Academic Year 2008-09
Strategic Plan

School of Engineering
University of California, Merced

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Contents

1 INTRODUCTION: ACADEMIC VISION 1

1.1 FOCUSING ON RESEARCH SYNERGIES 2
1.2 SCOPE OF THIS DOCUMENT 2

2 ACADEMIC PROGRAMS DEVELOPMENT 5

2.1 ANTICIPATED STUDENT GROWTH AT UC MERCED 5
2.2 PROGNOSIS FOR GROWTH OF ENGINEERING FACULTY RATIOS 7
2.2.1 The desired fraction of Engineering students at UC Merced 7
2.2.2 Targeted student/faculty ratio within the School of Engineering 8
2.2.3 Implications for faculty Engineering FTE requests 9
2.2.4 Workload Considerations 11
2.2.5 Summary of current and authorized faculty FTEs (need update) 11
2.2.6 Faculty Diversity 12
2.3 5-YEAR PLAN FOR EXPANSION OF ACADEMIC PROGRAMS 14
2.3.1 Electrical Engineering 15
2.3.2 Chemical Engineering 18
2.3.3 Engineering Economics and Management 19
2.3.4 Development of a Management Program and School 19
2.3.4.1 Natural Resource Management 19
2.3.4.2 Entrepreneurship 20
2.3.4.3 Management of Technology 21
2.3.4.4 Energy, Climate, and Sustainability 22
2.3.4.5 Biotechnology Management 23
2.3.4.6 Center for Entrepreneurship 23
2.4 REQUEST FOR SCHOOL OF ENGINEERING FACULTY POSITIONS FOR 2008-09 24
2.4.1 Bioengineering: Tissue Engineering 25
2.4.2 Bioengineering: Physiological Modeling 25
2.4.3 Bioengineering: Single Cell Quantitative Measurements 26
2.4.4 Computer Science Engineering: Instructor with security of employment. 26
2.4.5 Computer Science Engineering: Senior position complementary to existing CSE faculty with research emphasis in CS. 27
2.4.6 Computer Science Engineering: Senior position complementary to existing CSE faculty with research emphasis in EE. 27
2.4.7 Computer Science Engineering: Senior position complementary to existing CSE faculty with research emphasis in EECS. 27
2.4.8 Computer Science Engineering: Media Arts and Technology (MAT) (Cross-school) 28
2.4.9 Environmental Engineering: Junior or Senior Hire Environmental Microbiology. 28
2.4.10 Environmental Engineering: Junior or Senior Hire in Ecohydrology and Ecological Engineering. 28
2.4.11 Materials Science Engineering: MSE-6: Complex Materials 30
2.4.12 Mechanical Engineering: ME-6: Bio-Control 32
2.4.13 Mechanical Engineering: ME-7: Computational Engineering 33
2.4.14 Cross-School Hire 36

3 STRATEGIC PLANNING FRAMEWORK 37

3.1 REVISITING THE STRATEGIC FACULTY HIRING FRAMEWORK 37
3.1.1 Energy and Materials Technologies 37
3.1.2 Biological Engineering 39
3.1.3 Nanoscale Systems 39
3.1.4 Environmental Science and Engineering 39
3.1.5 Computer Science and Engineering 39
3.1.6 Modeling Sciences 41
3.2 STRATEGIC FACULTY HIRING 42

4 SPACE PLANNING AND MANAGEMENT 43

4.1 SPACE CHALLENGES AT UC MERCED 43
4.2 SPACE ALLOCATION, UTILIZATION MONITORING, AND REALLOCATION 43
4.2.1 Initial campus space allotment 43
4.2.2 Initial engineering research space allocation 44
4.2.3 Core research facilities 46
4.2.4 Teaching laboratory space allotment 46
4.2.5 Space utilization monitoring and reallocation planning 47

1 Introduction: Academic Vision

The goal of the School of Engineering at University of California, Merced is to develop a program that fosters fundamental research advances, the education of exceptional students, and the continued support of alumni who will assume leadership positions at all levels of engineering professions. Our highest priority is to create an environment for research and education that is aimed at changing the world around us. This document presents a strategic plan for faculty hiring for the School and discusses how this will assist us in achieving our full potential as a leader in engineering research, education, and professional service.

A major constraint in achieving our goal is the necessarily limited size of our faculty over the next few years. But it is imperative that we grow steadily and deliberately—particularly in our signature areas—and that our momentum in student recruiting, infrastructure development (both teaching and research support), and space and facilities not be hindered. In order to continue to compete with other universities, for which a sufficiently large Engineering faculty is essential, the School must exploit its small size by integrating our activities with those of the rest of the University. Anticipating that over the next decade, we will grow in size only to approximately 100 faculty, in part through joint appointments with other Schools in areas of mutual interest, a clear hiring strategy that is aggressive yet realistic is particularly important. This strategy is timely and essential, taking advantage of the fact that research in the sciences is rapidly becoming more technology based, allowing UCM to take the lead in applying engineering methodologies to new scientific frontiers.

The central theme of our strategic plan is our choice of selected research areas for investment and growth. We plan to emphasize six areas of research that we believe are critical for UCM's continued success: (1) Energy and Materials Technologies, (2) Biological Engineering, (3) Nanoscale Systems, (4) Environmental Science and Engineering, (5) Computational Science and Engineering, and (6) Modeling Sciences. These areas represent research activities that stretch across the School and the campus, and have the potential for strong and nourishing linkages across the University system, thus further leveraging our multi-disciplinary emphasis. At the same time, we realize the need to maintain strength in core disciplines and to balance these thrusts with disciplinary needs. This is specifically supported through the use of a hiring matrix that promotes this balance, and recognizes explicitly our responsibility to build a strong program for education of undergraduates, and support of the engineering professions. The School is also committed to combine teaching efforts, research activities, and public/community service through creative partnerships at the local and state levels.

Our graduate and undergraduate education will continue to provide a science-based, research-oriented curriculum that educates the next generation of innovators and leaders in engineering and enabling technologies. The School is committed to attracting and educating students from populations that have traditionally been underrepresented within the engineering profession, and to broadening their participation at all levels. To the extent that the development and timely evolution of new facilities can be coupled with *a long-term space plan* for the School, we will be able to provide an exceptional environment for research and education. The plan presented here represents a view of our School that will guide our detailed decisions over the next several years.

1.1 Focusing on Research Synergies

In response to the comments provided by CAPRA to the AY 05-06 School of Engineering Strategic plan, the faculty established a planning framework (matrix) that would guide future faculty FTE requests consistent with strategic and emerging research opportunities. This framework has as its central focus, an articulation of the research synergies not only between academic programs within the School of Engineering, but also between and among our sister Schools, graduate groups, and research institutes. It was offered as a framework that could be used to enhance communication among these entities, and was put forth as a means of providing continuity to the overall university strategic planning process.

The updated strategic planning matrix from AY 07-08 is reproduced herein as Table 1. The objective behind the use of this framework was to relate the faculty hiring plan of the School of Engineering for both current and future (requested) positions more explicitly to (1) our strategic intra-School research areas, and (2) strategic cross-School research areas set forth as listed in all three Schools original strategic plans. Because of the importance of Engineering's goal of developing (ABET) accreditable degrees, the academic undergraduate majors are also included as an important dimension of this framework.

The rows of the matrix are the strategic areas that have guided the School of Engineering's strategic planning process. The first areas listed are those that were agreed upon by the Schools as areas of particular interest for possible joint hires last planning cycle, and that motivated the allocation from the Provost of the cross-school positions currently being recruited. The columns of the matrix list research focus areas within Engineering—grouped by what would be departments at most universities—*majors*, at UC Merced, and areas of particular interest for recruiting Engineering faculty. The remaining areas listed—those below the double line—are those that were considered more likely to be of interest between or among engineering subdisciplines than between Engineering and other Schools.

The entries in this matrix described both our current faculty hiring profile at that time, and requested FTEs. The green cells denoted those faculty already hired, or anticipated to be hired to fill our inaugural 20 positions, and reflected their relationship with their specialty within Engineering, their principle teaching responsibilities, and their major multidisciplinary synergies with other academic entities (Schools, grad groups, institutes, etc.).

1.2 Scope of this Document

Before being able to propose confidently a specific hiring plan for the coming year and future years, it is important to establish a foundation for requesting a feasible number of faculty FTEs. A foundation that ties our annual faculty FTE request to student numbers and the evolution of our programs is presented in Section 2 with an overall review of projected student growth, followed by a discussion of targets for the fraction of UC Merced students who are engineering students, leading to targets for engineering student/faculty ratio. Section 2 concludes with a profile of our revised 5-year hiring plan, and our request for FTE positions to be hired during the next academic year.

