University of California, Merced
School of Engineering
Five-Year Strategic Plan (SP2015)

1. Introduction and Overarching Goals

The UC Merced School of Engineering (SoE) five-year Strategic Plan (SP2015) is outlined herein. The forwarded plan is based on an overarching strategy, which is summarized in Figure 1.

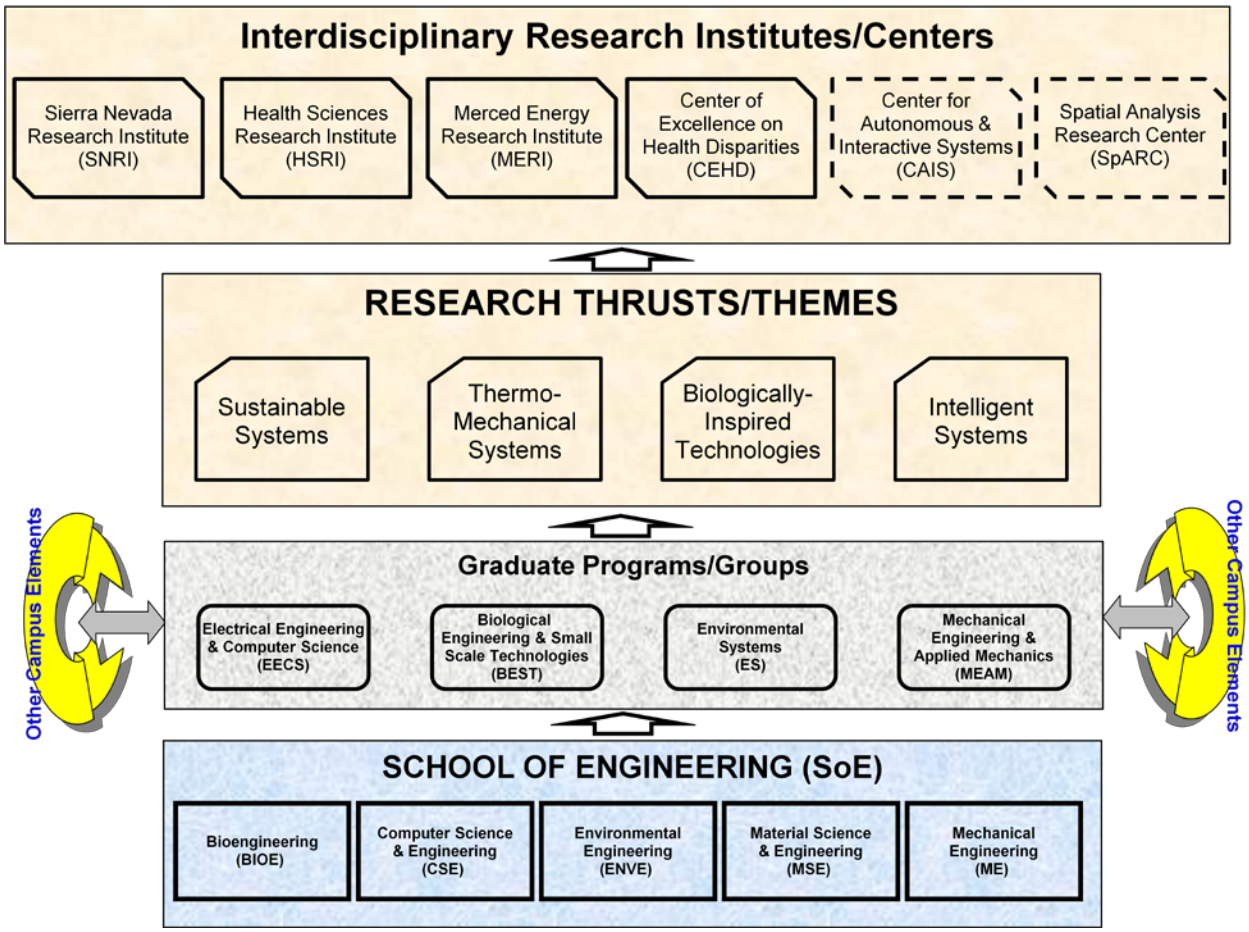

Figure 1. Guiding Strategy for the School of Engineering Strategic Plan.

The SoE faculty is organized in disciplinary groups, which align with their educational and research-related backgrounds as well as the current undergraduate SoE majors. The SoE faculty, along with faculty members from other schools, support four graduate groups/programs that are currently overseen by the SoE. Principal research and graduate program thrusts are organized in four broad interdisciplinary areas: 1) Sustainable Systems, 2) Thermo-Mechanical Systems, 3) Biologically-Inspired Technologies, and 4) Intelligent Systems. These emphases align the existing campus interdisciplinary institutes or centers, and new centers being proposed in the near future. The overarching strategy of the SoE faculty is consistent with the campus' 2009 Strategic Academic Vision.

This plan was formed by the SoE Resources Committee by synthesizing 1) input obtained during formal faculty meetings (bi-weekly), 2) information obtained from relevant research institutes and graduate groups, and 3) document exchange-review cycles that occurred from December 13, 2009 through February 15, 2010.

The SoE remains the smallest of the three Schools with a faculty numbering 31, or 26 regular full-time equivalents (FTE) when accounting for split and administrative appointments. This number constitutes about 26% of the ladder-rank faculty at UC Merced. Of the 31 faculty members, 14 are tenured and 17 are tenure-track. This faculty oversees 5 undergraduate majors and is affiliated with 4 graduate groups.

First and foremost, SP2015 reaffirms the SoE faculty commitment to building a world-class research university for the creation of new knowledge and the development of new technologies. The key success factors to achieve this goal are to: (1) hire the highest quality faculty (measured by their impact publications, awards, fellowships, service on editorial boards, etc.), (2) attract high quality graduate and undergraduate students, and (3) receive exceptional external funding.

However, we recognize the currently severe constraints on growth, especially with respect to faculty research space, startup funding, and the ongoing economic downturn in California. The status of the SoE and its assessable short-term goals for research and teaching are summarized in the following sections.

2. Proposed Milestone Goals

2.1. Research Goals

The SoE faculty continues to compete effectively for extramural support. Thus far during the 2009-2010 AY SoE faculty have been responsible for $0.8M to $2.3M per month of extramural funding, roughly 50 to 90% of the total campus award funding in a given month (Figure 2).

The SoE intends to improve upon this impressive effort in terms of both extramural funding and graduate student enrollment, both of which are a function of faculty size. Thus, additional FTEs are proposed in research areas that are either highly complementary to existing research strengths and increase multi-

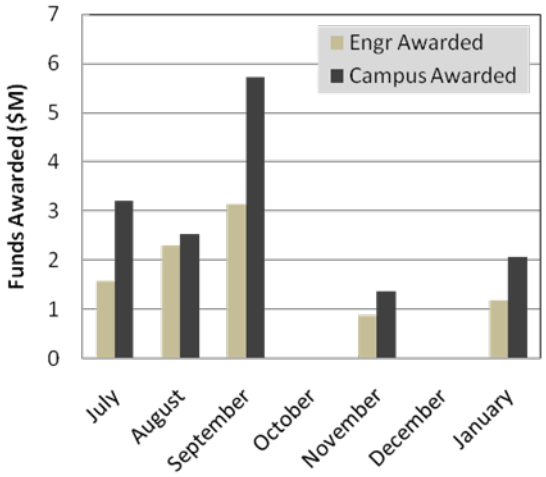

Figure 2 - Monthly contract and grant awards to SoE versus UCM Campus (data source: UCM Sponsored Research monthly activity reports).

disciplinary research opportunities. Although SoE investigators are rapidly becoming space-limited, they remain highly productive in terms of sponsored research. In the current academic year, SoE faculty have already exceeded $9M in awards, an amount which may be somewhat inflated by the availability of economic recovery funds in FY 2009-2010. However, it is realistic to expect an average of approximately $250,000 per year per SoE faculty member in absence of recovery funds from current and anticipated investigators. This average is similar to the current one and may be conservative as junior faculty mature and become more successful in acquiring grants. In addition, establishment of new interdisciplinary research centers (see Goal 2) is also expected to increase funding levels. However, it is important to note that space limitations in the near term may temper these affects.

SoE-Goal 1. **SoE investigators will maximize return on available facilities in the near term (SE2, Castle, and the academic surge building) by successfully competing for sponsored research awards amounting to more than $40M (direct + indirect cost) over the next 5 years.**

Interdisciplinary research and educational programs are central to the overall development of the UC Merced campus. During this planning horizon, the EECS faculty group intends to establish two new interdisciplinary centers, the *Center for Autonomous and Interactive Systems (CAIS)* and *Spatial Analysis Research Center (SpARC)*. Both of these centers are directed towards the Intelligent Systems thrust and the result of the maturing and growth of the CSE faculty, and collaborations with key researchers in our sister schools.

SoE-Goal 2. **SoE investigators will establish two new interdisciplinary research centers aimed at increasing research strengths and funding in the intelligent systems research thrust area.**

2.2. Graduate Enrollment Goals

Commensurate with the achieved research funding, the SoE faculty is also responsible for a significant fraction of the graduate student population, as about 76 of the 224 graduate students are affiliated with engineering faculty (34%). This represents an 11% graduate/total student fraction, compared to the other campus units (5.3%).

A projection goal for future PhD student productivity by the SoE faculty is shown in Figure 3. This projection assumes that the SoE faculty will grow at a rate of 4 regular FTE/year (full and partial FTEs), that each faculty member supervises an average of 3 PhD students, and that each junior and senior faculty member will graduate 0.20 and 0.40 PhD/year, respectively. These production rates are low relative to UC system wide productivity, which ranges from amout 0.8 to 1.0 PhD/faculty/yr, and may therefore be conservative. However, most of the graduate programs at UCM are at the developing stage and the typical rate of progress toward degree is not yet well-documented. Base on these estimates,

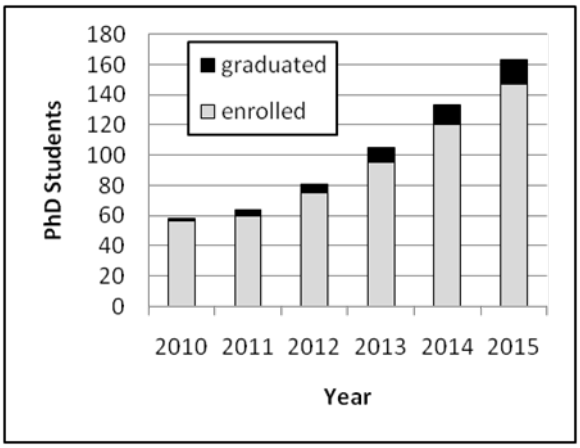

Figure 3. Projected PhD student enrollment by SoE investigators from AY 2009-10 (actual enrollment) to AY 2014-15.

the SoE faculty support the following School goal:

> ***SoE-Goal 3.*** **SoE investigators will be mentoring more than 160 PhD students and these students will complete 15 or more doctoral degrees during AY 2014-15.**

2.3. Undergraduate Educational Goals

Engineering majors remain popular at UCM, with several of the largest majors on campus being Mechanical Engineering (ME, 4th largest), Computer Science Engineering (CSE, 5th), and Bioengineering (BioE, 7th). We anticipate that these majors will continue to show strong enrollments. We also envision plans for increasing enrollments in other majors. For example, an expanded emphasis in Environmental Engineering (EnvE) on sustainably infrastructure is expected to create more interest in this major. Also, our Material Science & Engineering (MSE) faculty is building ties to the Bioengineering and Mechanical Engineering (bio- and energy materials) programs to strengthen their enrollments. Through prudent enhancement of these majors, the overall undergraduate enrollment goal is as follows:

> ***SoE-Goal 4.*** **SoE undergraduate majors will maintain its current fraction of undergraduate enrollment (approximately 18%), achieving a total enrollment of 950-1050 by AY 2014-15.**

Our main short-term undergraduate educational focus in the SoE is to (1) stabilize the curriculum in a sustainable manner so as to render short-term accreditation (ABET) is feasible, and (2) positioning ourselves for enrollment growth through modification of existing majors. One new major is being planned in the near term, the B.S. Engineering degree. However, as currently planned, this new major will have few resource implications because it will be designed to reside within the other majors. The motivation for this is that the ABET accreditation process is more feasible for this basic engineering major, and we anticipate that we can apply for accreditation approximately one year after the major is approved. Other majors for which accreditation is important (EnvE, ME), will follow later as they become able to expand their respective curricula. This leads to our second short-term SoE goal:

> ***SoE-Goal 5.*** **SoE will develop the B.S. Engineering degree program without encumbering new resources, and achieve ABET accreditation for this program by 2013, regardless of future faculty recruitment. Given successful faculty recruitment at the rates discussed herein, ME and EnvE will become ABET-accredited by 2015.**

Although no new majors are planned in the near term (beyond the B.S. Engineering mentioned above), we do recognize the need for an Electrical Engineering (EE) component in our curriculum. Initially, we plan to recruit faculty into the EECS group and charge them with creating an "emphasis area" within the existing CSE major. In fact, as the EE emphasis becomes more evident, we may decide to modify this major's name. When we have a sufficient faculty to support it, we can then develop the separate EE major.

