGIES]

A. Develop a recruitment plan for each program and provide focused, targeted, well-defined program information to capture the awareness and interest of potential applicants. Recruit students at conventions of organizations such as Tau Beta Pi. Invite top accepted students who live in the United States to visit campus with expenses paid. Faculty members on international travel will recruit at top foreign universities. Recruiting expenses will be paid through supplementary, not research, funds.

B. In admissions decisions, complement GRE and undergraduate GPA with other criteria that predict success, such as evidence of commitment, work experience, potential for innovation and creativity, originality of approach and successful undergraduate research. Cultivate and use faculty contacts at foreign universities to obtain frank assessments of applicants' research potential. Expand programs that bring undergraduates from other institutions here for summer research and thus facilitate student evaluation and recruitment.

C. Develop specific plans to guide each program's recruitment of under-represented groups: African Americans, Hispanic Americans and Native Americans (see goals above). Establish

contacts with minority undergraduate institutions, and recruit minority and female undergraduates to participate in summer research. Send faculty members, staff members and graduate students to recruit students at conventions of organizations of minority and female students in science and engineering.

GOAL II.4: The Clark School will prepare doctoral students who will be highly competitive and well prepared for positions at prestigious educational institutions and for responsible research positions in government, industry and non-profit organizations. Master's degree graduates will be in high demand for positions in their fields.

[STRATEGIES]

- A. Hold professional development seminars to help guide students in career preparation.
- B. Continue to offer the Clark School's Future Faculty Program, including training in writing and presentation skills, grantsmanship and a mentored teaching experience, for students who plan academic careers.
- C. Place 10% of doctoral recipients in tenure track positions at the top 65 U.S. engineering schools or in academic positions at prestigious foreign universities.



VISION

The A. James Clark School of Engineering will be a national and international leader in engineering research and will support and invest in research programs for the creation of new knowledge and technological solutions to major challenges faced by the world.

GOAL III.1: The Clark School will foster a culture in which every program and center engages in research and scholarship as a leader in its discipline.

[STRATEGIES]

A. To continue to match or exceed our aspirational peers, set a goal of \$155 million for fiscal year research expenditures in 2014, with the expectation that our growth trend, from \$86 million in 2003 to \$126 million in 2008, will continue. To achieve this goal, hire a diverse group of top-quality tenured and tenure-track faculty members with international leadership potential so as to increase our current total of 197 to at least 220 by 2014. At the same time, increase the number of our state-funded administrative and technical support staff members, recognizing that an appropriately-sized support staff is crucial to our success.

B. Form a standing Engineering Research Advisory Committee, with representation from each of the school's research-active units and led by the associate dean for research. The committee will provide regular recommendations to the dean on the research strengths of the school in relation to those of the campus, on developments in the broader technical community and on corporate, societal and governmental needs, so that the school's investment of resources is future-oriented, cost-effective and likely to achieve high impact.

C. Allocate and invest Clark School Incentive Funds to support new, unfunded research by faculty groups that will lead to new, large, multidisciplinary research centers, increased funding from federal and state agencies, high-impact publications, patents and technology transfer. Require submission of a related research proposal within one year of completion of the funding. Consider providing one to two years of support

for a graduate student starting in the year following successful promotion or post-tenure review.

D. To provide continued support for Clark School Incentive Funds, create a new agreement for the allocation of funds returned to campus from the indirect costs charged to grants and contracts for new major programs developed using those funds.

E. Sponsor a range of new awards to complement the Clark School Faculty Outstanding Research Award (which functions as a senior research award), including a Clark School Junior Faculty Research Award, Clark School Distinguished Ph.D. Dissertation Award and a Clark School Distinguished M.S. Dissertation Award.



GOAL III.2: The Clark School will be more widely known and respected nationally and internationally for its suite of outstanding interdisciplinary research efforts, many focused on major societal issues.

[STRATEGIES]

A. Develop national and international research leadership in biotechnology, nanotechnology and sustainably, environmentally engineered systems, critical research areas that encompass work in all departments and form the core for strategic investments by the school. In biotechnology, build on the new Fischell Department of Bioengineering and Robert E. Fischell Institute for Biomedical Devices and other departments' biotechnology efforts. In nanotechnology, build on the University of Maryland NanoCenter and investments by the state in the NanoCenter and the Nano-Bio seed funding program. In sustainability engineering, build on our culture of cross-disciplinary research and collaboration to develop leadership in: energy (through the University of Maryland Energy Research Center); green technologies for buildings and manufacturing; water resource management; transportation; and overall engineering design (considering such factors as reliability, manufacturability, testability, maintainability, obsolescence, survivability, recyclability and environmental compatibility).