Based on this FTE request—number of faculty positions that can reasonably be expected—our strategic cross-disciplinary hiring strategy is updated—as Table 10—showing the anticipated impact that allocation would have on the strategic research opportunities for the School of Engineering and UC Merced. The document concludes with a discussion of our space challenges. Further details of resource needs associated with the hiring of new faculty

are given in the Resource Plan submitted by the Dean of the SOE to the Provost for AY 2008-2009 (Appendix I of this document).

Table 1 – Framework proposed last year—AY 2006-07—by Engineering for strategic cross-Schools hiring plan.

Strategic Research Priorities within the School of Engineering

Strategic Faculty Hiring Planning Matrix--This matrix is intended as a framework for displaying the structure of faculty hiring within the School of Enigneering at UC Merced. The left column presents the strategic research priorities within Engineerring. Each area is further categorized by potential cross-School priority areas. The columns to the right reflect research emphasis areas grouped by disciplinary categories, also reflecting our current and future undergraduate majors. Entries in the table correspond to current, pending, and desired future faculty hires.

Current and Planned Undergraduate Majors witin the School of Engineering

Strategic Cross-School Research Opportunities	ENVE					CSE				BIOE					ME					MSE					EE						
	Hydrology	Microbiology	Water Quality	Air Pollution	Environmental Sustainability	Energy water & resource management	Networking	Data Base Mining/Informatics	Robotics/Autonomous Agents/AI	Graphics/Multimedia	Architecture/Systems	Bioelectronics	Biomaterials Engineering	Cellular Bioengineering	Tissue Bioengineering	Bioprocess Eng	Energy and Environment	Computational Mechanics	Complex and Intelligent Systems	Multiscale Physics and Modeling	Bioengineering	Nanomaterials	Composite materials	Materials Synthesis	Materials characterization	Environmental Aspects Materials	Materials Processing	Microelectronics and Nano Technology	Communication Networks	Bioelectronics	Optics and Photonics	MicroElectroMechanical Systems	Signal Processing	Circuits	Linear/Nonlinear Systems, Control
Energy and Materials Technologies: Energy; including optics, material sciences					☒																	☒									■				
Energy and Materials Technologies: Mechanical and electromechanical systems														■		☒			■					☒							☒				
Biological Engineering: Human biology, health and enviroment, including management and policy														☒																					
Biological Engineering: Regenerative medicine													■		☒																				
Nanoscale Systems: Nanotechnology												☒													☒		■								
Nanoscale Systems: Human dimesions of engineering and science																																			
Environmental Science and Engineering: Atmospheric & climate sciences, air resources			☒	☒		■																													
Environmental Science and Engineering: Energy, Water & Environmental sustainability, including policy	☒		☒		■	☒																													
Environmental Science and Engineering: Geography and spatial analysis and global change						☒	☒	☒			■																								
Computational Science and Engineering: Cognitive and computational sciences								☒	■	☒																									
Computational Science and Engineering: Media arts and Technology																																			
Computational Science and Engineering: Cyberinfrastructure and system							☒		☒		■																								
Modeling Sciences: Management and decision sciences					■	☒																													
Modeling Sciences: Mathematical sciences, applied mathematics, and applied statistics								☒						■			☒	■	☒		☒	■													
	8						9					6.5					6					5					1.5								

- Engineering faculty (first 20)
- ☒ Engineering faculty already hired
- Joint (cross-school) faculty hires or joint hires requested
- Joint (cross-engineering) faculty hires or joint hires requested
- Current faculty searches
- To be requested; need to be distributed into the matrix

This framework was used by the School of Engineering to articulate the relationship between cross-School strategic research faculty hiring requests and the majors within the School. It was suggested that an extended version of this framework be used in support of a comprehensive UCM hiring map with strategic cross school areas included as the rows of the table, with more School-specific research areas grouped by respective School undergraduate majors be used in considering future faculty hires, particularly cross-School hires.

The School of Engineering has refined this framework, and updated the matrix in presenting our AY 2008-09 hiring request, as presented in Table 10 of Section 3 of this Strategic Plan.

2 Academic Programs Development

The key resource for the strengthening and growth of academic programs within the School of Engineering is the faculty. Provided that we can hire a sufficient number of faculty having sufficient experience in building strong scholarly programs, we will grow at a reasonable rate into a leading engineering program. This is particularly challenging because of the extreme burden placed on faculty time required for program building—infrastructure, curriculum, programs to promote student success, etc.—all while maintaining the requisite high level of academic stature essential for a UC campus. The challenge is made even more daunting by the specter of inadequate future space for programs development, difficulty in attracting top graduate students, and continued substantial responsibilities for involvement in shared governance spread among relatively few—in contrast to established campuses—individuals. It is therefore unfortunate that future faculty FTE allocations to the Schools is based primarily on numbers of potential undergraduates who, as early high school seniors, are required to make a selection about the School and major through which they intend to matriculate.

This is especially challenging for Engineering because more than other professional disciplines or academic areas, the fields of engineering or the nature of what engineers do is not well known or understood by the general public and certainly not by typical high school students when they are presented with the need to commit to a Major course of study on an application form. The failure of UC Merced to succeed in our early goal of having a common freshman year across Schools preempted our vision of creating a first-year learning experience designed to help students make better decisions about their field of study. While this may not have increased the numbers of students choosing Engineering as a career choice, it would very likely have helped improve the retention rates among those who do.

Nonetheless, in order to prepare a realistic plan for faculty hiring in Engineering, we must begin with the reality of using potential undergraduate student Majors designation as a basis for potential faculty FTE allocations to the School. Section 2.1 of this document presents our perspective on the anticipated growth of student numbers and the resulting implications for FTE allocation to Engineering over our 5-year planning period and beyond. This provides the foundation for a more detailed discussion about how the anticipated allocation of FTEs to Engineering would be strategically allocated among disciplinary areas, and supports a subsequent discussion about the potential for hiring faculty for purposes of exploiting potential synergies across the Schools and among our graduate groups and institutes.

2.1 Anticipated Student Growth at UC Merced

The growth targets for UC Merced remain unchanged from those set forth in the original planning projections of the University as contained in the UC enrollment plan for the system. Column 2 in Table 2 presents these growth targets for UC Merced modified to reflect the 2005-06 actual admissions[i], and extending through 2011-12. Starting from a first-year enrollment of 875 students, it has been projected that UC Merced will enroll sufficient students each academic year that will result in a net increase of 600 student FTEs each year for the next 5 years resulting in a total student population in the fall 2010 of approximately 4,000 student FTE.

Table 2 – Projected student growth at UC Merced and implications for faculty hiring rates over the next decade.

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Academic Year	Student Enrollment	Targeted Engineering Student Fraction	Resulting Engineering Student Count	Resulting S:F Ratio	Engineering Faculty FTE (total)	Anticipated Engineering FTE Request for Next AY
2005-06	875	15%	135	7	20.0	
2006-07	1190	19%	222	9	26.0	
2007-08	1815	17%	307	11	29.0	3.0
2008-09	2447	18%	440	13	35.5	6.5
2009-10	3002	19%	570	14	40.5	5.0
2010-11	3524	20%	705	15	47.0	6.5
2011-12	4084	20%	817	16	51.0	4.0
2012-13	4548	20%	910	17	53.5	2.5
2013-14	4968	20%	994	18	55.0	1.5

Source UC Merced Instructional Planning Office

At present, the number of students who have designated Engineering as their School of matriculation is 307 (Column 4). Thus, Engineering students account for 16% of the total UC Merced student population (Column 3). The resulting engineering student count in future years, derived from the projected growth in overall student enrollment and assuming a 20% engineering student fraction, is shown by year in Column 4. These figures do not take into account attrition of engineering students or selection of engineering as a major by students who are currently undeclared, since these figures are difficult to project given only one year's worth of data. Attrition of engineering students who entered UC Merced in AY 2005-2006 was 15%, far below the national average attrition rate of about 25% for first year engineering students. It should be noted that engineering attrition rates generally decline sharply after the Freshman year. With a current faculty of 29 FTE, the current undergraduate student faculty ratio (S:F) within the School of Engineering is 9 (Columns 6 and 5, respectively). This ratio jumped to 11 in AY 2007-2008 and continue to increase in subsequent years

While the School of Engineering employs a common freshman year, and as such does not hold students to initial major declarations made upon enrollment, estimates for matriculation across undergraduate majors over the planning horizon are shown in Table 3. These estimates are based on initial designations, and national trends in Engineering enrollments at other top Engineering programs and within the Engineering programs at other UC campuses.