To support the ambitious research and educational goals outlined above, additional FTEs in the form of regular faculty and lecturers will be needed. Given the near term resource constraints, recruitment must be highly strategic. The FTE recruitment plan proposed by the SoE is front-loaded over the next three years to insure against failed searches; it corresponds to an overall recruitment effort of 15 regular ladder faculty members, 5 cross-school positions, and 5 lecturers over a five-year period. It also assumes that all SoE administrative appointments are adequately compensated with respect to school teaching allocations. Projecting these assumptions over the next five years, accounting for regular promotions, leads to the projection shown in Figure 4. The SoE faculty will be composed of 55 regular faculty and lecturers (31 tenured (senior) faculty, 18 tenure-track (junior) faculty, and 6 full-time lecturers).

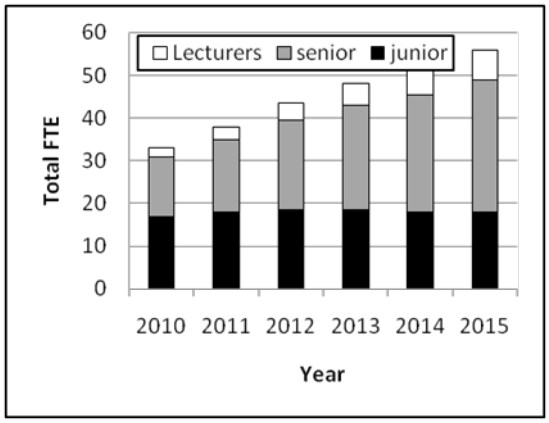

Figure 4. Projected SoE faculty number and distribution over the next 5 years.

In support of the aforementioned School goals, SoE proposes a steady hiring plan that respects short-term resource constraints. First, to immediately enhance program stability and existing research strengths in concomitance with the campus' Strategic Academic Vision, the SoE proposes 12 regular FTEs and 5 lecturers with potential security of employment (LPSoE)—see Table 1. Each of these positions is discussed further in program-specific context in Section 4 of this plan. The SoE faculty recognizes that this goal extends them beyond the three positions allocated for 2010-11. Each of these positions will require relatively modest startup and space as searches will focus on computational investigators. Furthermore, critical needs in all of these groups imply that "over-searching" is prudent as insurance against failed searches.

In addition to SoE FTE recruitment, and in order to enhance SoE synergy with other academic and research units, particularly the UCM management program, we propose the cross-unit hires summarized in Table 2.

Table 1. Summary of FTE Requests by the School of Engineering for the next three AYs.

Position	Graduate Research Program(s)[1]	Undergraduate Program(s)[2]
AY 2010-2011		
SoE-1. Computer Systems	EECS primary; MEAM, ES secondary	CSE
SoE-2. Energy Storage Technologies	MEAM primary; BEST, ES secondary	ME
SoE-3. Energy Materials	BEST primary; MEAM, ES secondary	BioE/MSE/ME
SoE-4. Physiological Modeling	BEST primary; MEAM secondary	BioE/MSE/ME
SoE-5. Stochastic Modeling	MEAM primary; ES secondary	ME/EnvE
SoE-LPSoE-1. EECS Lect.[3]	NA	CSE
SoE-LPSoE-2. Fundamentals Lect.	NA	ENGR
SoE-LPSoE-3. EECS Lect.	NA	CSE

[1] Recommended search committee to include primary (chair) and secondary graduate group or institute representations.
[2] Undergraduate teaching assignments will be in areas of greatest need at the time of the hire.
[3] A candidate for SoE-LPSoE 1 is currently under consideration.

	AY 2011-2012	
SoE-6. Computer Science Theory **SoE-7. Air Pollution Modeling** **SoE-8. Mechatronics** **SoE-9. Ecological Engineering**	EECS primary ES primary, MEAM secondary MEAM primary, EECS secondary ES primary, BEST secondary	CSE ME/EnvE ME/CSE EnvE
SoE-LPSoE-4. Lab/Design Lect. **SoE-LPSoE-5. Fundamentals Lect.**	NA NA	ENGR ENGR
	AY 2012-2013	
SoE 10. Intelligent & Adaptive Control **SoE 11. Environmental Biotechnology** **SoE 12. Computational Materials** **SoE 13. Biosensor Development** **SoE 14. Medical Imaging**	EECS primary, MEAM secondary ES primary, BEST secondary BEST primary, MEAM secondary BEST primary, EECS secondary BEST primary, EECS secondary	CSE/ME BioE/EnvE MSE/BioE/MEAM BioE/CSE/EnvE BioE/CSE

Table 2. Proposed cross-unit positions for the upcoming three AYs.

Position	Graduate Research Program(s)	Undergraduate Program(s)
	AY 2010-2011	
Cross 1. Information Management **Cross 2. Natural Resource Management** **Cross 3. Sustainable Building**	EECS, SNRI, UCMERI, QSB, Mgmt ES, SNRI, UCMERI, Mgmt ES, MEAM, BEST, Mgmt	CSE/Mgmt EnvE/ESS/Mgmt MSE/ME/EnvE
	AY 2011-2012	
Cross 4. Virtual Environments **Cross 5. Technology Management** **Cross 6. Media Arts & Technology**	EECS, SCS EECS, BEST, QSB EECS, CIS, World Cultures	CSE/Cog Science Engr/Mgmt CSE, Arts

3. Summary of Goals

A visualization of the milestone goals outlined in this Strategic Plan is presented in Figure 5. It is evident in reviewing this milestone chart, that the primary goal that must be achieved by the School of Engineering is growing the faculty. Unfortunately, the lack of research/office/instructional in the near term severely restricts faculty growth. Thus, the highest priority, both in the near-term and long-term, for the School of Engineering as well as the campus in general, must be to obtain additional research and instructional space to grow the faculty and the emerging student population.

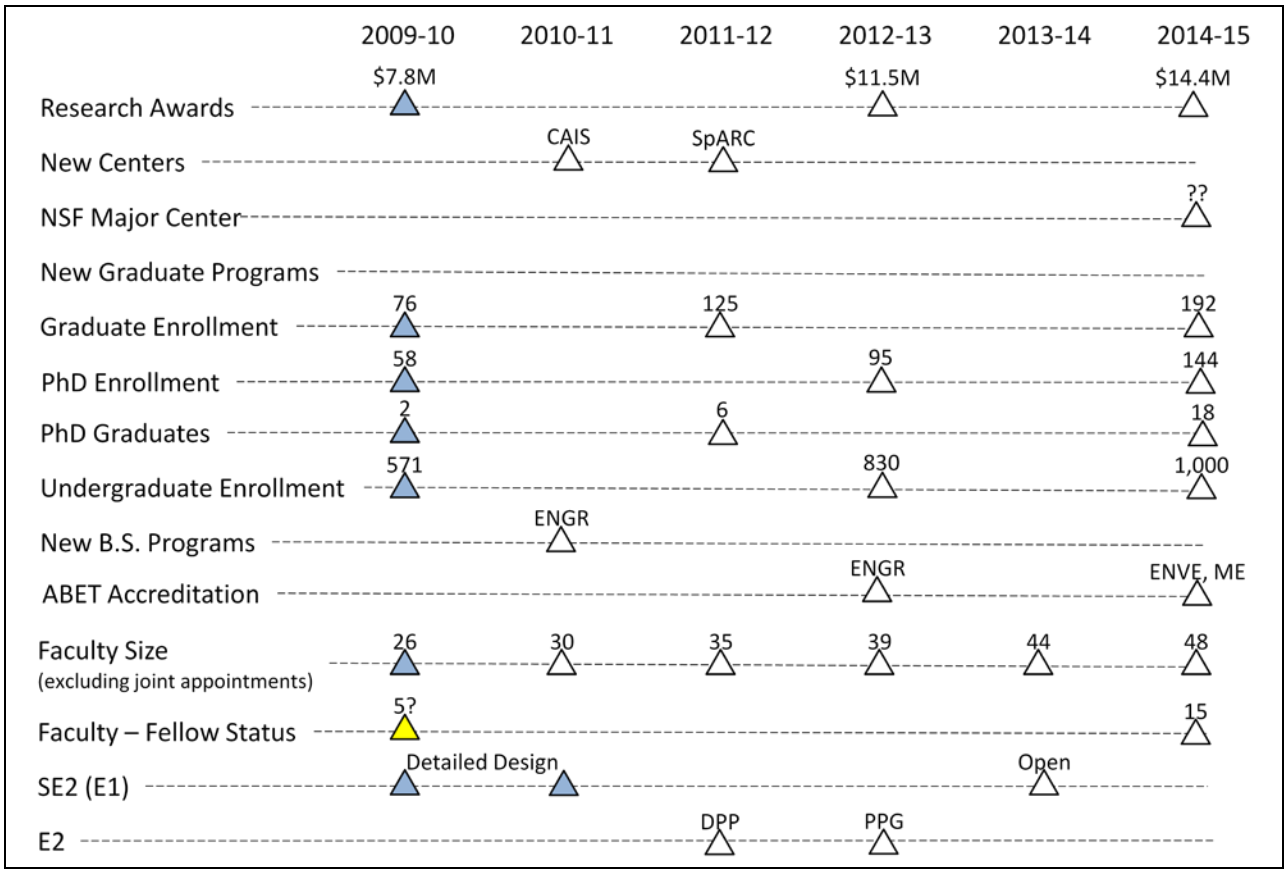

Figure 5. Milestone Goal Timeline for the School of Engineering

Appendix: Program-Specific Vision, Goals, and Rationale for FTE Requests

Electrical Engineering and Computer Science (EECS)

EECS Overview - The EECS faculty offer a popular undergraduate major in Computer Science & Engineering (CSE), as well as graduate degrees under the EECS and ***Cognitive & Information Science (CIS)*** program. EECS faculty members have diverse research interests with areas of investigation in artificial intelligence, computational neuroscience, computer animation and graphics, computer vision, machine learning, speech processing, robotics, and distributed networked systems.

These research themes frequently share a focus on ***intelligent systems***, and this focus has been consciously adopted by the group to build research excellence in a specific intellectual area. The EECS faculty regularly collaborates with colleagues in other fields across the UCM campus, contributing to interdisciplinary work in computational biology, environmental systems, and cognitive science. Indeed, the group has a strong bond to the CIS program, with several funded research projects spanning this cross-campus gap. The EECS program is critical to the success of UCM, playing a central role in implementing the campus' strategic focus on "Cognitive Science and Intelligent Systems", as highlighted in its *Strategic Academic Vision* document.