B. Derive new research initiatives from the ground up, building on the unique and differentiating strengths of the school and its faculty. Encourage faculty collaborations and the development of new interdisciplinary research centers, and provide tools to allow faculty members to become international leaders.

C. Encourage strategic partnerships with other schools, government agencies and corporations that combine research and education. As examples, consider efforts now underway to: establish an M.D./Ph.D. program involving the University of Maryland Medical School and the Clark School in which they eliminate subcontracts or establish a single point of contact in joint proposals and place their students in each other's laboratories for short- or long-term research activities; and the pilot program to explore joint education and research activities leading to four-year aerospace engineering and mechanical engineering bachelor of science programs in Southern Maryland, through a partnership of naval and higher education organizations (the Naval Air Warfare Center-Aircraft Division, the College of Southern Maryland, the Southern Maryland Higher Education Center and the Clark School).

D. Improve awareness, among our peers and the general public, of our research programs and faculty members. Establish an awards nominating committee in each unit to increase the number of nominations of faculty members for NAE memberships, national awards, editorships and society fellowships. Create a Clark School Faculty Fellows Program to support two to three external academic leaders in stays of six months to one year at the Clark School during which they would interact with faculty members and students; support Clark School faculty members with up to one year of teaching relief to pursue innovative research; and encourage Clark School faculty members to utilize support offered by the university's Vice President for Research. Create, through the Clark School communications department, an annual research video featuring for each research-active unit one significant research accomplishment. Increase the number of research press releases by providing better and timelier information about funded proposals to the Clark School communications department, which will produce releases in cooperation with units. Increase faculty participation in research awareness activities by including

metrics in the Faculty Activity Report for participation in press releases, award programs, conferences and workshops.

E. Increase ongoing development efforts to secure funding for research laboratories, named chaired professorships, graduate fellowships and facilities, including buildings, to bring the Clark School in line with peer institutions.

GOAL III.3: Taking advantage of its close proximity to Washington, D.C., the Clark School will strengthen its research programs by further expanding collaborations with national and international partners for mutual benefit, including the sharing of expertise and personnel and the use of advanced facilities.

[STRATEGIES]

A. Simplify the collaborative process by engaging the Engineering Research Advisory Committee (see III.1.B above), the dean and the university vice president for research in establishing blanket agreements with nearby government labs and corporations to support faculty collaborations with their researchers.

B. Increase interactions with nearby research funding agencies such as the Department of Energy, Department of Defense, National Science Foundation, National Institute of Standards and Technology and others, and improve our understanding of the funding process and priorities, by identifying faculty members to take Intergovernmental Personnel Act positions at those agencies, with appropriate incentives to ensure faculty members can maintain their research programs.

C. Increase awareness of the Clark School and its research by sponsoring on-campus technical conferences normally held at other venues in the Washington area for organizations whose research agendas complement ours. Assist faculty members in running both small workshops and larger-scale meetings.

GOAL III.4: The Clark School will employ its research enterprise in such a way as to increase substantially its role in entrepreneurship, technology transfer and commercialization, and venture creation, enhancing significantly the state's and the nation's competitiveness and fueling the region's economic development engine.

[STRATEGIES]

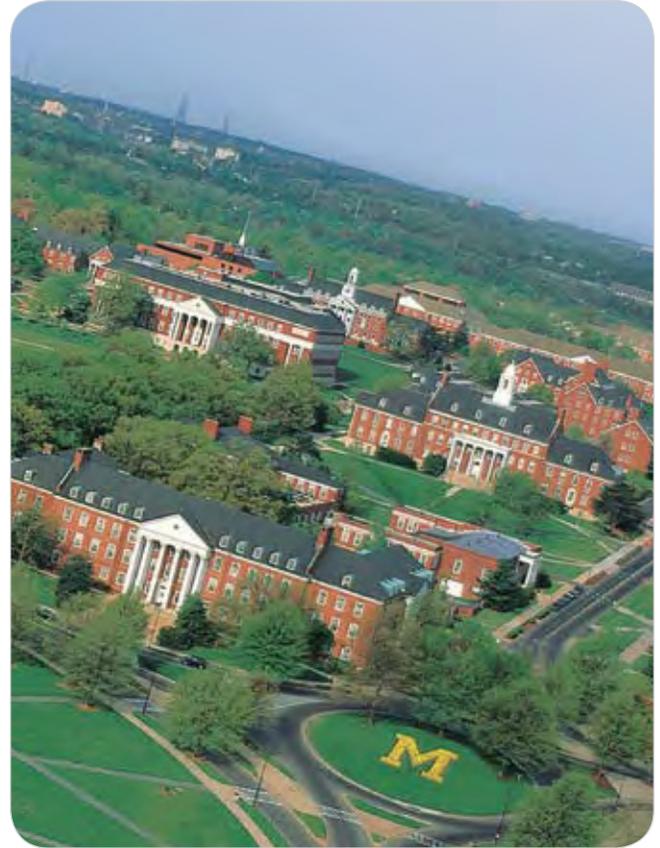
A. Further enhance the school's technology entrepreneurship programs (administered through the Maryland Technology Enterprise Institute), and attain international leadership status for them, by providing new entrepreneurship education opportunities to undergraduate and graduate engineering students; by working more closely with the College of Computer, Mathematical and Physical Sciences, College of Chemical and Life Sciences, the Smith School and the University of Maryland School of Law to expand and enhance programs; and by drawing on the experience and contacts of the Clark School's Board of Visitors, many of whose members have direct experience in starting and leading technology-based companies.