Table 3– Anticipated distribution of students across Engineering majors over the 5-year planning horizon.

	2006-2007		2007- 2008		2008 -2009		2009- 2010		2010 - 2011		2011 - 2012	
	SoE Student Count											
Targeted Annual Enrollments for UCM[1]	**1190**		**1815**		**2447**		**3002**		**3524**		**4084**	
Percent Engineering	**19%**		**17%**		**18%**		**19%**		**20%**		**20%**	
Engineering Student Count	**222**		**307**		**440**		**570**		**705**		**817**	
BioE	23%	50	20%	62	20%	88	20%	114	20%	141	20%	163
CSE	36%	79	31%	96	30%	132	29%	165	29%	204	27%	221
EnvE	8%	17	10%	31	10%	44	10%	57	10%	70	10%	82
MSE	12%	26	1%	4	3%	13	4%	23	4%	28	5%	41
ME	1%	2	22%	69	23%	101	24%	137	24%	169	25%	204
Undeclared	23%	51	15%	45	14%	62	13%	74	13%	92	13%	106

[1] **UCOP Data**

2.2 Prognosis for Growth of Engineering Faculty Ratios

Because the size of the faculty within a school is effectively being dictated by the number of students working towards degrees in that school, two factors that are important in developing an estimate for the number of faculty FTEs that will be allocated to that school:

1. What is the total fraction of the student body that can be counted for that School; and
2. What is the desired student/faculty ratio within that School?

At the present time, insufficient data exist to be able to base such allocations on student success, or trends and norms for faculty productivity in other areas. Consequently—and because there is no direct mechanism at present for controlling Engineering student enrollments—an indirect means of influencing such an allocation is to consider what would be the most appropriate targets for these measures, and base the resulting request for faculty FTE allocations on these assumptions.

2.2.1 The desired fraction of Engineering students at UC Merced

Because UC Merced aspires to become a leading academic institution in all areas of scholarly endeavor that we undertake, and in particular because of our commitment to achieving the high status level of our sister campuses, it is important to consider carefully and realistically our goals for student recruitment and success. Specifically, a comparison among the Engineering programs at the 9 UC campuses having Schools of Engineering is presented in Table 4. Each column of that table displays current faculty and student data for each UC campus; faculty FTEs; graduate and undergraduate numbers for each engineering program; and for similar numbers for the campus as a whole. For example, the first column of Table 4 reports that engineering students at Berkeley (UCB) account for 13.4% of the total student population at Berkeley—resulting from 2,894 engineering undergraduates, and 1,590 graduate students—and that approximately 13% of the regular full time faculty at Berkeley are Engineering FTEs.

Reflecting the heavy emphasis on research within the School of Engineering at Berkeley, graduate students account for 35% of all UCB engineering students. In contrast, the fraction of graduate students within all departments at Berkeley is 30%. This general characteristic is

common across all UC campuses. Indeed, a very obvious characteristic of Engineering on UC campuses is a very strong emphasis on graduate research and education. Systemwide, the total fraction of engineering students who are graduate students is nearly 28%, compared with the fraction of graduate students in all other departments; 19%. The total number of graduate students assigned to faculty in the School of Engineering at UC Merced is currently 23.5 (10% fraction of all engineering students), with this number expected to increase significantly when two new graduate groups with a strong emphasis in engineering (Biological Engineering and Small-scale Technologies, and Mechanical Engineering and Applied Mathematics) became available in AY 2007-2008. For UC Merced to take its place among our sister engineering programs, we must place having a strong research program, with requisite need to develop research infrastructure to maintain that program, at the top of our list of priorities.

A similar comparison with other top engineering programs in the U.S. is consistent with the observation that the best engineering programs place a very strong emphasis on graduate research and education. Table 5 presents similar data for 10 top engineering programs in the US—our Comparison 10 universities. While the range is understandably larger, these top schools of engineering place a relatively greater emphasis on graduate research on their respective campuses than for other disciplines, at least with respect to the distribution of students. It is interesting to note that in contrast with the data for UC campuses, in general the fraction of students who are engineering students at these top institutions tends to be higher than within the UC—UCSD being a glaring exception.

The faculty of the School of Engineering at UC Merced has established a goal of achieving a level of 20% of total enrolled students with a corresponding—though yet to be defined explicitly—emphasis on graduate student fraction. Not only will this result in a very healthy research foundation for our student community, but will accelerate UC Merced's goal of enhancing economic growth in the Central Valley through the enhancement of its technical workforce.

2.2.2 Targeted student/faculty ratio within the School of Engineering

Tables 4 and 5 also contain data on the student/faculty ratio within engineering programs within the University of California and at the 10 of the top engineering research programs in the country (respectively). Because of the heavy emphasis at UC Merced on undergraduate declarations of academic major upon application, the student faculty ratio considering only undergraduate student numbers is presented separately from the corresponding ratio of all engineering students considered. For example at Berkeley, the student/faculty ratio considering only undergraduates is 13.3:1 whereas the overall ratio considering all engineering students at Berkeley is 20.6:1. In contrast, the current undergraduate student/faculty ratio in Engineering at UC Merced is 9:1, while the overall engineering student/faculty ratio is only slightly higher at 10:1. This is projected to increase to an undergraduate student/faculty ratio of 13:1 and an overall student/faculty ratio of 15:1 in AY 2009-2010. Our goal is to grow steadily yet deliberately to a level where the overall student/faculty ratio is in the low 20s, with the undergraduate student/faculty ratio in engineering being somewhere between 15:1 to 17:1

Maintaining a balance in growing these metrics at a gradual rate is important while the campus is in its infancy. For example, increasing the undergraduate fraction too abruptly would excessively burden the faculty during a time when they are already overloaded with

responsibilities of building the university. It is also important to note that regardless of the faculty to student ratio, courses necessary for students to graduate must still be taught. As a result, faculty at UC Merced currently have a high teaching load. The need for a parallel growth in graduate student numbers is not only important while faculty are developing their research programs, but to insure that we have sufficient numbers of graduate students to support our undergraduate programs (TAs, lab assistants, etc.).

Attaining this balance while maintaining the overall fraction of engineering students at 20% will, we feel, provide a robust and strategically positioned academic program, and one that will serve well both our undergraduate and graduate student populations.

Table 4 – Data on student enrollment in engineering within the University of California system (2005 data).

		UCB	UCD	UCLA	UCI	UCM	UCR	UCSB	UCSC	UCSD	System
Engineering	Undergrad	2,894	3,059	2,269	3,252	225	1,275	1,468	759	4,035	19,011
	Grads	1,590	1,116	1,256	995	22	291	694	274	1,147	7,363
	Total	4,484	4,175	3,525	4,247	247	1,566	2,162	1,033	5,182	26,374
	Faculty	218	176	150	154	26	73	125	66	166	1,128
	% UG	65%	73%	64%	77%	91%	81%	68%	73%	78%	72%
	% Grads	35%	27%	36%	23%	9%	19%	32%	27%	22%	28%
Campus	Undergrad	23,447	22,618	24,946	19,930	1,191	15,089	18,114	13,669	20,679	158,492
	Grads	10,036	4,051	10,771	3,774	76	1,965	2,905	1,344	5,121	39,967
	Total	33,483	26,669	35,717	23,704	1,267	17,054	21,019	15,013	25,800	198,459
	Faculty	1,671	1,450	1,692	839	90	610	781	542	984	8,569
	% UG	70%	85%	70%	84%	94%	88%	86%	91%	80%	80%
	% Grads	30%	15%	30%	16%	6%	12%	14%	9%	20%	20%
Engineering % of Campus	% UG	12.3%	13.5%	9.1%	16.3%	18.9%	8.4%	8.1%	5.6%	19.5%	12.0%
	% Grads	15.8%	27.5%	11.7%	26.4%	28.9%	14.8%	23.9%	20.4%	22.4%	18.4%
	% Total	13.4%	15.7%	9.9%	17.9%	19.5%	9.2%	10.3%	6.9%	20.1%	13.3%
	% Faculty	13.0%	12.1%	8.9%	18.4%	28.9%	12.0%	16.0%	12.2%	16.9%	13.2%
S/F R	Undergrad	13.3	17.4	15.1	21.1	9	17.5	11.7	11.5	24.3	16.9
	Total	20.6	23.7	23.5	27.6	9.5	21.5	17.3	15.7	31.2	23.4

2.2.3 Implications for faculty Engineering FTE requests

The faculty of the School has established a target schedule for extending and expanding our program consistent with those of the engineering programs at the other UC campuses, and those of the top engineering programs in the country. It is reflected in terms of a 10-year planning horizon as reflected within the shaded portion of Table 2.[ii]

With engineering students currently comprising slightly over 19% of the UC Merced student body, this places UC Merced in the upper quartile of UC campuses in terms of engineering emphasis during a time when UC Merced is making its mark as a university having a strong emphasis in the STEM areas.[iii]

Realizing the overall student growth based on the targets established for UC Merced, coupled with the decision by the faculty of the School of Engineering to maintain a total student fraction of 20% of students being engineers within the planning horizon, a framework is established that will guide the growth of our faculty numbers. Specifically, our student/faculty ratio will grow from a current level of about 9:1 to somewhat greater than

18:1 by the time our campus student population becomes 5,000 as specified in the original planning documents for the campus.