EECS Teaching Programs – The undergraduate CSE major is designed to provide students with both breadth and depth in the exciting and rapidly expanding fields of: *Computer Science* - the study of computation, including algorithms and data structures, and *Computer Engineering* - including hardware, software and network architecture. CSE is the 4th largest major on campus with an enrollment of 161 in AY 2009-2010). Given awareness of and demand for this major, undergraduate enrollment is expected to continue to grow as long as space and faculty are added to the program. From this perspective, it will soon become important to examine the tradeoff between increase in enrollment and selectivity for this program.

EECS Goals

EECS Research Goals - The EECS group has identified two main research goals, which it will pursue over the course of **t**he next five years:

- **Achieve High Levels of Research Productivity -** The EECS group seeks means to enable their faculty to achieve levels of research productivity comparable to researchers at other leading research universities. To assess progress toward this goal, counts of peer-reviewed journal publications and peer-reviewed conference publications.
- **Receive International Recognition as a Leader in "Intelligent Systems" -** Anecdotal accounts have already been reported of members of the broader academic computer science community recognizing UCM's strength in "intelligent systems". Our goal is to be recognized as an international leader in this field.

These goals may be refined over the course of the next five years, particularly with regard to how progress is evaluated. In an effort to both increase research productivity and receive international attention, the EECS group has adopted two more immediate goals. First is establishing the *Center for Autonomous and Interactive Systems (CAIS)*. This UCM Centralized Research Unit (CRU) has recently been proposed by EECS faculty members Stefano Carpin and Marcelo Kallmann. The center will coordinate shared resources and facilitate interdisciplinary research activities involving intelligent

systems. The EECS faculty expects to establish CAIS formally as a UCM CRU before the end of the 2010–2011 academic year. Second, EECS faculty member Shawn Newsam is actively developing the *Spatial Analysis Research Center (SpARC)* as a CRU. SpARC is a highly interdisciplinary focus that encompasses faculty from SSHA, NS, and other engineering faculty (Environmental).

EECS Teaching Goals - One of the leading goals of the EECS program is the **establishment of a CCGA approved EECS graduate program** and corresponding graduate group. There are a number of obstacles that must be overcome to accomplish this goal, including:

- The number of EECS research faculty must be increased to achieve a critical mass. At minimum, the group is expected to need 11–12 faculty members. If the current open senior position search is successful, and one new faculty position is created for EECS in each of the next three years, this minimal number can be reached by the end of the 2012–2013 AY.
- The number of senior EECS research faculty must be increased. Currently, the EECS faculty includes only one tenured member, and that individual has a heavy administrative burden (i.e., he is the Chancellor of UCM). Between the filling of a currently open senior position and the expectation of a number of successful promotions in the years to come, it is expected that at least a third of the EECS faculty will be senior by the end of the 2012–2013 AY.
- A curriculum of core graduate courses must be designed and regularly taught. These courses must span the fundamental topics central to a graduate education in EECS. The shaping of this curriculum is already underway. The recruitment of additional tenure-track faculty will be needed to ensure that these courses are offered on a regular basis, however. If planned requests for new EECS faculty positions are met, and if hiring for these positions is successful, a graduate curriculum of this kind could be ready by the 2012–2013 AY.
- A comprehensive CCGA proposal must be prepared. Given the additional faculty resources that will be requested, it is expected that the EECS faculty will have adequate time to prepare this proposal over the 2012–2013 AY.

In summary, successfully preparing a viable CCGA proposal by the end of the 2012–2013 academic year is a reasonable goal, but meeting this goal will require the allocation of additional faculty positions to EECS, at least one junior tenure-track position per year, as described later in this document.

The EECS **undergraduate CSE degree program** is currently established and has already produced graduates. With continued support for 2–3 EECS lecturers, and the creation of at least one additional tenure-track position, there are adequate labor resources to offer the current complete CSE curriculum. The EECS faculty has identified a number of important ways to improve the current curriculum, however, and these improvements will be needed to produce an undergraduate CSE program of international stature. The EECS faculty has identified the following goals with respect to undergraduate education:

- To modify the CSE curriculum, and augment the set of courses regularly offered, so as to produce an undergraduate training experience that is comparable in quality to those offered at our sister campuses.
- To continue to plan for a degree program in *Electrical Engineering (EE)*, beginning with an EE emphasis area with the CSE degree program, and (given adequate resources) to begin to implement this emphasis area

The quality of an undergraduate program is difficult to measure objectively. One might be tempted to use common university rankings, such as those provided by *U.S. News & World Report*, to evaluate such a program, but these rankings are often misleading. An alternative is to seek formal accreditation through an educational accreditation agency, such as ABET. The accreditation process is resource-demanding, however, and many leading computer science programs in the world do not seek accreditation. Thus, while ABET accreditation may eventually be sought, particularly if an electrical engineering major is

introduced, there are *no* plans to seek such accreditation during the upcoming five years. Lacking such an accreditation process, the EECS faculty could engage in a self-study activity, including the solicitation of input from distinguished faculty at our sister campuses, to formally evaluate progress toward a quality CSE degree program.

Priorities - The achievement of many of these goals depends upon the successful recruitment of new tenure track faculty members. The goals will be met naturally as newly hired faculty members do the jobs that they were hired to do. Still, situations may arise in which these goals are competing for resources or are otherwise at odds with each other. In preparation for these contentious situations, the EECS faculty has prioritized these goals as follows:

1.1.1.1. The establishment of a CCGA approved EECS graduate program.
1.1.1.2. Meeting our research goals.
1.1.1.3. Improving the curriculum for the CSE major, and complete the planning for an EE major.

EECS Current Academic Resources - The EECS group currently consists of 7.5 tenure-track faculty members and 2 lecturers. Of the tenure-track faculty, only one is tenured, and that individual has substantial administrative responsibilities (i.e., he is Chancellor of UCM). One member of the EECS faculty has a split appointment with SSHA, providing 0.5 FTE to EECS. Lecturers play a critical role in providing lower division computer programming classes, including classes for CSE majors (CSE 30/31), classes for all engineering majors (CSE 20/21), and even a class for students in other schools (CSE 5).

EECS Current Academic Resources – The current EECS group consists of 6.5 assistant professors. One faculty position and one LPSoE are being searched during AY 2009-10 in EECS. The EECS program currently occupies offices (converted to dry lab space) and 1 dry lab suite in Science and Engineering I.

EECS Envisioned Program by 2020 – We envision that the EECS program will comprise 13-15 ladder faculty members and 3-4 lecturers by 2020. The number of undergraduate (CSE, and potentially EE majors) will be around 300. We expect to have 50-60 graduate students in EECS program.

EECS Resource Requirements 2010 – 2015 – More facilities are needed for the EECS program to maintain its standard in teaching quality and research excellence as enrollments grow, and to develop an undergraduate EE program. Appropriate space allocation (dry lab) will be necessary for the recruiting of additional faculty members.

EECS Academic Resources Request (FTEs)

A five year plan has been fabricated for the hiring of new EECS faculty. That plan involves the following positions:

- **Computer Systems (SoE-1)**. During the 2010–2011 academic year, the EECS group proposes the creation of a new faculty position at the Assistant Professor level focusing on **Computer Systems**. The successful candidate for this position will conduct research related to the design and analysis of complex computer systems. Potential research areas include, but are not limited to: computer architecture, distributed sensing and monitoring, mobile computing, networking, operating systems, privacy and security, & ubiquitous computing. This position is critical for establishing international respect as a leading computer science program, as any strong computer science program will be expected to include a solid foundation in systems. Furthermore, this new faculty member is needed if a reasonable range of foundational graduate program core classes are to be offered on a regular basis. Such courses will be needed to produce a viable CCGA proposal. In addition to supporting EECS program needs, this position will likely produce fruitful cross-campus collaborations, though the nature of these collaborations is difficult to predict, given the ubiquity of complex computer systems in virtually every contemporary field of

inquiry. While laboratory space needs can vary widely among computer systems researchers, candidates who focus on software solutions are expected to require relatively small labs.

- **CSE Lecturer Team (SoE-LPSoE-1, SoE-LPSoE-3).** Lecturers are needed to cover lower division EECS classes, serving CSE majors, all engineering majors, and students from other schools. It may not be necessary to allocate any new positions to fill this need, as at least 2 Lecturers are currently employed in support of the EECS program. Indeed, a Lecturer with Potential Security of Employment (LPSoE) position was previously created, and we are currently attempting to fill that position. Should the current efforts fail, the EECS group recommends that such a position be re-advertised and filled promptly, supplying an individual who can manage all of the lower division CSE courses while teaching several of them. An additional 1 to 2 Lecturers will be needed to cover the remaining lower division courses. These positions should be made relatively permanent (i.e., LPSoE) in AY 2010-11 and 2011-12, at the latest, as we are extremely vulnerable in this area given the large number of students required to take these courses and the difficulties associated with rapidly identifying temporary lecturers in this area.

- **Computer Science Theory (SoE-6)**. During the AY 2011–2012, the EECS group proposes the creation of a new faculty position at the Assistant Professor level focusing on **Computer Science Theory**. The successful candidate for this position will conduct research in the mathematical foundations of computation. Potential research areas include, but are not limited to: computational complexity, computational game theory, computational geometry, computational learning theory, cryptography, networking theory, numeric optimization, & numerical analysis. This position is critical for establishing international respect as a leading computer science program, as our current faculty lacks a theoretician. This hire will also be expected to contribute to the EECS graduate program core curriculum, providing students with a graduate level survey of computer science theory. Contributions are also expected to the CSE undergraduate degree program, strengthening this program by providing automata theory, complexity theory, and other foundational courses.

- **Intelligent & Adaptive Control (SoE 10)**. During the 2012–2013 academic year, the EECS group proposes the creation of a new faculty position at the Assistant Professor level focusing on **Intelligent & Adaptive Control**. The successful candidate for this position will conduct research on the design and analysis of control systems, making use of methods from artificial intelligence, control theory, cybernetics, machine learning, and/or robotics. Potential application areas include, but are not limited to: active sensing, environmental control, intelligent transportation systems, mechatronics, power management, & robotics. This position is important for building the EECS program's reputation in "intelligent systems". This hire will also be expected to contribute to the set of EECS graduate courses, speeding preparations for a CCGA proposal submission. Note that this position also will contribute to the campus-wide focus on "Cognitive Science and Intelligent Systems", as highlighted in the *Strategic Academic Vision* of the University of California, Merced. Finally, since the field of control theory traditionally spans computer science, electrical engineering, and mechanical engineering, there is good reason to expect this position to additionally support the mechanical engineering programs in the School of Engineering.

- **Senior EECS FTEs.** During the 2013–2014 and 2014–2015 academic years, the EECS group proposes returning to efforts to recruit senior faculty members in EECS. Considering the difficulty that UCM has had in attracting senior EECS faculty, it is considered unwise to unnecessarily restrict the research focus of this position. Instead, any strong senior EECS researcher who can demonstrate synergy with established EECS faculty would be considered.

Strengths commensurate with developing the EE emphasis area within the CSE program, and eventually the EE degree program, would be particularly attractive at this point.