B. Foster a stronger culture of entrepreneurship and innovation among faculty members and students that focuses on uniting engineering research, knowledge of intellectual property concepts and the development of new companies through our Venture Accelerator and Technology Advancement Program incubator programs.

C. Expand our international research impact by creating a China Research Park near campus. Primary tenants will include corporations with headquarters in China.

D. Establish alliances with international universities to encourage exchange of undergraduate and graduate students, with a focus on entrepreneurial training.

E. Establish and promote a high school entrepreneurship program to educate young people about starting their own businesses.



VISION

The A. James Clark School of Engineering will become widely known for its excellence in international collaboration and outreach through its leadership of global research and education partnerships; active participation in educating a significant number of international undergraduate students; inclusion of an international component in the education of its undergraduate students; expansion of signature graduate education programs that leverage the existing distinctive advantages of the school and that have clear international applications; and placement of its doctoral candidates in positions of influence in prestigious academic and research institutions world-wide, as well as in positions of international influence.

GOAL IV.1: The Clark School will greatly increase the participation of its students in study, research, internships and especially service-learning experiences abroad.

[STRATEGIES]

A. Increase the percentage of Clark School students receiving academic credit for foreign study courses from 7% currently to 15% by 2014. Increase the percentage of Clark School students engaged in non-credit experiences (currently not tracked) to 25% by 2014. Apply these targets to the Clark School and to its departments.

B. Continue to collaborate with Engineers Without Borders, and form new collaborations with the Peace Corps and other service organizations, to develop experiential and service-learning opportunities abroad that complement educational programs and goals and mesh with institutional efforts and scholarly research. These opportunities will attract students who desire serious engagement with the greater social, cultural and scientific issues of our time. Through service-learning, students engage in integrative learning informed by service; help improve the quality of life in communities around the world; and develop skills, knowledge and positive attitudes for a lifetime of meaningful global citizenship.

C. At the department level, develop additional summer- and winter-term courses and term- or year-long programs

abroad. These programs will address significant issues, engage students' interest and enhance and fit seamlessly into academic majors and minors and General Education themes. Each department will identify one or more semester-long credit-bearing study abroad options for each of its undergraduate majors and develop a transparent mechanism for individual course approval. Each department will provide detailed online information to assist its students in selecting an appropriate program. Semester-long programs should allow students to study abroad for at least one semester and graduate with a bachelor of science degree in four years or a bachelor/master's degree in five years.

D. Develop additional funding from foundations, private donors and other sources to provide travel grants and support for students who might not otherwise have the resources to participate in international experiences. Deny no student an international experience because of cost or country of citizenship.

E. Hire adequate staff and provide resources to promote and coordinate international opportunities (including study, research, co-op, internship and volunteerism), assist in student placement, advise for study abroad through the Minor in International Engineering, and provide logistical and administrative support for faculty-led, short-term programs.

GOAL IV.2: The Clark School will greatly increase the global focus of its academic programs through curricular development, enrollment of international students, participation of international faculty members and the development of international collaborations.

[STRATEGIES]

A. By 2014 define elements of global focus for all Clark School departments and academic programs. Give an associate dean the mandate to guide, encourage, monitor and evaluate the school's progress in international collaboration and include this goal in each department chair's annual objectives.

B. Adjust the curricula of all departments and programs to encourage and easily accommodate study or experiential



learning abroad. Support foreign language study, possibly through CORE requirements, as a useful adjunct to other program goals.

C. Develop and implement a plan, based on the best practices of peer institutions, to recruit and retain academically talented students from abroad (as indicated in the recruitment goals of the Undergraduate Education section of this plan). Seek assistance from the international communities in Washington, D.C., international agencies and corporations. Seek scholarship funds to support international students.

D. Hire adequate staff to develop, for both students and faculty members, new international internships and expanded exchange programs with top universities abroad. These programs will be well-focused, have specific mechanisms and resources for implementation, include research exchanges and opportunities for students to work in local and regional projects across many disciplines and take advantage of existing international collaborations such as the Burgers Consortium in Europe.