Table 5 – Data on student enrollment within the top engineering programs in the United States (2004 and 2005 data).

		UCM	UCB	GaTech	UIUC	UMich	Purdue	UCSD	UTAust	TAMU	UCLA	Wiscon
Engineering	Undergrad	225	2,894	5,200	5,329	4,874	6,049	4,035	4,553	5,930	2,269	3,137
	Grads	22	1,590	3,062	2,681	2,704	2,272	1,147	2,013	2,202	1,256	1,378
	Total	247	4,484	8,262	8,010	7,578	8,321	5,182	6,566	8,132	3,525	4,515
	Faculty	26	218	407	408	310	321	166	239	299	150	200
	% UG	91%	65%	63%	67%	64%	73%	78%	69%	73%	64%	69%
	% Grads	9%	35%	37%	33%	36%	27%	22%	31%	27%	36%	31%
Campus	Undergrad	1,191	23,447	11,842	30,452	25,467	30,851	20,679	36,478	36,227	24,946	28,217
	Grads	76	10,036	5,275	9,112	20,986	7,096	5,121	11,282	8,028	10,771	8,973
	Total	1,267	33,483	17,117	39,564	46,453	37,947	25,800	47,760	44,255	35,625	37,160
	Faculty	90	1,671	805	3,973	2,400	1,635	984	2,639	2,500	1,692	2,064
	% UG	94%	70%	69%	77%	55%	81%	80%	76%	82%	70%	76%
	% Grads	6%	30%	31%	23%	45%	19%	20%	24%	18%	30%	24%
Engineering % of Campus	% UG	18.9%	12.3%	43.9%	17.5%	19.1%	19.6%	19.5%	12.5%	16.4%	9.1%	11.1%
	% Grads	28.9%	15.8%	58.0%	29.4%	12.9%	32.0%	22.4%	17.8%	27.4%	11.7%	15.4%
	% Total	19.5%	13.4%	48.3%	20.2%	16.3%	21.9%	20.1%	13.7%	18.4%	9.9%	12.2%
	% Faculty	28.9%	13.0%	50.6%	10.3%	12.9%	19.6%	16.9%	9.1%	12.0%	8.9%	9.7%
S/F R	Undergrad	9	13.3	12.8	13.1	15.7	18.8	24.3	19.1	19.8	15.1	15.7
	Total	9.5	20.6	20.3	19.6	24.4	25.9	31.2	27.5	27.2	23.5	22.6

Blue entries in the table are 2004 data; all others are 2005 data.

After that time we intend to continue maintaining our student fraction at 20%, but will be well established enough to increase our student/faculty ratio well beyond that level as appropriate. Agreeing to do so prematurely would be detrimental to our overall academic stature and to our students. This is a strategy that is both responsible and achievable, and will result in a program that is both technically strong and sustainable, and will be one that will have a strong positive influence in expanding the technical workforce in the Central Valley.

The rationale discussed in Sections 2.2.1 and 2.2.2, and presented in Table 2, is based on growing the S:F ratio in the next few years to a level similar to other comparable universities. It suggests the allocation of 6.0 FTE new faculty positions for the next hiring cycle. However, regardless of student enrollment, a minimum number of faculty in each discipline are necessary to deliver the curriculum. Compelling arguments are presented in each major's section for a total hire of 13.5 FTE new faculty positions in SOE to adequately support teaching needs. Following a review of our current faculty authorizations, and a reconsideration of our proposed expansion of our academic programs, the specific description of these positions will be presented.

2.2.4 Workload Considerations

The academic planning model for the School of Engineering has been expended to include a consideration of faculty workload count as determined by the Office of the Registrar, and summarized in Table 6. It should be noted that the Registrar's data only reflects classes for which Engineering faculty are listed as the primary instructor. Engineering faculty participate in many co-taught courses, both those taught in other Schools and in the general education curriculum. Accordingly, faculty workload is underreported in this matrix and it is imperative that a mechanism of properly crediting shared teaching responsibilities be developed in order to accurately assess Student FTE counts. Anticipated Engineering student FTE count as presented in Table 2 over the planning period is repeated in the first row of Table 6. Normalized student FTE estimates—those student FTE teaching load units resulting from these actual student numbers—are presented in the second row of Table 6. Current

Table 6 Estimated student, faculty, and instructor FTE projections for the planning period.

	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011
Expected Student FTE	222	307	440	570	705
Normalized Student FTE1	367	400	560	660	760
Targeted Faculty FTE	26	29	35.5	52	60
Estimated Instructor FTE	2.0	3.0	5.0	7.0	8.0
[1] Includes students FTE for Introduction to Comping for NS and SSHA					

(Column 2), future (Column 3) and proposed (Columns 4 – 6), are presented in the third row of Table 6. Based on a detailed estimate of course offerings compared to anticipated teaching loads, including graduate course offerings within each discipline, row four of Table 6 lists the anticipated number of instructors that will be required to support lower division courses offered by the School of Engineering over this planning period.

Adjunct faculty are not included explicitly in this table because the few adjunct faculty we bring on will likely be involved in teaching upper division and graduate courses, and other specialized learning experiences not anticipated to be a regular contribution to our normal faculty workload. In many cases, adjunct faculty will be involved in co-teaching graduate courses with regular faculty, and engaging students with specialized directed reading or projects courses. In any case, the workload of adjunct faculty is not considered in the determination of instructors needed to deliver important elements of the lower division undergraduate program.

Faculty of the School of Engineering are, and will continue to be heavily and directly involved in the teaching activities of College One, including leadership of the Core 1 and Core 100 foundational general education courses; sharing the lecturing burden within these courses; participating equitably in the offering of freshman seminars; and sharing involvement in undergraduate research experiences consistent with the emergence of this program during the coming year.

2.2.5 Summary of current and authorized faculty FTEs (need update)

Searches currently in progress include 2.5 positions as a result of the AY2005-2006, strategic planning process (with 2.0 FTE Engineering allocations indicated by the non-underlined cells shaded yellow, and 0.5 FTE denoted as cross-School positions indicated by

the underlined cells shaded yellow in Table 7); and 3 positions allocated from the AY2006-2007 strategic planning process (shaded brown).

200-06-0108 Mechanical Eng

200-05-0109 Electrical Eng

200-06-0110 Bioengineering

200-07-0131 Bioengineering

200-02-0111 CSE (Systems)

200-07-0112 CSE

200-07-0113 Mechanical Eng/ Complex Systems

200-02-0114 Materials

200-05-0115 Environmental Engineering/Env. Systems (Air Pollution)

200-07-0116 Multiscale Modeling (Mechanical/Bioengineering)

200-07-0117 Sustainability Science (Environmental Systems)

200-07-0134 Cognitive Engineering

This format will be used in the following discussion and strategic plan for faculty hiring both for the 5-year faculty hiring plan, and the AY 2008-09 request for next years faculty FTE allocation (to be hired during Academic Year 2008-09 to be on board by the 2009-10 Academic Year. Additional columns will be added to denote that the corresponding faculty and positions will have responsibilities for launching new undergraduate majors. Descriptions of each position being requested within our 1-year FTE request will also describe research emphases of these individuals, as well as cross-School and cross-Engineering synergies.