EECS Interdisciplinary and Cross-School FTE Requests

In addition to positions focusing on EECS priorities, the EECS group suggests a number of interdisciplinary, potentially cross-school, positions, including:

- **Information Management (Cross 1).** The EECS group proposes the creation of a new interdisciplinary faculty position at the Assistant Professor level focusing on **Information Management**. This position would involve research into database systems, decision support systems, automated information retrieval, and/or other technologies that are critical to modern Management Information Systems (MIS). The successful candidate would bring highly relevant technological expertise to UCM's evolving business management program, while offering core computer science knowledge to CSE majors. The creation of this position could substantially increase the employment prospects of UCM graduates, as database design and related skills continue to be in extremely high demand. Also, opportunities for industrial funding of research are expected to be (relatively) abundant in this domain.
- **Virtual Environments (Cross 4).** The EECS group proposes the creation of a new interdisciplinary faculty position at the Assistant Professor level focusing on **Virtual Environments**. The successful candidate for this position would conduct research on tools and applications for virtual reality systems, constructing digital "worlds" and facilitating seamless and fruitful interactions between these virtual spaces and human users. Application areas include, but are not limited to: computer game design, educational and training software, digital heritage, and social networking. This interdisciplinary domain lies at the intersection of fields like computer graphics and animation, human-computer interaction, human perception and motor control, human communication (including both natural language and gestural communication), and the humanities. This position would build on existing collaborations between faculty in EECS, faculty in Cognitive & Information Science, and other faculty in the School of Social Sciences, Humanities, and Arts (SSHA). With the help of this additional faculty position, these cross-campus research collaborations could quickly evolve into high-profile, innovative, and unique interdisciplinary programs, providing students with various backgrounds hands-on training in this rapidly growing field. With regard to EECS programs, this position could contribute to a "computer games" track in the CSE major, which would be expected to swell the ranks of undergraduates pursuing that degree.
- **Media Arts & Technology (Cross 6)**. The EECS group proposes the creation of a new interdisciplinary faculty position at the Associate Professor level focusing on **Media Arts & Technology**. The successful candidate for this position would develop and/or use innovative technologies in the service of artistic expression. The basis for such a program already exists in EECS, with two faculty members conducting research in related areas (3D modeling, computer graphics, computer animation, image-processing, digital libraries, multimedia). This position could seed programs in media arts and technology — programs that could easily become very popular at both the undergraduate and graduate levels. UCM's proximity to the San Francisco Bay Area, which has a tradition of art and technology interaction, would provide an additional stimulus for such programs. The space requirements for this position are expected to include modest dry lab space for a research studio and space for a motion-capture system, which could be shared among several of the faculty.

EECS Space and Special Equipment Requests

The EECS short- and long-term space needs will be fulfilled by existing dry lab space in Science & Engineering 1 and proposed dry/computational space in Science & Engineering 2. No special equipment is needed at this time.

Bioengineering

Bioengineering Overview - Bioengineering is a highly interdisciplinary field in which the techniques, devices, materials and resourcefulness of engineers are used to address problems in biology and healthcare; and lessons from biology are used to inspire design and inform progress in engineering. During the past 40 years, this synergy between biology and engineering has led to a wide range of implantable materials, diagnostic devices, sensors and molecular characterization techniques, and it has produced tools that greatly expedited the sequencing of the human genome. Along with these practical innovations has come a rapidly increasing need for personnel with the necessary hybrid skills to capitalize on them; undergraduate bioengineering programs have proliferated alongside the continued growth of bioengineering research.

The current bioengineering faculty members are affiliated with the **BEST** and **QSB** graduate programs. The faculty constitutes a strong research core which, with a few additions, can develop into a nationally competitive research cluster. The current faculty members have a wide range of expertise in physiological engineering, tissue engineering, regenerative medicine, biophysics and etc. The BioE faculty is committed to expand the research scope in the major to complement the research area of the current faculty.

The undergraduate major in **Bioengineering (BioE)** is designed to provide students with both breadth and depth in two exciting and rapidly expanding fields: tissue engineering and nano-bioengineering. The nano-bioengineering track reflects the strong synergy that exists between the "nano" and "bio" themes in engineering and science. The name also highlights an initial focus on things molecular, supramolecular, cellular and material, which will allow the program to draw efficiently on the talents of the biologists, chemists, physicists and other UC Merced faculty in basic engineering and science programs.

BioE Teaching Programs – Currently BioE program has only three faculty members. It is extremely difficult to deliver a major and a graduate program (BEST) with such few people. A consolidation effort has been made to prioritize the class offering in BioE. The plan will reduce the total required credits and incorporate electives from other areas (e.g., Mechanical and Materials Science Engineering) to maintain their undergraduate major while continuing to develop their graduate research program.

BioE Goals

BioE Research Goals – The research goal for BioE program is to maintain high level of federal and national funding as well as to publish peer-reviewed research articles in reputational journals.

BioE Teaching Goals – Bioengineering is a field including expertise in areas such as drug delivery, tissue engineering, medical imaging, physiological modeling, molecular engineering, biomechanics, bioinstrumentation and medical device developments. With sufficient faculty available, more diverse courses can be offered to undergraduate and graduate students in order to provide a comprehensive and broad bioengineering education experience. The teaching goals will be the program learning outcomes of the BIOE major reflect seven of UC Merced's eight guiding principles of general education.

BioE Current Academic Resources – One full professor and two assistant professors. BioE program currently has wet lab around 1.5 suites in SE1 building.

BioE Envisioned Program by 2020 – We envision BioE Program will have 7 to 9 faculty members. The number of undergraduate program will be around 150 to 200. We expect to have 20 to 25 graduate students in the BEST program.

BioE Resource Requirements 2010 – 2015 – More faculty members (3 more) are needed for BioE program to maintain its standard in teaching quality and research excellence. Appropriate space allocation (both wet and dry lab) will be beneficial for the recruiting of these additional faculty members.

BioE Academic (FTEs) Requests

To deliver the BIOE undergraduate program, 26 program specific credits have to be offered. These credits do not include engineering fundamentals courses, service learning, freshman seminars, or graduate courses. They also do not allow for multiple offerings of any course in an academic year.

BIOE has currently only 3 existing faculty positions that cannot realistically deliver 26 BIOE related credits (lecture and laboratory courses) in the foreseeable future. Using a model in which a faculty member would typically offer one fundamental/core course, one specialist/upper division course or one graduate course in a year (plus a freshman seminar and/or mentor a service learning team), it is clear that BIOE does not have the minimum number of faculty FTEs to deliver the major. In addition, BIOE is part of BEST (Biological Engineering and Small-scale Technology) graduate group and has to cover two required graduate courses and sufficient advanced elective classes (3-5) for BEST students.

Given the current limitation due to the economical recession, a minimum of three FTE are urgently needed as identified by the faculty in BIOE (listed in the priority order):

- **Physiological Modeling (SoE-4) -** We have been experiencing unprecedented advances into the complex nature of biological systems in recent years. Current advances in biology, genomics, proteomics, cellular level modeling methods, simulation capabilities, new technologies for imaging and measuring biological phenomena and molecular level interfacial characterization tools present the engineering community with unique opportunities to advance the understanding of these biological or even ecological systems to deliver desired functions. Currently the lack of involvement of engineering has hindered the complete understanding of the complex biological systems. Furthermore, there is a need to understand how the desired or additional functionality can eventually be accomplished and integrated over larger scales and complexities from cellular, organism to ecosystem level. Systematic modeling incorporating various engineering concepts such as optimization, database management, control and network formation based on large body of experimental results would lead to complete understanding of the non-linear nature of biological systems. Being an interdisciplinary field between engineering and biology, BioE has a strategic advantage in engineering to address this unique challenge and opportunity.

  Current the faculty members in bioengineering at UCM are experimentally oriented researchers. Modeling expertise at multiple levels is needed to tackle more complex biological projects. This requested multiple-scale modeling position will be at junior (assistant professor) level. This faculty member is expected to collaborate with the current faculty members to link various research areas to study specific biological/physiological problems from system point of view. This position will develop quantitative modeling and simulation methods that faithfully represent the complexity of biological/ physiological systems based on experimental data and deal creatively with the hierarchical and nonlinear nature of living systems. This position will integrative knowledge from various research fields to serve a focal point for faculty members from NS, ME and BIOE to collaborate on projects that cannot be addressed from the view point of a single discipline.

- **Recombinant Sensor Development (SoE 13) –** Recombinant protein sensor development has made tremendous progress in recent years. Various protein sensors that report wide range of physiological and biochemical information inside cells have been created. These protein sensors exhibit many different spectral characteristics depending on the need of the application. The area of recombinant sensor development is, by nature, cross disciplinary in that it employs cell culture methods combined with appropriate organic chemistry, biophysics, molecular biology, genetic

engineering, non-linear optics as well as nano-bioengineering. Moreover, this sensors can be genetically engineered in animals or gene delivered by electroporation or adenoviral transfection.

The Recombinant Sensor Development position could also compliment and synergize with the research of a number of faculty in the areas of Biophysics, Physiological Engineering, Stem Cells, Vascular Tissue Engineering, Nanotechnology, and Microfluidics/Microchip design. We expect that this faculty hire would contribute to our growing graduate program in BEST and Quantitative and Systems Biology Depending the particular area of research, this faculty position could possibly contribute to helping build a Stem Cell Clean Room Facility at UCM. We propose this position to be appointed at senior level (Associate or above).

- **Medical Imaging (SoE 14) -** Recent developments in optical/imaging techniques (such as ultrasound, MRI, PET, CT or IR imaging) clearly indicate the enormous potential of Medical Imaging in clinical applications. The imaging sciences are in the midst of a profound revolution that stems from new and fundamental advances in imaging, tissue engineering, biophysics, physiology and molecular and cellular biology. This is due in large part to the new technology and quantitative approaches developed in the disciplines of chemistry, physics and engineering. Due to its highly multidisciplinary nature, Medical Imaging technology presents a unique opportunity for Engineering at UCM. Our unique campus environment is an ideal location to cultivate Medical Imaging technology. This research area will apply tools in optics, physical chemistry, physics, computer sciences, electronics, nanotechnology and analytical chemistry for medical applications. The development of such technology enables many bioengineering research and clinical applications. Currently, there is no faculty with medical imaging background in BioE program. This proposed new hire will expand the research capacity and course diversity in our program. Medical Imaging research area represents an outstanding opportunity to involve faculty members in natural sciences, optical physics, bioengineering, materials science and engineering, mechanical and electrical engineering/computer sciences in a cross-disciplinary project.

  This position would compliment and synergize with the research of a number of faculty in many areas of research. Therefore, this position compliments the growing needs for graduate programs such as BEST or Quantitative and Systems Biology. It is proposed that this position will be designated at the rank of full professor.

BEST Interdisciplinary and Cross-School FTE Requests - none

BEST Space and Special Equipment Requests – none

Environmental Engineering

EnvE Overview - The San Joaquin Valley has experienced substantial population growth and with it the scarcity of water and deterioration of air quality. Today, the San Joaquin Valley harbors the most polluted air in the United States causing adverse health effects particularly among children and the elderly. Most lakes are gone, rivers have dried up and water diverted from the Sierra Mountains has been channeled into a vast agricultural irrigation system and drinking water supply for the nearby and distant urbanized centers. With climate warming, less and less rain is expected to fall in the mountains, already causing great distress in the Valley. Consequently, there is a great need to research stressors of environmental systems in the Sierra Nevada/San Joaquin Valley and to develop engineering as well as social and policy solutions to restore and maintain the beauty and natural resources of this part of California. Today, California faces challenges of how to sustain and restore natural systems as these stressors – climate change and drought, air pollution, intense agricultural production and population growth – put ever-increasing demands on both the San Joaquin Valley and Sierra Nevada ecosystems.

Environmental engineers and hydrologists within the Environmental Systems graduate program are distinguished from other environmental professionals through their focus on problem solving, design and implementation of technological or management systems. Environmental engineers search for creative and economical ways to use resources efficiently, limit the release of residuals into the environment, develop sensitive techniques to track pollutants once released and find effective methods to remediate spoiled resources. They serve as the vital link between scientific discovery, technological development and the societal need for protecting human health and ecological integrity. In the coming decades, environmental engineers will increasingly be called upon to address broader issues of environmental sustainability by minimizing the release of residuals through altered production processes and choice of materials; by capturing the resource value of wastes through recovery, recycling and reuse; and by managing natural resources to meet competing societal objectives.