E. Develop innovative curricular and technical approaches to facilitate educational programs offered in collaboration with universities and research institutes around the world. Create programs and activities to promote strong international culture at the school. Provide support for lectures and activities that bring well-known international scholars and thought leaders to the school and pursue opportunities to host talks by distinguished world visitors when they come to Washington.

F. Develop an international incubator in collaboration with the Maryland Department of Business and Economic Development. Through a targeted array of business services, state-of-the-art facilities and world-class resources offered by the incubator, connect international companies with Maryland companies, university researchers and students for successful joint ventures. Increase economic activity in Maryland as well as student internships with international companies, providing students with intellectual and cultural opportunities.



VISION

In keeping with the University of Maryland Strategic Plan, during the next five years the Clark School of Engineering will become as “networked” as any engineering program in the world, achieving distinction for the quality and breadth of its partnerships with other organizations and its academically-based engagement activities. The school will be recognized regionally, nationally and internationally for the impact and value of its service.

GOAL V.1: The Clark School will sustain and significantly increase the breadth, quality and impact of its partnerships, outreach and engagement initiatives that address critically important intellectual and societal issues.

[STRATEGIES]

A. By the end of 2009, develop a plan for maintaining and strengthening the partnerships, outreach and engagement activities of the Clark School’s Maryland Technology Enterprise Institute (Mtech), based on further enhancing the highly successful Maryland Industrial Partnerships Program, Maryland Technology Extension Service and Biotechnology Research and Education Program, and including specific goals and benchmarks to be updated annually.

B. Continue the development of an Mtech incubator for international companies. Engage Clark School and university faculty in new collaborations and students in international internships and other opportunities. Work with the Maryland Department of Business and Economic Development to attract and retain international companies capable of significant linkages with the Clark School faculty, staff and students.

C. Expand Mtech’s efforts in sustainability initiatives by supporting collaborative research and development of new technology solutions, creation of new enterprises in clean/green industry, engaging local companies and state authorities in providing energy assessments, and providing clean energy internship opportunities for Clark School students.

D. Develop new ways to provide experiential educational opportunities in technology entrepreneurship for undergraduate and graduate students, working more closely with other colleges (including the R. H. Smith School of Business) and drawing on the expertise of the Clark School’s Board of Visitors to enhance these efforts.

E. Further develop awareness of and appreciation for the partnership, outreach and engagement activities sponsored by the Clark School, Mtech and the Clark School’s departments, institutes, centers and laboratories. These efforts may include continued publishing of feature articles on such activities in the school’s *E@M Magazine* and other communications programs, and in Mtech’s and the departments’ and institutes’ own publications; continued preparation of articles about

outreach activities for national organizations such as *ASCE Prism Magazine* and discipline-specific conference publications; continued preparation and distribution of press releases concerning specific newsworthy accomplishments; reports and publications by faculty and staff members resulting from partnerships; and the designation of one or more additional faculty or staff members responsible for further promotion of such activities.

F. Continue to act as thought leaders in entrepreneurship, new venture creation and partnerships with industry by speaking at national and international meetings, hosting delegations of visitors, and disseminating best practices in technology-led economic development.

G. Further expand the Clark School’s non-credit entrepreneurship courses and programs to equip young students with the skills to launch and manage successful new ventures. Develop pre-college programs aimed at middle school and high school students interested in entrepreneurship and innovation.

H. Offer a series of professional education programs on a non-credit basis for aspiring entrepreneurs, small-business owners, and executives responsible for innovation and corporate venturing. The University of Maryland’s Robert



PARTNERSHIPS, OUTREACH AND ENGAGEMENT

H. Smith School of Business and the A. James Clark School of Engineering have partnered to deliver a groundbreaking executive education series that leverages the unique capabilities of these two world-class institutions. This jointly offered Innovation Management Program is designed to provide the tools and frameworks needed to succeed in an increasingly competitive landscape. Subsequent offerings may expand on this certificate and involve new course and certificate offerings.



1. Develop an Entrepreneurship Fellows Program based on the premise that most students who start companies do so at the place where they receive their terminal degrees. Design the program to keep the most entrepreneurial Clark School students at the university for their graduate and perhaps post-doctoral work; and to attract the most entrepreneurial engineering students across the nation for their graduate work and post-doctoral work. Continue to build the technology entrepreneurial culture in the Clark School; create new tech companies to populate the region; and bring national and international attention to the Clark School as a leading entrepreneurial engineering school.

The Clark School Strategic Plan 2009-2014 was endorsed by the Engineering Council and adopted by Dean Darryll Pines, October 15, 2009.

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