Finally, these positions will be reflected explicitly within a revised strategic hiring matrix presented initially in Table 1, and revised in Table 10.

2.2.6 Faculty Diversity

Representation of women and minorities in the faculty ranks has been a high priority in the School of Engineering at UC Merced since its inception. Comparison data with other campuses for the percentage of women faculty members is shown in Figure 1, and that for Hispanic faculty members is shown in Figure 2. There are currently 19% women faculty members and 19% Hispanic faculty members in the School of Engineering. These numbers compare very favorably to those of other UC campuses and our comparison 10 universities. The School of Engineering continues to seek diversity among new faculty joining its ranks. This includes consideration of President's Post-doctoral Fellows in engineering disciplines that match hiring needs (although there are relatively few engineering Fellows awarded each year).

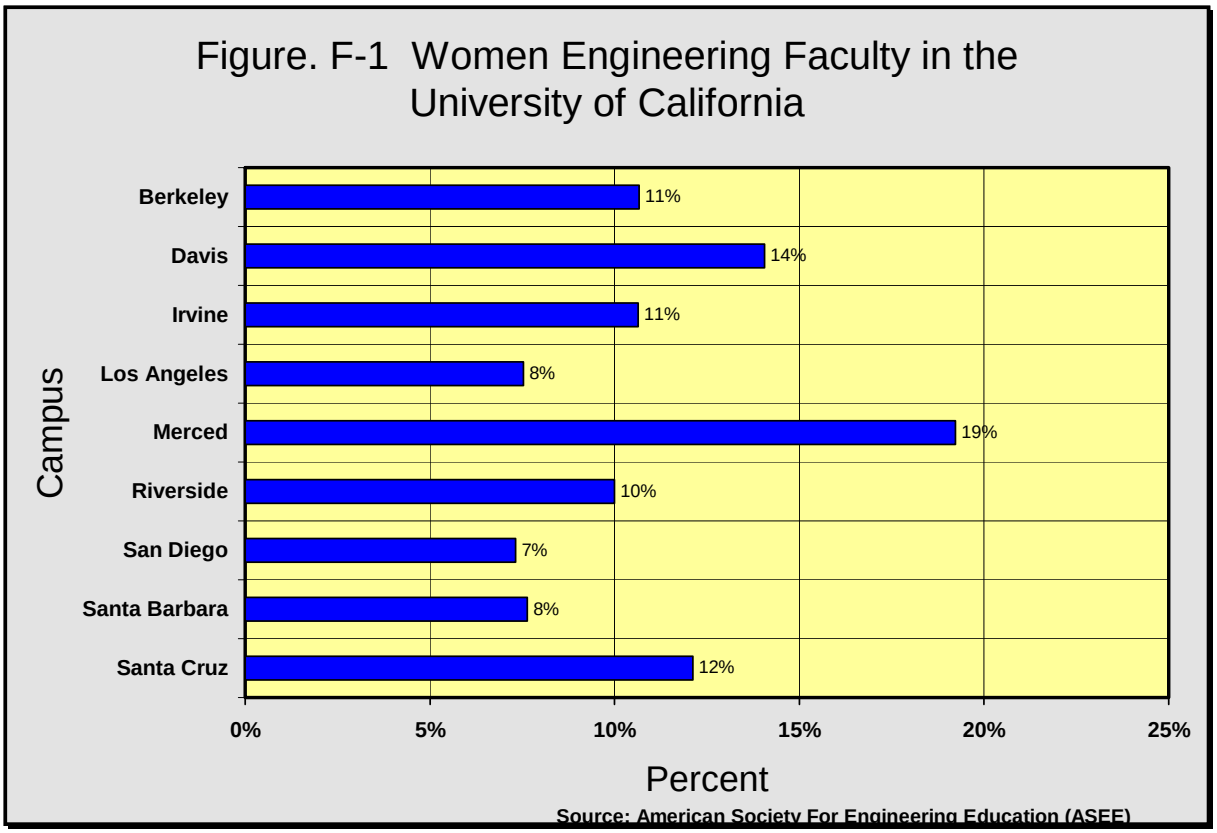
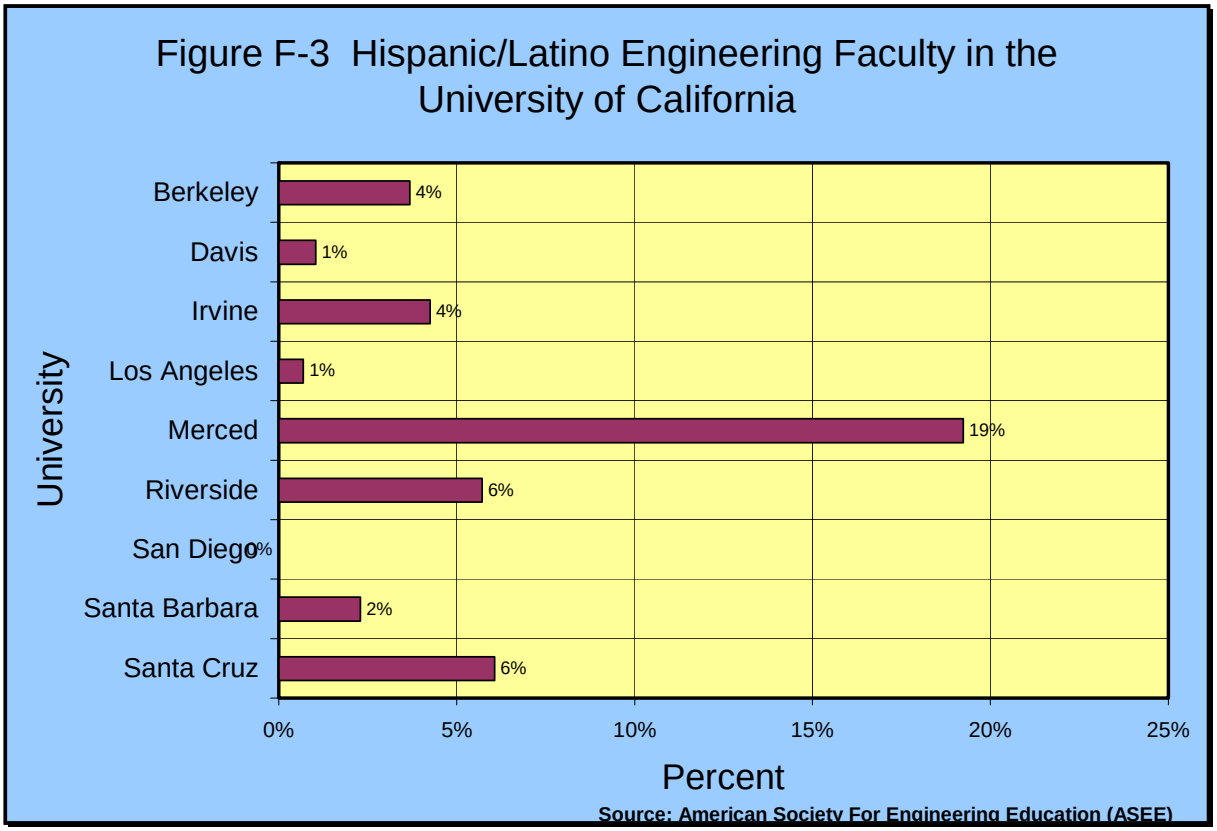


Figure 1 Comparison women faculty UC Campuses



2.3 5-year Plan for Expansion of Academic Programs

Table 7 – Status of School of Engineering faculty hiring reflecting primary disciplinary associations.