Environmental Teaching Programs - The undergraduate major in ***Environmental Engineering (EnvE)*** prepares students for careers in both industry and government agencies concerned with managing water, energy, public health and the environment. The program also provides an excellent foundation for further study in Earth science, engineering, business, management, law and public health. The curriculum provides students with a quantitative understanding of the physical, chemical and biological principles that control air, water and habitat quality and sustainability on Earth, along with expertise in the design, development, implementation and assessment of engineering solutions to environmental problems. The program emphasizes a highly interdisciplinary approach to environmental engineering, combining a strong theoretical foundation with field studies, laboratory experiments and computations. Core courses within the major provide students with a firm foundation in the physical and life sciences and the ways that they apply to energy, hydrology, air and water quality issues.

In addition to serving its majors, the EnvE program provides a large service course for SSHA in terms of EnvE 10 The Environment in Crisis (Gen Ed science and laboratory units for non-science and engineering majors). The program also offers an upper division writing-intensive environmental policy course, EnvE 118 Global Change, which may be modified in the near future to serve as an acceptable substitute for CORE 100.

The ***Environmental Systems (ES)*** graduate program is one of the first and truly interdisciplinary graduate programs jointly with the School of Natural Science (SNS). The program offers individualized, research-based courses of study leading to the M.S. and Ph.D. degrees and is the first and only graduate program at UCM that achieved UC system approval. Through the interdisciplinary ES graduate group, ENVE is affiliated with the Sierra Nevada Research Institute (SNRI), the powerhouse for ecological and environmental research geared towards sustainability of the Sierra Nevada and San Joaquin Valley.

EnvE Research Programs - Environmental engineering graduate research is an integral and complementary part of the interdisciplinary environmental systems program at UC Merced administrated jointly by faculty from the School of Engineering and School of Natural Science. The role of environmental engineering is to connect and translate research into workable environmental engineering solution. Environmental engineering has three main focus areas:

Hydrology - Hydrology focuses on the sources, balance and use of water in both natural and managed environments, including precipitation, mountain snowpack, river runoff, vegetation, water use and groundwater. Both the physical and chemical aspects of the water cycle are included. Water resources are experiencing unprecedented stresses, owing shifts in temperature and precipitation patterns associated with climate change, as well as shifts in land use and land cover in response to growing populations.

Water quality - The water quality area focuses on engineering solutions to water and waste issues, including measurement technology, water quality assessments, treatment systems and remediation of contaminated waters. Physical, chemical and biological aspects are included.

Air Pollution - This focus area investigates solutions to air quality in a regional setting. Air pollution focuses on issues arising from primary emissions within different regions of the United States. Recent

areas of research included: Pittsburgh, Baltimore, and the San Joaquin Valley and its precursor airflow corridors. A key focus is on particulate matter released from primary direct emission point and fugitive sources as well as the atmospheric chemical gas-to-particle conversion added by photochemistry.

S**ustainable Energy -** Current research focuses solutions to energy problems, both regionally and globally. Solar energy research includes the development of medium-temperature solar thermal collectors and a project to initiate the development of a novel cost-effective concentrating photovoltaic system.

Environmental Policy - Policy effect of climate change on wildfires and effect of emission trading systems due to interaction between environmental policies and industry activities.

Environmental Geographical Information System - Application of geospatial techniques in solving large-scale ecological and geographical problems, with emphasis on the effects of invasive species, climate change, and human disturbance on terrestrial ecosystems.

EnvE Goals

1. Grow Research by Focused Investment in Faculty Hires in Key Areas - Similarly to all academic programs at a growing new university that has been hit by this economical depression, the environmental engineering program growth is delayed, resulting in reduced research synergism in key areas that have to overcome in order multiply the impact of the current research endeavors.

2. Obtain ABET accreditation for EnvE Undergraduate Program by 2015 - The growth of our undergraduate program as well as the quality of students is substantially reduced because the program is not ABET-accredited. To achieve the level of breath and depth needed for our environmental program to pass the accreditation hurdle as well as to serve our ES graduate program and conduct world class research, additional faculty are urgently needed that will fill key gaps in expertise and research. As soon as the environmental engineering program is accredited, more and better prepared students will join our program that would otherwise not come given the professional implications of having an undergraduate engineering degree from a not accredited institution.

3. Enhance interdisciplinary and cross-disciplinary research initiatives - The graduate program, ES, environmental engineering faculty are associated with is truly cutting across disciplines, including SNS and SSH. The ES program is highly link with research and academic activities under the umbrella of SNRI. Already several EnvE faculty are partners in the UC Merced Energy Research Institute (MERI). The Health Science Research Institute (HSRI) was founded in 2009 and is expected to involve faculty members across many disciplines, including EnvE. O thers are associated with the UC Merced Spatial Analysis and Research Center. As the university grows in faculty numbers, diversity, capabilities, and space, more cross-disciplinary research initiatives will natural follow. Here, the metric of success will be measured by (a) faculty linkage and number of interdisciplinary research that otherwise could not have been obtained, and (b) total competitive research funding of these centers and initiatives.

4. Maintain high-level of research productivity - Scholarly productivity is a key outcome measure together with national and international reputations of our faculty researchers. To fuel further high level of research productivity, potential research links that are currently not available due to the missing expertise have to be filled with strategic faculty hires.

5. Develop Civil and Sustainability Engineering - The world is changing quickly. Already, with the global challenges of climate change, population growth, and diminishing resources, the need emerges to face these challenges and develop new sustainable technology, housing, materials, transportation systems, and energy systems. To face these challenges, civil engineers with a deep conviction towards sustainability have to be educated, providing the SoE at UCM with a great potential of building an undergraduate program in civil/sustainability engineering. To have a viable Civil engineering undergraduate program, at least three focus areas are needed. Here at UC Merced, we already have environmental engineering and hydrology. What is needed to complete a viable undergraduate program is hires in the areas of sustainable structures, building materials, and transportation systems.

ENVE Outcome Metrics

3.1. Research Assessment

- Funding increase
- Funded and unfunded graduate research projects
- Graduate degree production increase
- Number of publications in peer reviewed journals and journal impact factor

3.2. Education Assessment

- Substantial enrollment increase (comparably staffed Civil & Environmental Engineering programs nationwide are roughly double the size of the current Environmental Engineering program).
- The EnvE program assessment plan includes continual course and program level assessment vehicles culminating in a periodic self-evaluation and review by the Accreditation Board for Engineering and Technology (ABET).
- Number of undergraduate students participating in research.
- Number of doctorial students and graduation rates.
- Number of woman, minority and U.S. citizen graduate applicants.

EnvE Current Academic Resources – Six full professor (2 of which have full administrative appointments), one associate professor, and four assistant professors (2 of which have 0.5 appointments in SoE), for a total count of 7 FTE. This group occupies wet and dry lab research space in SE 1.

EnvE Resource Requirements 2010 – 2015 – In the short term, two more faculty members (ecological engineering, air pollution modeling) would greatly assist the EnvE program as it moves toward ABET accreditation and would also better position the EnvE and Environmental System group to compete for interdicisplinary research projects. Several other faculty lines shared with the management program efforts would also help to initiate the sustainability effort discussed below. Appropriate space allocation (both we and dry lab) will be beneficial for the recruiting of these additional faculty members.

EnvE Envisioned Program by 2020 – We envision that EnvE program (by then, the Civil & Sustainability Engineering) will have 10-12 faculty members (including split appointments). The number of undergraduate program will be around 150-200. We expect to have 60-80 graduate students in the ES program.

ENVE Resources Requirements 2010 – 2015 – Critical academic resource requests are based on (1) need to obtain critical faculty numbers to achieve ABET accreditation, (2) continued build up of research capacity in existing research areas, and (3) responding to global challenges, sustainability engineering faculty is needed to respond to novel research needs and societal demands.

ENVE Academic Resources (FTEs) Request - For the next 5 plus years, environmental engineering group has two areas of need: (1) filling gaps that currently limit the teaching and research, and (2) expand into sustainable engineering/civil engineering. Given the limited space and resources available for the next years due to the recession, the priority has been placed on filling gaps in our existing research and teaching programs and delay the buildup of sustainable engineering until 2015. The top four priorities of FTE positions for 2010-13 are as follows:

- **Ecological Engineering or Ecohydrology (SoE-9) -** We recommend an assistant or associate level search for a faculty member who uses engineering principles to design **sustainable systems that integrate human activities with the natural environment**, with particular emphasis on the linkage between hydrologic and ecological systems. Possible areas of research emphasis include interactions among hydrologic, biogeochemical, physiological, and soil processes; hydrologic

ecosystem services, integrating water quality, water cycling; spatial analysis and scaling. Use of remote sensing, field-based measurements, laboratory experiments and modeling are all of interest. As a discipline, ecohydrology addresses the bi-directional regulation of hydrologic and ecological processes, e.g., the flow regime and pollutant levels of water in wetlands regulate the species and the populations that live in the ecosystem, while ecological processes in the wetland regulate the timing and magnitude of water and nutrient fluxes through the system. Ecological engineering involves the design, construction, restoration and management of aquatic and terrestrial ecosystems that have value to both humans and the environment, using principles from engineering, ecology, economics, and natural sciences. The extensive and large-scale ecosystem restoration efforts planned in the Central Valley provide excellent opportunities for both natural laboratories, and research support through applications partnerships with local landowners and conservation entities. Similar efforts are being carried out across the Western U.S. This position would have collaborative opportunities and synergy with Campbell, Bales, Conklin, Harmon, Guo in SoE and Aguilar, Dayrat, Keepers, O'Day, Traina in SoNS.

- **Air Pollution Modeling, Management and Control (SoE-7) -** We recommend an assistant or associate professor position, preferably someone with both a management and technology focus in the area of air quality engineering. A background in mechanical engineering is desirable. This position could focus on engineering design of systems, technology for air pollution control, or modeling and impacts of air pollution. California's Central Valley offers an excellent natural laboratory for research to devise air pollution control systems. Organic and inorganic particulates, persistent organic pollutants, and precursor gases for ozone formation are produced during routine agricultural practices and weekday commutes. These pollutants are lofted into the atmosphere to interact with other chemicals or microbes and are eventually deposited in the respiratory systems of humans and animals, as well as on plant leaves. The resulting effects on human and ecosystem health are devastating. A significant air pollution-related research effort aimed at the understanding and mitigating the escalating air quality problems in the Central Valley, Sierra Nevada, and elsewhere has already been initiated in the Environmental Systems graduate group. This new position could also be helpful in understanding the effects of air quality on climate and of climate policy on air quality. This position is central to our developing strength in the air pollution area, and is an excellent complement to research by Rogge, Traina, Westerling.
- **Environmental Biotechnology (SoE 11) -** We recommend an assistant or associate professor position who has extensive experience in urban and agricultural wastewater treatment, advanced treatment techniques, remediation, and expertise in toxicology. This person could also contribute to environmental bioengineering. The San Joaquin Valley is one of the fastest growing areas within the US and likewise harbors the most intensive agricultural industry in the Nation. Consequently, not only the quantity of water is an issue, but also the quality of water for households, crops growing and animal husbandry in large concentrated animal feeding operations. A great portion of the wastewater produced during agricultural activities is more or less released to the environment with little or no treatment.

ENVE Cross-School FTE Requests

- **Natural resource management** (**Cross 2**) **-** It is recommended that a tenured faculty member at the full or associate professor level be hired in this area. It is expected that this person would help lead the planning for a natural resources management track within the proposed management program and eventual School of Management. A research emphasis on water, forest, or range would complement existing faculty and help fill an important niche in the UC system. This person could also contribute to planning for a Center for Spatial Analysis that is being investigated by faculty in SoE and SSHA, contribute to developing a Geography degree at UCM, and contribute to refocusing of the Earth Systems Science degree in the School of Natural

Sciences. At the graduate level, a number of discussions have taken place around starting a program in Public Lands Management, with linkages to the NPS, USFS and other land-management agencies; and this person could also anchor that program. This position should complement Hart, who has some expertise in this area, having been on the faculty in natural resource programs for 19 years before coming to UCM; Hull, who has 20 years experience in cultural resource management, and potentially UCM's World Heritage program.