Academic Year	ENVE		CSE		BIOE		ME		MSE		EE		ChE		EEM		CE		Cumulaive Faculty FTEs
	Name	FTE	Name	FTE	Name	FTE	Name	FTE	Name	FTE	Name	FTE	Name	FTE	Name	FTE	Name	FTE	
	Bales	1.0	Newsam	1.0	Chin	1.0	Diaz	1.0	**Viney**	1.0	**Chiao**	0.5							
	Conklin	1.0	Kallmann	1.0	McCloskey	1.0	**Sun**	1.0	**Leppert**	1.0	**EE-2**	1.0							
	Harmon	1.0	Cerpa	1.0	Khine	1.0	Coimbra	1.0	Lu	1.0									
	Winston	0.5	Carpin	1.0	**(Escobar)**	1.0	**ME-4 (Fried)**	1.0	MSE-4	1.0									
	Guo	1.0	Carreira	1.0	**BIOE-5**	1.0	**(Modest)**		(Davila)	1.0									
	Rogge	1.0	Oh	1.0	BIOE-6	1.0	*Flex Systems*	1.0											
	Ervans(x)	*0.5*	Noelle	0.5	*Multi Scale*	0.5	*Multi Scale*	0.5											
	Westerling	0.5	CSE-8*	1.0			*Shen*												
	Chen	0.5	**CSE-9***	1.0			*Davinson*												
	Sustain	1.0	CSE-10(x)	0.5															
AY 05-06	5.5		6.0		4.0		2.0		2.0		0.5		0.0		0.0		0.0		20.0
AY 06-07	7.0		6.5		4.0		3.0		4.0		1.5		0.0		0.0		0.0		26.0
AY 07-08	7.0		7.5		5.0		4.0		4.0		1.5		0.0		0.0		0.0		29.0
AY 08-09	8.0		9.0		6.5		5.5		5.0		1.5								35.5
AY 09-10																			0.0
AY 10-11																			0.0
AY 11-12																			0.0

Underlined (x) denotes cross-School hire - *Italics* denote cross-engineering hires - (Paranthetical) entries denote individuals under consideration - **Bold** denotes senior FTE

	Future FTE
FTE	**Current searches**

AY 07-08 UG Enrollment	31	96	62	69	4				
Student Faculty ratio	3.9	10.7	9.5	12.5	1				
				Ratio does not include Shen and Davinson					

Our previous strategic plan called for starting two new majors during 2006-07 (Mechanical Engineering and Materials Science and Engineering), one new major during 2007-08 (Electrical Engineering), one new major during 2008-09 (Engineering Economics and Management), one new major in 2009-10 (Chemical Engineering), and one new major in 2010-11 (Civil Engineering). Budget and space considerations make this less likely than originally envisioned, and consequently we plan to delay the introduction of the Electrical Engineering, Engineering Economics and Management, Chemical, and Civil Engineering majors by one year. In particular, the dramatic shortfall in faculty FTE reduction from the allocation requested last year would, if continued this year and beyond, make even this schedule infeasible.

Adjustments to our 5-year hiring plan are based in part on a reconsideration of these future academic programs. Employment opportunities for graduating engineers in general, and those from disciplines being offered at UC Merced in particular, are expected to continue to be in high demand. Recent data from the Bureau of Labor Statistics indicate that the overall demand for engineers in all industries will increase by nearly 20% during the period of this planning exercise, with engineering jobs in the health service—including computational and information systems support areas—and medical instrument industries—including bioengineering, and several areas within mechanical and electrical engineering—forecasted to increase by more than 33%. Specifically, the 20 fastest growing professional jobs as reported by a recent issue of Fortune Magazine are displayed in Figure 3. Inaugural majors of the School of Engineering are well represented on this list. In addition, Mechanical and Electrical Engineering remain the largest engineering professions both nationally and globally, and are expected to continue to be so in the foreseeable future. While Materials

Science and Engineering is not anticipated to be large in terms of demand by undergraduates,

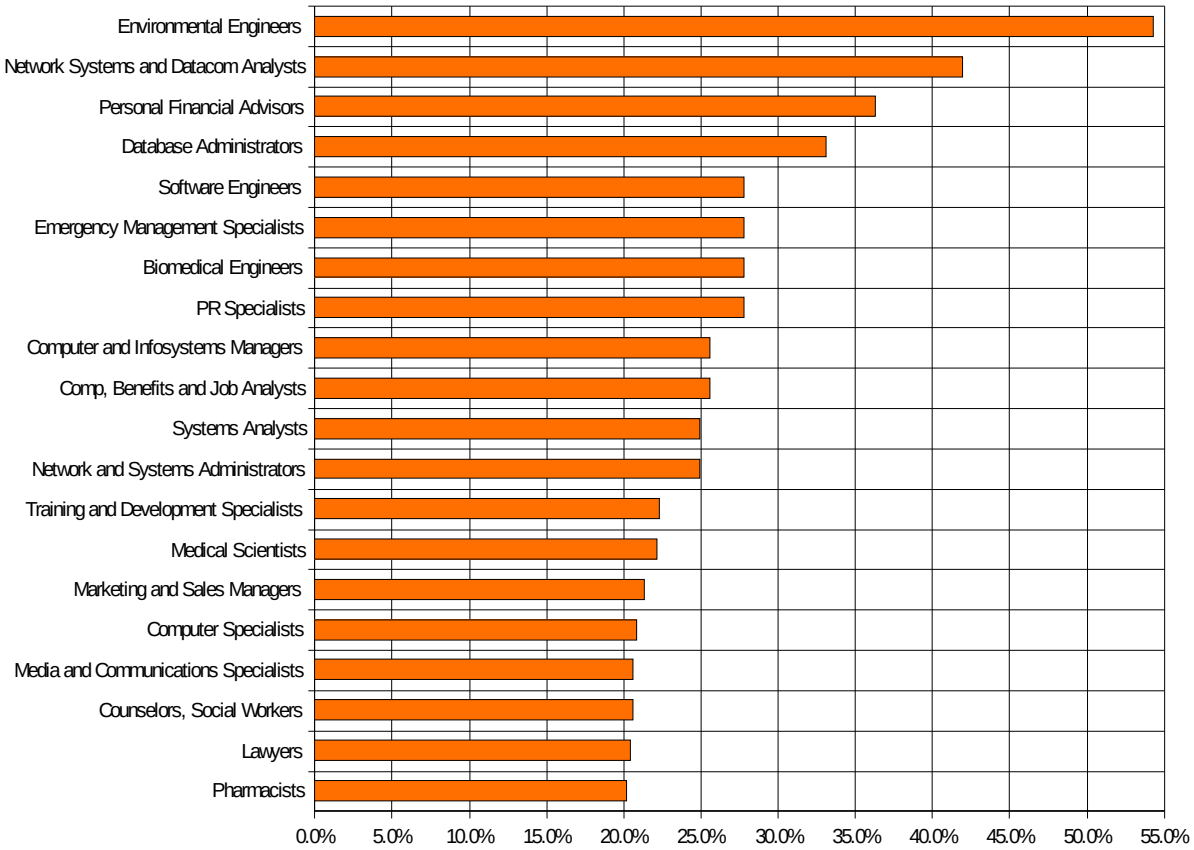


Figure 3: Twenty Most In-demand Professions Between 2002 and 2012 (Bureau of Labor Statistics)

the faculty who will support this major are key to the development of teaching and research programs in nanotechnology (an important and rapidly emerging technology sector), and will synergize extremely well with other emerging Engineering majors, with faculty and graduate student colleagues in the School of Natural Sciences at UC Merced, and those at other UC campuses.

2.3.1 Electrical Engineering

The School of Engineering at UC Merced currently offers an undergraduate degree in Computer Science and Engineering (CSE) and expects to offer an undergraduate major in Electrical Engineering (EE) starting in fall semester 2008. A search is currently underway for a Senior faculty member to guide development of the EE program, but introduction of the major has been delayed by one year due to current budget conditions. In order to better position these disciplines to attract and serve future students at both the graduate and undergraduate levels, and to attract research funding, the Engineering faculty has initiated a discussion about the possibility of merging the undergraduate programs in electrical engineering and computer science and engineering. While this discussion is still at the very preliminary stages, the implications for faculty FTE hiring could be significant. Thus prior to describing our 5-year hiring strategy, a brief discussion of the motivation for considering such a merger is presented.

There is considerable pedagogical motivation for a joint EECS program. The disciplines of CS and EE are clearly related. They are often considered as the endpoints of a linear continuum of disciplines that include CSE and Electrical and Computer Engineering (ECE), as shown in Figure 4.

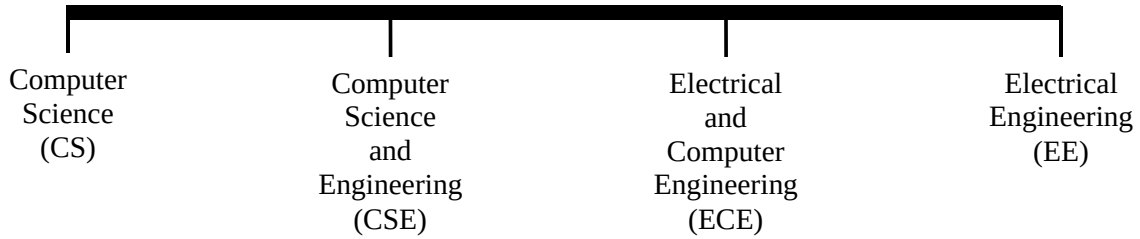


Figure 4 – Continuum of computational disciplines from Computer Science ←→ Electrical Engineering

Another, more revealing perspective posed by Edward Lee (professor and associate chair of EECS at UC Berkeley) and David Messerschmitt (professor of EECS at UC Berkeley) in their article *Engineering an Education for the Future*,[iv] views a circular continuum with three core areas as listed below and shown schematically in Figure 5:

1. Electronics (E)
2. Electronic information systems (EIS)
3. Computer science (CS)

And three overlap areas,

1. Computer hardware (E and CS)
2. Electronic systems (E and EIS)
3. Computer information systems (EIS and CS)

This joint EECS model supports two hallmark principles of the School of Engineering at UC Merced: (1) interdisciplinarity, and (2) common initial coursework that allows students to learn about and explore their interests. The boundary between hardware and software has been blurred through cross-fertilization such as software adopting modular components that were traditional to hardware—i.e., object oriented programming—and hardware becoming software-like via programmable logic. The opportunities for interdisciplinary work extend beyond the hardware/software boundary, however. Two of the three inaugural CSE faculty at UC Merced come from hybrid EE and CS backgrounds. Professor Newsam's research interests include image processing which exists at the boundary between CS and EIS. Professor Cerpa's research interests include computer networking and distributed systems, which also lie at the boundary between CS and EIS. The educational backgrounds of both professors include computer science and electrical engineering degrees, or hybrids thereof.

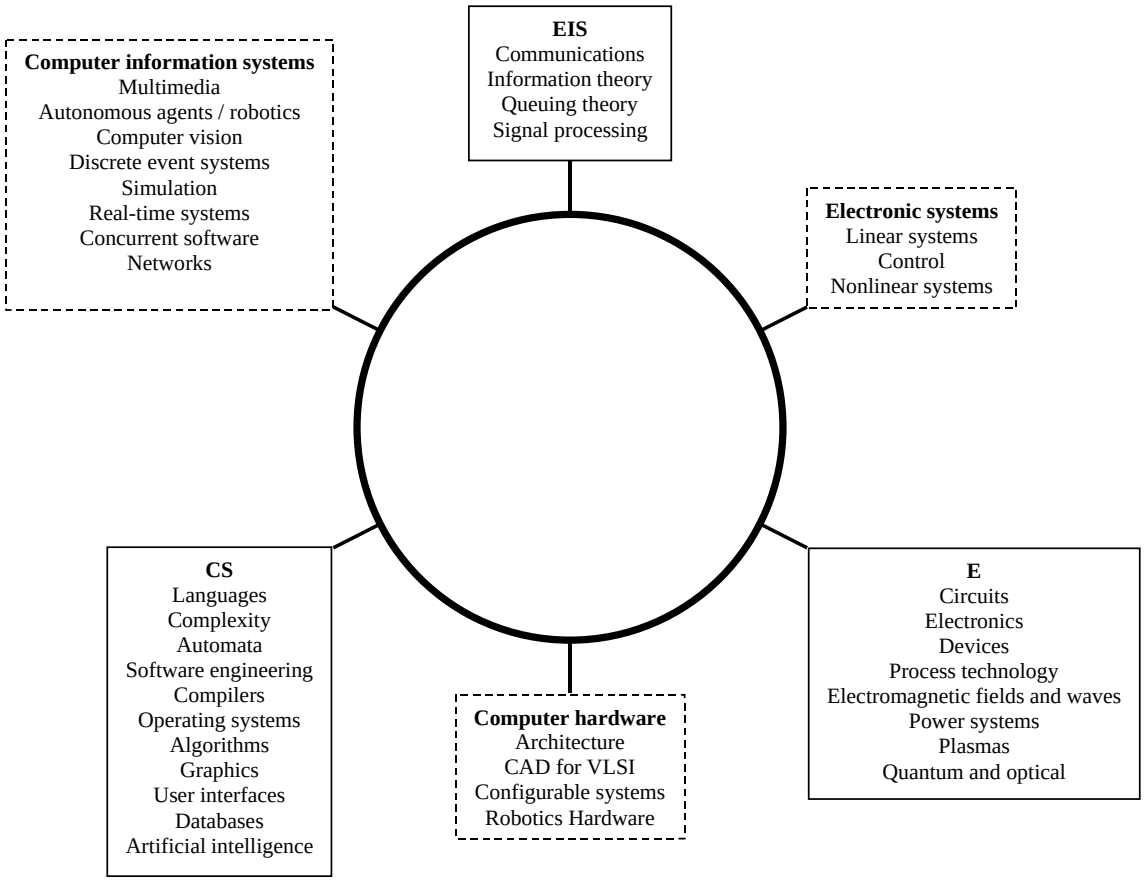


Figure 5 – A circular continuum along with sample topics. The core areas are shown in solid boxes and the overlap areas in dashed boxes.

The differences between disciplines in the EECS continuum is often confusing, especially to students seeing the topics for the first time. Just as it is unrealistic to expect graduating high school seniors to make a knowledgeable choice on undergraduate major, so too is it unrealistic to expect freshman or even sophomore college students to decide between CS, CSE, ECE, or EE. Having a joint EECS program with common freshman and sophomore years allows students to be exposed to a variety of topics from the continuum. This will prepare them to make a more knowledgeable decision about which emphasis or track to follow during their junior and sophomore years. We will likely consider a set of initial courses modeled on the recently revised EECS curriculum at UC Berkeley. Students in the EECS program would be required to take the following courses by the end of their sophomore year:

- CSE 30 – Introduction to object oriented programming and data structures
- CSE 31 – Systems programming and C.
- ENGR XX – Introduction to microelectronic circuits
- ENGR XX – Structure and interpretation of signals and systems

The ENGR course on microelectronic circuits is a modern, more digital version of a traditional circuits course. The ENGR course on signals and systems is modeled on a course

recently introduced at UC Berkeley that complements the circuits course to provide a better introduction to the EECS continuum.[v]

Additional arguments for a comprehensive consideration of merging these programs include:

1. Many of the top engineering schools at US institutions have joint EECS programs, including UC Berkeley, MIT, and the University of Michigan at Ann Arbor. Prior to a formal proposal to merge our programs, a comprehensive review of these programs will be made;
2. In addition to the pedagogical motivation, forming a joint EECS program at UC Merced probably makes sense from a resource perspective. Rather than struggling to hire the minimum number of faculty to support both CSE and EE degrees, the EECS program can spread to fill out the continuum as resources permit. The current CSE faculty lie on the CS to EIS arc of the continuum so this is a natural starting place for this growth; and
3. It would be significantly easier and more cost effective to form a joint EECS program initially that is later split, than vice versa.

Certainly many questions remain, such as what it means to have a joint EECS program at UC Merced where there are no departments. At larger, established schools, EECS is typically a department that offers either a single undergraduate degree (Berkeley offers only an EECS degree) or multiple degrees (MIT offers three degrees: Electrical Science and Engineering, EECS and CSE; and Michigan also offers three: EE, CE and CS). Offering only an EECS degree with several tracks (the Berkeley approach) would be the most straightforward way to achieve the objectives described above. However, other approaches might be possible. Another question concerns the relation of a joint EECS program to the yet to be formed graduate group that includes the current CSE faculty. Further consideration of a restructuring of our programs in CSE and EE will remain a major topic for discussion during the coming year.

2.3.2 Chemical Engineering

Our previous strategic plan reflected our intent to hire our first faculty member in chemical engineering in academic year 08-09, for roll-out of the major in 09-10. At the current rate of faculty hiring, bringing this major on this soon will come at the risk of having insufficient faculty personnel support for our current majors. Therefore, we propose postponing the roll out of this major until 10-11. Since chemical engineering is expensive in terms of both infrastructure and space, resource needs will have to be carefully considered. The chemical engineering curriculum requires sufficient support in space and personnel, especially in its required “unit operation lab” class.