Materials Science and Engineering

Materials Science and Engineering (MSE) applies fundamental principles of physics and chemistry to designing materials with desired combinations of mechanical, optical, electrical, magnetic, electrochemical and other properties. Increasingly, innovative materials are being developed with the benefit of lessons that have been learned from nature. Examples include armor based on the structure of abalone shells and rats' teeth, optical materials that owe a debt to sea urchin spines and peacock feathers, high-performance ballistic fibers modeled on spider silk, self-cleaning surfaces copied from lotus leaves, and strong, reusable adhesives that emulate the behavior of gecko feet. Also encompassed in MSE are the methods by which particular atomic and molecular arrangements (nanostructures and microstructures) are achieved, the overall cost of the ingredients and processes used to produce particular materials, the effects of the environment on materials, the effects of materials and materials processing on the environment, and characterization of materials structure and properties. Because MSE embraces skills from physics, chemistry, mathematics and biology, it is especially appealing to anyone who enjoys interdisciplinary studies and who seeks to apply such knowledge to solving practical engineering problems.

Energy and sustainability have both been identified as leading research priorities for the School of Engineering and the UC Merced campus, while plans are underway to consolidate the SOE undergraduate curriculum to offer a more streamlined set of courses at the undergraduate level and expand course offerings at the graduate level. Strategic planning for MSE is focused on 1) building critical materials expertise into the energy and sustainability research themes of UC Merced, and on 2) supporting instructional programs *across SOE* and *the campus* at the undergraduate and graduate levels.

Energy and Sustainability Materials Research - Rising industrialization of developing countries in response to economic globalization since the late 1980s and population growth have contributed greatly to an unsustainable demand for energy and raw materials for manufacturing. China, in particular, is on track to become the top manufacturing nation in the world by 2020, and by some estimates has already become the world's second largest economy after the United States. This manufacturing capacity, initially spurred by export demand, is increasingly geared towards meeting the internal demands of a rising middle class in a nation in excess of 1.3 billion people.

Among the plethora of possibilities for materials research in energy and sustainability that exist, some key areas that are synergistic with present efforts by other disciplines in SOE and across campus have been identified for development within MSE over the next 5-10 years. These include 1) energy materials, 2) sustainable manufacturing, and 3) sustainable building.

Energy Materials - Although energy materials research has many disciplines that contribute to it, the relationship between structure-properties-processing-application is a special focus of Materials Science and Engineering that gives it a strong engineering design component that is particularly relevant to the energy industry where many new technologies have not been adopted due to cost, processing, maintenance or other engineering constraints. Tto leverage the existing strength of UC Merced in non-imaging solar optics and other energy conversion technologies involving high temperature processes, as well as in nanotechnology, we propose to focus faculty hires in the areas of high temperature materials (relevant to receiver materials for high-temperature solar concentrators and solid-oxide fuel cells), nano-enabled energy technologies, and modeling of processing pathways for the synthesis of new metastable energy materials. The first two areas are experimental in nature, but have only modest dry laboratory

space needs due to our ability to leverage existing shared resources in nanofabrication and characterization. The third area is theoretical in nature and only requires computational resources that are available through shared faculty computer clusters on campus or national computational facilities.

MSE at UC Merced already has a primary research thrust in energy materials, however at present there are only 3.4 faculty in MSE (one faculty member, Christopher Viney, has administrative responsibilities as the Vice-Provost for Undergraduate Education and as the Dean of College One). Jennifer Lu studies the synthesis of carbon nanotubes and other nanostructures and nanomaterial-based composites for photovoltaic , battery, and energy-scavenging applications. Lilian Davila models the structure of silicates to understand and predict their properties, and her results have been applied to studying diffusion in 17 silica zeolites (applicable to sequestration of nuclear waste) using computer simulations and thermochemistry data, failure mechanisms of optical lenses at the National Ignition Facility at LLNL (nuclear fusion studies), and silica nanowires (hydrogen and energy storage, biological and chemical sensing with NEMS). Christopher Viney's research fits into the broad concept of energy materials and sustainability, in that bioinspired materials guide us towards efficient, sustainable use of matter and energy through environmental benign processing routes. Valerie Leppert specializes in materials characterization in the electron microscope, which is pertinent to all fields of energy materials research.

Sustainable Manufacturing - Sustainable Manufacturing seeks long-term alternative technologies, processes, materials, chemicals, and/or products so as to reduce pollution and waste, and create sustainable solutions. Its practice requires expertise in environmental regulations, recycling, life-cycle assessment, economic analysis, green chemistry and toxicology. Sustainable Manufacturing practice is rapidly becoming a necessity for companies engaged in manufacturing and several programs have recently begun cropping up around the country to meet industrial demand for training in this emerging field. Since the field is just developing, there is an opportunity at UC Merced to create a competitive research program in Sustainable Manufacturing that leverages the Sierra Nevada Research Institute and existing research and instructional programs in Environmental Systems, Biological Engineering and Small-Scale Technologies, Mechanical Engineering and Applied Mechanics, Computer Science and Quantitative Systems Biology, as well as the nascent School of Management.

To build a sustainable manufacturing program, expertise is needed in <u>life cycle and cost-benefit analysis of materials and manufacturing processes</u>, and <u>modeling of synthesis routes (often bio- or geo-inspired) to new metastable materials that reduce the use of energy and rare metals</u>. Both areas of research are computational in nature and have modest space and resource needs that can be met by shared faculty computer clusters or national computational facilities.

Sustainable Building - Sustainable building is an emerging area of interest for resource conservation, with a growing number of government agencies offering incentives for its practice. In addition, sustainable building is one of two research areas for the FY2010 Emerging Frontiers in Research and Innovation (EFRI) research program funded by the National Science Foundation. (The EFRI program was established by the Directorate for Engineering at NSF to focus on important emerging areas of research in a timely manner.) Green building materials are an important component of sustainable building practices that offer reduced construction costs, reduced maintenance and replacement costs over the life of the building, energy conservation, improved occupant health and productivity, and lower costs due to flexibility in design for specific occupants. The research emphases described above for sustainable manufacturing and energy materials can also contribute to a sustainable building focus in MSE. For example, a faculty with expertise in material lifecycle and cost-benefit analysis can contribute analysis of the resource efficiency of proposed green materials, while expertise in energy materials can contribute to the identification and development of cost-effective methods of conserving or harvesting energy in buildings. In addition, we would like to <u>build expertise in structural materials with MSE</u> to further the development of new green building materials that reduce the use of nonrenewable resources and environmental degradation. This position can be computational in nature or requiring only modest dry laboratory space due to shared materials synthesis and characterization equipment in MSE.

MSE Support of Instructional Programs - The 3.4 faculty allocated to Materials Science and Engineering have designed an efficient curriculum with five required MSE courses for undergraduate MSE students that allows the program to still make a significant contribution to several instructional programs in engineering and across campus.

In additions to serving their major and the BEST graduate program, the MSE faculty is making extensive contributions to engineering as a whole and general education. With consolidation of the undergraduate engineering curriculum in order to offer an ABET accredited General Engineering degree with specialist tracks and further streamlining of courses for the MSE major, it is expected that contributions to programs outside of MSE and the BEST graduate program will increase. Only two courses (MSE-111 and MSE-119), each offered every two years, will exclusively serve MSE majors in the future (this represents 1/7 of the MSE teaching capacity each year). Every other course offered by MSE will satisfy requirements for engineering students in other majors or in the general engineering program. MSE-111 is needed for the BEST graduate program, because graduate students for BEST are drawn from diverse disciplines and need some training in materials processing via the graduate cross-listed course for MSE-111, BEST-211 (CRF to be submitted to GRC). MSE-119, with a focus on modeling of mechanical properties, may additionally be of interest to other majors. MSE faculty will continue to contribute to General Education.

Outcome Metrics

Resources Requirements

Academic resource requests for MSE are based on the discipline's contribution to energy and sustainability research themes at UC Merced, its contribution to instructional programs across SOE and general education, its undergraduate and graduate teaching needs, and its contribution to student recruitment and retention through the COINS undergraduate research program (described above).

MSE Academic Resources (FTE) requests

- **Energy Materials (SoE-3) -** We are requesting an FTE at the Junior/Senior level to be housed in MSE for High Temperature Energy Materials, specifically ceramic materials, as priority for Year 1. This person will contribute to research efforts in energy conversion technologies (e.g. receiver materials for solar concentrators and solid oxide fuel cells) and secondarily, to a possible future program in sustainable building. He or she can also contribute to MSE, Engineering, and General Education instructional responsibilities as detailed in MSE's 5 year strategic plan. This position (the only experimental one that MSE is requesting over the next 3 years) has modest dry laboratory space needs and start-up costs due to shared characterization facilities (DTA, DSC, AFM, XRD, TEM, SEM). The only major experimental need is likely to be for high and mid temperature furnaces for synthesis and processing that can be accommodated on laboratory benches and venting to the hood exhaust system (this equipment does not need to be placed in a hood, it only requires hook-up to the hood ventilation system). Space needs and start-up costs are detailed in the SOE FTE request table.
- **MSE-6: Computational Materials (SoE 12) -** An FTE in computational materials at the Junior/Senior level, centered on modeling of metastable materials processing is requested as a priority in Year 3. This hire would contribute to ongoing efforts in energy and sustainability through the design of new materials for energy and replacement materials for manufacturing/building sustainability. Modeling assists the development of new materials through identifying efficacious metastable pathways for materials synthesis and processing that may be inspired by nature, as well as identifying new processing techniques that can be used to improve the recyclability of materials (pressure fabrication of hard plastics vs. thermosetting that allows recycling of hard plastics, for example). There are also collaborative opportunities with cognitive science that explore the use of materials visualization for materials teaching and

learning. Since this is a computations position no experimental laboratory space is needed (only space to house computers and researchers). Start-up costs are minimal, with shared computer clusters or national computational facilities available. Specific space needs and start up costs are detailed in the SOE FTE request table.

- **Sustainable Manufacturing Management (Cross 3)-** We are proposing an opportunity hire in Engineering to contribute to development of the School of Management, specifically to allow the establishment of a Sustainable Manufacturing Management program (described in more detail in the 5 year strategic plan) that can leverage existing courses across multiple instructional programs. This leadership position requires a tenured faculty member at the full or associate professor level. Appropriate disciplinary backgrounds for this position include industrial engineering, engineering economics, management and/or economics, environmental engineering, or materials engineering. A research emphasis on lifecycle and/or cost-benefit analysis would complement existing faculty expertise in the Schools of Engineering and Natural Sciences. The ideal candidate would have a proven track record in connecting engineering economic analysis to research in environmental systems, toxicology, or materials engineering, as well as the social science and policy aspects of sustainable manufacturing. The space and start-up needs for this position are modest, as it is theoretical in nature. Specific needs are detailed in the SOE FTE request table.

MSE Cross-School FTE Requests

- **Technology Management (Cross 5) -** We are proposing an opportunity hire in Engineering to contribute to development of the School of Management, specifically to allow establishment of a Technology Management program that can leverage existing courses across multiple instructional programs in Engineering and Natural Sciences.

Mechanical Engineering

Overview – The Mechanical Engineering faculty at UCM are affiliated primarily with the **Mechanical Engineering and Applied Mathematics** (**MEAM**), but several ME faculty are also affiliated with the BEST, and ES graduate programs. The ME faculty are dedicated to the education of a new generation of mechanics researchers, applied mathematicians and/or researchers of ME-related areas who aim to master the fundamentals of the mechanical sciences (which include disciplines such as continuum mechanics, rheology, fluid mechanics, heat and mass transfer, energy conversion, etc.) while being exposed to the forefront of research techniques, methodologies and equipment to solve problems that are relevant to modern society (green energy, mechanical modeling and synthesis, robotics and mechatronics, control systems, etc.).

Mission Statement - The mission of the MEAM program at UC Merced is to provide a modern, comprehensive, and interdisciplinary educational experience to its students with the objective of preparing them for successful careers in the current and dynamically changing professional environment. To achieve this mission, the MEAM program strives to accomplish the following educational objectives:

Program Educational Objectives

1. To provide a solid background on the pertinent mathematical, physical, chemical and engineering concepts that make up the foundations of the broad disciplines of mechanical engineering and applied mechanics, as well as on their closely associated fields;

2. To provide our students with the knowledge to correctly apply natural laws to the creative formulation and solution of engineering problems through the use of analytical, computational and experimental techniques;
3. To expand the reach of research in mechanical engineering and applied mechanics to non-traditional areas by continually seeking to incorporate new methodologies and research findings to our graduate curriculum.

Research

Mechanical Engineering and Applied Mechanics represent two distinctive but overlapping research areas that together form some of the most fundamental pillars of the academic enterprise. While the various disciplines that compose the field of Applied Mechanics are associated with rigorous and rapidly developing branches of human thought, Mechanical Engineering is currently undergoing a fundamental transformation at several distinct levels. At the design level, computer aided engineering and fast prototyping automated tools are revolutionizing the way new products are conceptualized, evaluated and deployed into the market. At a more fundamental level, computational methods that are based on judicious use of advanced concepts in Applied Mechanics (including stochastic evolutionary methods, uncertainty analysis, artificial cognition, etc.) have expanded the portfolio of research methodologies much beyond the usual designer-based experience. Today, Mechanical Engineering is evolving into a discipline where more emphasis is placed on teaching a machine how to design, other than using the machine to optimize a pre-selected design. In other words, instead of using the engineering methodology to optimize a pre-existing concept, MEAM research is transitioning to a new paradigm where only the goals and constraints of the object are known to the designer, and a stochastic algorithm uses a variety of advanced computational methods to explore the complete space of solutions that satisfy the goals and constraints of the problem at hand.

The MEAM group at UC Merced emphasizes this new approach to Mechanical Engineering, and therefore is unique among all UC campuses in placing a much higher emphasis on advanced computational methods. Formed in August of 2007, the MEAM group is composed of eleven faculty members from various disciplines, including Mechanical Engineering, Electrical Engineering, Physics, Applied Mathematics and Computer Science and Engineering.

3.3. **Research Themes of MEAM Program -** As mentioned above, there are many exciting research opportunities within the context of the MEAM program, and we have prioritized research areas that would better complement and add value to the overall research and educational mission of UC Merced. The chosen research themes also add a unique flavor to our program not only within the UC system, but also in comparison to other programs in the nation. The MEAM program will initially focus on two major themes, which are described below.

Energy Systems (I)— Mechanical engineering is a core discipline for the development of energy conversion technologies, and the MEAM program at UC Merced is well poised to take the lead on the renewable energy initiative in our campus. Professors Winston, Sun, Coimbra, and Diaz have all established track records in research funding in the energy research area. There is very strong synergy between the MEAM graduate program and the Merced Energy Research Institute (MERI), as well as with UC CITRIS (Center for Information Technology Research in the Interest of Society) and the new CITRIS initiative C-GRACE (CITRIS Global Research Alliance for Climate and Energy). Within the Energy Systems theme, the main areas of activities of the MEAM program include: solar concentrators, solar availability mapping, renewable fuel conversion, fuel cell technology, concentrator controls, direct solar conversion, and solar power applications to environmental health monitoring. The MEAM program has several overlapping research projects with other graduate groups within the energy systems theme, including Environmental Systems (ES) and Electrical Engineering and Computer Science (EECS). The MEAM faculty has been very successful in attracting sizeable research grants in this area.

In the next five years, we would like to build a strong focus on energy research, and shall explore the research topics including solar energy, wind energy, building efficiency, building energy sensor network, and energy storage technologies.

Biologically Inspired Technologies (II) — Although one of the primary goals of this MEAM research theme is in the development of advanced computational methodology, there is important synergy with experimental methods in bio-controls, mechatronics, multi-scale material properties, and complex fluids that will enable the maturation of this area into a new paradigm of engineering design. A strong computational component on novel genotype optimization methods will allow us to explore bio-inspired solutions beyond the traditional bio-mimetic approach. However, it is the concurrent and parallel experimental development of advanced materials (and the associated understanding of complex constitutive relations) that will enable the development of a full spectrum of engineering solutions for complex problems for engineered materials (as opposed to biological materials). An important component of the MEAM strategic plan is to build critical mass in this research theme. There is a very good opportunity for future collaboration between several graduate programs at UC Merced in this area, including Biological Engineering and Small Technologies (BEST), Electrical Engineering and Computer Science (EECS), Quantitative and Systems Biology (QSB), and Applied Mathematics (AM).

The two research themes above reflect a sensible compromise between depth, breadth, impact and quality of MEAM research. Equally relevant is our effort to combine the needs of the very popular undergraduate program in Mechanical Engineering with the development of a strong research program in MEAM.

Synergistic Growth with ME Undergraduate Program - The mechanical engineering (ME) undergraduate major was launched during Fall 2006 accepting only freshman students. The plan was to start accepting transfer students only in the Fall 2008. However, a large number of current upper division students at UC Merced have approached ME faculty or the engineering student counselors to explore the possibility of transferring to the ME major before they complete their degree. By now, ME has become one of the most popular engineering majors at UC Merced. In Fall 2009, we had 176 ME students, the largest group among all the majors in Engineering, with only five faculty. ME also has currently the largest student-to-faculty ratio in the SoE by a large margin.

To evolve into a top ME program, it is absolutely necessary to develop a strong and comprehensive foundation in key areas, with a sufficient number of faculty to build a modern program with state-of-the-art research infrastructure. In addition, because ME is a key component of any modern engineering academic program in serving key and foundational needs for many engineering sub-disciplines. Delaying the hiring of ME faculty will dramatically constrain the growth of our engineering program and could significantly impair the image and reputation of the ME program and the School of Engineering as a whole.

Currently, ME provides service to other majors by teaching a number of engineering fundamentals courses that include: ENGR 57 (Dynamics), ENGR 151 (Strength of Materials), ENGR 130 (Thermodynamics), ENGR 135 (Heat Transfer), and others. This situation increases dramatically the teaching load of ME faculty.

From the outset, there was a concerted effort to provide a seamless experience to SOE undergraduate students interested in pursuing post-graduate education in the MEAM program. The MEAM program offers research opportunities for students interested in projects at the interface between Complex Analysis, Mechanics, Manufacturing, Bio-Inspired Engineering, Applied Computational Sciences, Mechatronics, Advanced Materials, Energy Conversion, and Controls. Due to the interdisciplinary nature of the topics covered in MEAM courses, a number of these courses serve graduate students from many different disciplines. This also increases the teaching load of ME/MEAM faculty. For instance, in the

past the following courses were populated by graduate students from other programs: ME 135/ES 235 (Heat Transfer), MEAM 201 (Advanced Dynamics), ME 210 (Linear Controls), and MEAM 251/ES 237 Viscous Flows.

There are currently five FTE positions filled in mechanical engineering (listed here in order of hiring): Professor Diaz, Professor Coimbra, Professor Sun, Professor Modest and Professor Ma. The expertise of the current faculty covers a relatively unbalanced portion of the overall research area in Mechanical Engineering and Applied Mechanics since 4 out of the 5 faculty hired have main expertise in Thermofluids, and only one faculty (Prof. Sun) has expertise on Solid Mechanics.

Outcome Metrics

Resources Requirements - For the next five years, a total of ten desired positions have been identified and described below in descending level of priority for both the ME and the MEAM programs):

1) Computational Engineering (I and II)
2) Energy Storage Technologies (I)
3) Mechatronics (I and II)
4) Buildings Energy Efficiency (I)
5) Nonlinear Analysis (I and II)
6) Bio-Controls (II)
7) Bio-Inspired Mechanics (II)
8) Computational Fluid Dynamics (I and II)
9) Turbulence (I and II)
10) Complex Systems (I and II)

In addition, four instructors will be needed to cover the engineering fundamentals and capstone design.

For AY 2010-2013, the program is requesting ***three lecturers*** **(SoE-LPSoE-2, SoE-LPSoE-4, SoE-LPSoE-5)**. Two will concentrate on the engineering fundamentals (ENGR) courses that serve all programs in the SOE, and the other on ME electives that may serve BIOE, ES, ME, MSE and CSE students. The final lecturer will help faculty to develop and deliver the capstone and other design-related courses.

The top three priorities of regular faculty FTE positions for 2010-13 are as follows:

- **Computational Engineering with emphasis on Stochastic Optimization (SoE-5) -** This senior/junior position is an important and strategic area of research in ME. It will cover, but will not be limited to, development of numerical schemes to treat problems in structural, thermal-fluids and energy systems. It can relate to parallel computing and high performance algorithm development applied to engineering problems. The undergraduate program in Mechanical Engineering will benefit with courses such as FEA and CAE. The graduate program will benefit with courses in the particular areas of research of this FTE. Natural synergies with other programs include Computer Science and Engineering, and Applied Mathematics.
- **Energy Storage Technologies including Turbulence Modeling (SoE-2) -** This senior/junior position will add an important and strategic area of research in ME to broaden and strengthen its actual capabilities. This position will cover, but will not be limited to, design and analysis of energy storage devices, thermal fluids, turbulence, and high temperature mechanics of materials. The undergraduate program in Mechanical Engineering will benefit with courses such as strength of materials, and the capstone design. The graduate program will benefit with courses in the particular areas of research of this FTE. Natural synergies with other programs include Material Science, Computer Science and Engineering, and Applied Mathematics.

- **Mechatronics (SoE-8) -** This senior/junior position will add an important and strategic area of research in ME to broaden and strengthen its actual capabilities. This position will cover, but will not be limited to, dynamics, control systems, and sensor network and optimization with an emphasis on applications to building energy efficiency. The undergraduate ME program will benefit with courses such as dynamics, vibration and control, and capstone design. The graduate program will benefit with courses in the particular areas of research of this FTE. Natural synergies with other programs include Computer Science and Engineering, and Applied Mathematics.

Resource Needs for MEAM and ME Programs

There is a minimum number of specialized faculty members required to deliver a comprehensive program such as Mechanical Engineering in parallel to a successful graduate program in MEAM. Although we are falling short of the projected need for FTEs, an even more pressing problem is space allocation for both instructional and research use. The ME/MEAM faculty believe that the instructional laboratory allocation to ME-lead classes is insufficient for achieving success in the accreditation process with ABET.

Core Facilities - Both the MEAM research program and the ME instructional program need adequate lab space and machine shop support to exist. The current machine shop is not supported at a level that will allow Capstone Design and MEAM research programs. This limitation will severely impact the ability of the ME program to be ABET accredited in the coming years. All ME faculty members, in collaboration with the SOE staff, have been actively involved in extracting the most out of the limited instructional lab space available to deliver the ME classes. However, even considering the best use of the instructional labs (which include rotating schedules, sharing of the labs by several different disciplines, and modular educational benches that are put aside after use) it is very clear that the currently available space will not withstand ABET scrutiny. The same is true with the machine shop support.

The MEAM needs in terms of space include extra 5,000 sf laboratory space beyond what is available now for ME faculty at the SE building, of which about 2,000 sf need to be “damp” lab space. Given our emphasis on computational methods, this need is rather modest in comparison to other graduate programs, but it is critical for us in order to attract the few experimentalists needed for reaching critical mass in both energy systems and bio-inspired technologies.

Appendix 1: **Requested FTEs, Year 1 of 3-year Plan, AY 2010-2011**

Priority	Name of Position	Level (Lecturer/Assistant/ Associate/Full)	Primary Major Contribution (current or planned)	Secondary Major Contribution (optional)	Primary Graduate Group	Secondary Graduate Group (optional)	Estimated start-up costs	Estimated Lab Space needs	Special needs and strategic considerations, if any
1	Computer Systems	Junior/Senior	CSE	ME	EECS	MEAM/ES	$200k-300k	400-800 sq ft dry	
1	Energy Storage Technologies	Junior/Senior	ME		MEAM		$150K	250-500 sq ft	
1	Energy Materials	Junior/Senior	MSE	ME	BEST	MEAM	$150K	250-500 sq ft	Contribute to MERI (high T materials, energy harvesting, catalysis) - existing materials characterization resources can be leveraged to bring down the cost of the start-up package
1	Physiological Modeling	Junior/Senior	BioE	ME	BEST	QSB	$150-250K	400 sq ft	
1	Computational Engineering (emph. stochastic optimization)	Junior/Senior	ME		MEAM		$150K	250-500 sq ft	
1	SoE-LPSOE-1	EECS Lecturer[1]	EECS					office	
1	SoE-LPSOE-2	Fundamentals Lecturer	ENGR					office	
1	SoE-LPSOE-3	EECS Lecturer	EECS					office	

[1]A candidate for SoE-LPSoE 1 is currently under consideration.

Appendix 1: **Requested FTEs, Year 2 of 3-year Plan, AY 2011-2012**

Priority	Name of Position	Level (Lecturer/Assistant/ Associate/Full)	Primary Major Contribution (current or planned)	Secondary Major Contribution (optional)	Primary Graduate Group	Secondary Graduate Group (optional)	Estimated start-up costs	Estimated Lab Space needs	Special needs and strategic considerations, if any
1	Computer Science Theory	Junior/Senior	CSE	Applied Math	EECS	Applied Math	$150-250k	400 sq ft students office	
1	Air Pollution Modeling, Management, & Control	Junior/Senior	ME or ENVE	Management	ES	ME	$150-250K	400-800 sq ft	Possible use of GIS & computer cluster facility
1	Mechatronics	Junior/Senior	ME		MEAM		$150K	250-500 sq ft	
1	Ecological Engineering	Junior/Senior	BioE	ENVE	ES	BEST	$300-500K	600-1,000 sq ft wet/dry	Possible use of GIS & computer cluster facility
1	SoE-LPSOE-4	Lab/Design Lecturer	ENGR					office	
1	SoE-LPSOE-5	Fundamentals Lecturer	ENGR					office	

Appendix 1: **Requested FTEs, Year 3 of 3-year Plan, AY 2012-2013**

Priority	Name of Position	Level (Lecturer/Assistant/ Associate/Full)	Primary Major Contribution (current or planned)	Secondary Major Contribution (optional)	Primary Graduate Group	Secondary Graduate Group (optional)	Estimated start-up costs	Estimated Lab Space needs	Special needs and strategic considerations, if any
1	Intelligent & Adaptive Control	Junior/Senior	CSE	ME	EECS	MEAM	$100-200k	400-800 sq ft dry	
1	Environmental Biotechnology	Junior/Senior	ENVE	BioE	ES	BEST	$300-500K	600-1,000 sq ft wet/dry	
1	Computational Materials	Junior/Senior	MSE	ME	BEST	MEAM	$150K	250-500 sq ft	Computational - modeling of metastable materials processing/materials properties - ties to MERI and cognitive science (materials visualization for learning/research)
1	Physiological Modeling	Junior/Senior	BioE	ME	BEST	QSB	$150-250K	400 sq ft	
1	Computational Engineering (emph. stochastic optimization)	Junior/Senior	ME		MEAM		$150K	250-500 sq ft	
1	Recombinant Sensor Development	Senior	BioE		BEST	EECS	$250-$350K	office	
1	Medical Imaging	Senior	Bio		BEST	EECS	$250-$350K	office	

Appendix 1: Requested Cross-unit FTEs, Year 1 of 3-year Plan, AY 2010-2011

Priority	Name of Position	Level (Lecturer/Assistant/ Associate/Full)	Primary Major Contribution (current or planned)	Secondary Major Contribution (optional)	Primary Graduate Group	Secondary Graduate Group (optional)	Estimated start-up costs	Estimated Lab Space needs	Special needs and strategic considerations, if any
1	Information Management	Junior/Senior	CSE	Management	EECS		$100-200k	400 sq ft dry	fills need for databases knowledge in CSE while providing engineering expertise to management program
1	Natural Resource Management	Junior/Senior	Management, ENVE, ES	Management, ENVE, ES	ES	SCS	$200-300K	800-1,000 sq ft	Possible use of GIS & computer cluster facility
1	Sustainable Building/ Manufacturing Management	Junior/Senior	Management	MSE/ME/ ENVE/BioE	BEST	MEAM/ES	$150K	250-500 sq ft	Economic Modeling - Primarily Computational - Lifecycle and Cost Benefit Analysis of Green Manufacturing - Contribute to development of management program and possible engineering economics or management program..

Appendix 1: Requested Cross-unit FTEs, Year 2 of 3-year Plan, AY 2011-2012

Priority	Name of Position	Level (Lecturer/Assistant/ Associate/Full)	Primary Major Contribution (current or planned)	Secondary Major Contribution (optional)	Primary Graduate Group	Secondary Graduate Group (optional)	Estimated start-up costs	Estimated Lab Space needs	Special needs and strategic considerations, if any
1	Virtual Environments	Junior/Senior	CSE	Cognitive Science	EECS	Cognitive Science & Information Systems	$200-300k	400-800 sq ft dry	could contribute to interdisciplinary program in computer game design
1	Technology Management	Junior/Senior	Management	MSE/ME BioE	BEST	MEAM BioE	$150K	250-500 sq ft	Management of Intellectual Property - Contribute to development of management program and possible engineering economics or management program.
1	Media Arts & Technology	Junior/Senior	EECS	CIS/World Cultures	EECS	World Cultures/ Art	$100K	250-500 sq ft	

Appendix 2: **Majors and Graduate Group**

Name	Established or Planned Start Date	Number of Majors (08-09)[1,2]	Student Credit Hours (08-09)[2]	Number of Current Faculty (and Names)	Number of Current Searches (and Names)	Requested FTEs (and Names)
Environmental Engineering	Established	51	524	8.0 FTE Bales, Campbell, Chen (0.5),Conklin, Harmon, Guo, Rogge, Westerling(0.5), Wright		
Computer Science & Engineering	Established	152	1661	6.5 FTE Carpin, Carreira, Cerpa, Kallmann, Newsam, Noelle(0.5), Yang	1 LPSOE 1 EECS Senior/Junior	
Bioengineering	Established	104	951	3 FTE Chin, Escobar, McCloskey	1 Bioengineering	
Mechanical Engineering	Established	121	1257	5 FTE Coimbra, Diaz, Modest, Ma, Sun		
Material Science Engineering	Established	16	140	3.4 Davila, Leppert, Lu, Viney (40% Eng)		

[1]Undecided Engineering = 49
[2] Data Source: Institutional Planning & Analysis Office

Appendix 3: **Future Space Needs**

	Position	Primary Major	Office Location	Offices needed	Theoretical/ Experimental	Research Space Location	Research Space (sq ft)	
2010-11							**Dry**	**Wet**
SoE-1	Computer Systems	EECS	Campus	1	Theoretical	Campus	600	
SoE-2	Energy Storage Technology	ME	Campus	1	Theoretical/Experi	Campus	400	
SoE-3	Energy Materials	MSE	Campus	1	Theoretical/Experi	Campus	400	
SoE-4	Physiological Modeling	BioE	Campus	1	Theoretical	Campus	400	
SoE-5	Stochastic Modeling	ME	Campus	1	Theoretical	Campus	400	
SoE-LPSOE1	EECS Lecturer	EECS	Campus	1				
SoE-LPSOE2	Fundamentals Lecturer	ENGR	Campus	1				
SoE-LPSOE3	EECS Lecturer	EECS	Campus	1				
2011-12								
SoE-6	Computer Science Theory	EECS	Campus	1	Theoretical	Campus	400	
SoE-7	Air Pollution Modeling	ME/ENVE	Campus	1	Theoretical/Experi	Campus	600	
SoE-8	Mechatronics	ME	Campus	1	Theoretical	Campus	400	400
SoE-9	Ecological Engineering	BioE	Campus	1	Theoretical/Experi	Campus	400	
SoE-LPSOE4	Lab/Design Lecturer	ENGR	Campus	1				
SoE-LPSOE5	Fundamentals Lecturer	ENGR	Campus	1				
2012-13								
SoE-10	Intelligent & Adaptive Control	EECS	Campus	1	Theoretical	Campus	600	
SoE-11	Environmental Biotechnology	ENVE	Campus	1	Theoretical/Experi	Campus	300	700
SoE-12	Computational Materials	MSE	Campus	1	Theoretical	Campus	400	
SoE-13	Biosensor Development	BioE	Campus	1	Theoretical/Experi	Campus	-	-
SoE-14	Medical Imaging	BioE	Campus	1	Theoretical/Experi	Campus	-	-
Total Research Space needed							5,300	1,100
Total Office Space needed				19				
Space already allocated to ENGR				7			1,500	1,100
Space Need				12			3,800	0

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1	Energy Materials	Junior/Senior	MSE	ME	BEST	MEAM	$150K	250-500 sq ft	Contribute to MERI (high T materials, energy harvesting, catalysis) - existing materials characterization resources can be leveraged to bring down the cost of the start-up package
1	Physiological Modeling	Junior/Senior	BioE	ME	BEST	QSB	$150-250K	400 sq ft	
1	Computational Engineering (emph. stochastic optimization)	Junior/Senior	ME		MEAM		$150K	250-500 sq ft	
1	SoE-LPSOE-1	EECS Lecturer[1]	EECS					office	
1	SoE-LPSOE-2	Fundamentals Lecturer	ENGR					office	
1	SoE-LPSOE-3	EECS Lecturer	EECS					office	

[1]A candidate for SoE-LPSoE 1 is currently under consideration.

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1	Ecological Engineering	Junior/Senior	BioE	ENVE	ES	BEST	$300-500K	600-1,000 sq ft wet/dry	Possible use of GIS & computer cluster facility
1	SoE-LPSOE-4	Lab/Design Lecturer	ENGR					office	
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1	Sustainable Building/ Manufacturing Management	Junior/Senior	Management	MSE/ME/ ENVE/BioE	BEST	MEAM/ES	$150K	250-500 sq ft	Economic Modeling - Primarily Computational - Lifecycle and Cost Benefit Analysis of Green Manufacturing - Contribute to development of management program and possible engineering economics or management program..

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1	Technology Management	Junior/Senior	Management	MSE/ME BioE	BEST	MEAM BioE	$150K	250-500 sq ft	Management of Intellectual Property - Contribute to development of management program and possible engineering economics or management program.
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SoE-5	Stochastic Modeling	ME	Campus	1	Theoretical	Campus	400	
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2011-12								
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SoE-8	Mechatronics	ME	Campus	1	Theoretical	Campus	400	400
SoE-9	Ecological Engineering	BioE	Campus	1	Theoretical/Experi	Campus	400	
SoE-LPSOE4	Lab/Design Lecturer	ENGR	Campus	1				
SoE-LPSOE5	Fundamentals Lecturer	ENGR	Campus	1				
2012-13								
SoE-10	Intelligent & Adaptive Control	EECS	Campus	1	Theoretical	Campus	600	
SoE-11	Environmental Biotechnology	ENVE	Campus	1	Theoretical/Experi	Campus	300	700
SoE-12	Computational Materials	MSE	Campus	1	Theoretical	Campus	400	
SoE-13	Biosensor Development	BioE	Campus	1	Theoretical/Experi	Campus	-	-
SoE-14	Medical Imaging	BioE	Campus	1	Theoretical/Experi	Campus	-	-
Total Research Space needed							5,300	1,100
Total Office Space needed				19				
Space already allocated to ENGR				7			1,500	1,100
Space Need				12			3,800	0