Nonetheless, chemical engineering is an important component in the engineering portfolio of a mature campus. The motivation to plan *now* for UC Merced’s offering in this area is spurred by several factors:

4. Traditional ChE programs are converting away from the traditional areas of petroleum and bulk chemical processing to the scale up of biotechnological processes and specialized materials manufacture. UC Merced is in the unique position of being able to *start* a program in these strategic areas without having to dismantle an existing, unproductive, program or appease a “dead-wood” faculty;
5. UC Merced’s existing and planned engineering faculty already have a focus in the areas of biotechnology, materials, and nanoscale science that are mutually

complementary with strategic directions in ChE. The costs of bringing on a focused ChE degree program that complements the others would be less than that of restructuring an established program or starting a new one in a traditional, departmentalized environment;

6. Two of our existing faculty (Professors McCloskey and Chin) have undergraduate and graduate degrees in ChE that give them and us insights into the development of a cutting-edge program; and
7. We anticipate that existing synergies between Engineering and NS with respect to the chemical, biological and materials sciences will be able to grow to accommodate the teaching and research needs of a non-traditional ChE program.

2.3.3 Engineering Economics and Management

The undergraduate major in Engineering Economics and Management (EEM) is still under consideration. However, introduction of the major has been delayed due to budget uncertainties, as well as lack of clear information about the future development and growth of the management school.

2.3.4 Development of a Management Program and School

The School of Engineering (SOE) wishes to provide input into the planning of the School of Management (SOM). To help expedite success of SOM, we can leverage the research successes and strengths of SOE. Positions readily synergistic with the research thrusts of SOE and anticipated to be of particular benefit to both schools are: Technology Management, Entrepreneurship, and Natural Resource Management.

Below we provide a working definition of each of these research areas from the SOE perspective as well as a description of the type of faculty candidate most appropriate to head such areas.

2.3.4.1 Natural Resource Management

Natural Resource Management encompasses ecosystem management, habitat conservation, sustainable land management and water resources, with the goal of protecting, conserving, and rationally using natural resources. We proposed a Natural Resource Management focus within the SOM to advance our knowledge and understanding of our environment in order to develop innovative solutions to complex environmental challenges. Natural resources management employs a systems approach that combines and uses knowledge from natural science, engineering and social science to manage natural resources as an integrated system.

UC Merced's Sierra Nevada Research Institute provides the faculty expertise and unparalleled real-world research opportunities, including field work, in Natural Resource Management. Our location in the San Joaquin Valley near the Sierra Nevada offers an excellent and diverse real-world laboratory for studying the natural environment and how it is affected by human activity. It is envisioned that UCM would develop both undergraduate and graduate degrees in Natural Resource Management. The SoM would initiate the B.S.; initially, the graduate degrees could be offered under the Environmental Systems graduate group. At the graduate level, a number of discussions have taken place around starting a program in National Parks or Public Lands Management.

The Natural Resources Management program will be designed for students who are interested in pursing a career in both private and public sectors that engage in natural

resources management. The students who graduate from the program are expected to equip with necessary managing skills and solid understandings of how natural systems interact with human activities. We will focus on ecosystem stewardship, environmental governance, climate applications, policy and science, technology and its effects on the environment. While various foci should be considered, the following areas take advantage of capacity within UCM's existing schools: watershed, water resources, land, forest, public lands and wildlife management.

The demand for a workforce to carry out management of natural resources, including sustainable management, is always high as most resources used by human beings are depletable. Graduates of the program will be poised to pursue employment in a variety of federal, state agencies, non-profit organizations and the private sector. We expect the curriculum and aforementioned areas to qualify graduates for many state and federal jobs. Employment opportunities in California at the federal level include the, National Park Service, Fish and Wildlife Service, Forest Service, Geological Survey, Bureau of Reclamation, and Army Corps of Engineers. State and local level opportunities include various departments within the Resources Agency, water management agencies, parks and recreation departments, health departments, planning departments, and secondary school education. Non-profit and private sector employment opportunities include consulting firms, mining and lumber companies, and non-governmental organizations (e.g., Environmental Defense, Nature Conservancy, land trusts).

Natural Resource Management Position

This founding and leadership position requires a tenured faculty member at the full or associate professor level. Areas including global environmental issues (climate change, loss of biodiversity), critical natural resources (freshwater systems, forests), and health (air and water quality) are particularly encouraged. A research emphasis on water, forest, or range would compliment existing faculty and help fill an important niche in the UC system. The ideal candidate would have a proven track record in connecting their research with its social sciences and policy aspects and implications.

2.3.4.2 Entrepreneurship

Society depends on the advance of knowledge generated by scientists, engineers and researchers. However, entrepreneurs materialize this knowledge by undertaking innovative business plans. As an example, society's dependence on increasingly advanced materials, from lightweight yet strong composites for aeronautics to fiber optics for communications to bio-compatible materials for medical implants and drug delivery to silicon microchips for information storage and sensors, demands ever evolving new materials and the associated engineering processes for manufacturing them. Nanotechnology, the production of devices and machines at the molecular level, is heralded to drive the next technological revolution. This includes advances to enable: quantum information processing, orders of magnitude increase in strength of materials, and new strategies to address critical biomedical challenges.

As such, we feel it imperative to teach our students how to leverage the science and engineering fundamentals they learn by simultaneously providing them the real-world tools to do so. Entrepreneurship will draw on the research conducted by Materials Science and Bioengineering faculty and other disciplines in SOE. This position will be in the SOE. We will provide a framework for students to invent, develop new technologies, and recognize opportunities. As such, students will learn about intellectual property and patents, technology

and product development, discovery pipelines, the dynamics of innovation and technology management, risk management and regulatory compliance, and technology and start-up strategy.

Entrepreneurship Technology Position

This founding and leadership position requires a significant background in Materials Science, with also a demonstrated track-record in entrepreneurship. This will be the first Entrepreneurship position. The candidate should be well versed in topics including: advanced materials, biomaterials and bio-compatibility, nanotechnology, opportunity recognition, cost analysis, and manufacturing engineering. The ideal candidate would be a start-up veteran with a proven academic track-record.

The ideal hire for this position would have a background in MSE, allowing him/her to contribute to the teaching of engineering fundamentals and/or MSE core subjects. Their research area would have to be consistent with the goals of the BEST graduate group. This person would additionally have significant experience in the corporate world, of taking intellectual property past the concept stage to material or device fabrication. At UC Merced, the successful applicant would develop strong links with our economics and management programs, helping to create a degree pathway that emulates the successful MEM program at Oxford. Because it is likely that the candidate will have had limited teaching experience, an appointment to the assistant or associate professor ranks would be anticipated.

While detailed laboratory needs will emerge when strong candidates are interviewed, we again expect that considerable space use efficiency will derive from our ongoing efforts to develop shared facilities for nanofabrication and characterization.

2.3.4.3 Management of Technology

Management of Technology involves the operational and organizational issues associated with managing: innovations of the 21st century, information technology, environmental issues, and entrepreneurship in high and bio-technology. UCM's proposed *Management of Technology Joint Management & Engineering Program* seeks to employ rigorous research methods, including optimization, simulation, and empirical approaches, in a comprehensive and multidisciplinary framework to teach our students how to develop, plan, implement, and assess the technological capabilities which shape the strategic and operational objectives of organizations.

To help launch the Management School, we feel that one initial, effective focus would be on Management of Information Technology, to leverage the expertise of strengths of the Computer Science Faculty within the SOE. Information Systems Management focuses on the collection, processing, storage, distribution and utilization of an organization's information resources. According to the US Department of Labor, Bureau of Labor Statistics, employment of computer and information systems managers is expected to grow faster than the average for all occupations through the year 2016. Because Information Systems Managers must possess a solid mix of business and technical knowledge to understand organizational structures, objectives, operations and the resulting financial implications, we must have a comprehensive and rigorous program in which our students will be equally trained in the math and science fundamentals of computer science as well as in understanding

the environment in which their solutions will be applied, through economics and business courses.

Only by understanding both these facets can our students communicate effectively with users to design systems that support their needs.

Management of Technology Position

This founding and leadership position requires a broad and significant background in engineering and also in business/economics or related field, a demonstrated record of successful teaching, plus extensive research experience in academia and industry, with strong ties to industry. The ideal candidate should be well versed in topics including: systems development tools and techniques, information architecture, network configurations, databases structures, systems integration, knowledge management, technology development and process improvement, and performance measurements and technology drivers. This person could initially contribute to graduate education through the EECS graduate area.

2.3.4.4 Energy, Climate, and Sustainability

Our state, nation and world face unprecedented challenges in developing sustainable solutions to the global environmental problems associated with the production and consumption patterns that have developed in our industrial societies. Climate change is perhaps the most difficult problem that today's society and nations must solve. The knowledge base for finding solutions is particularly weak and effective policy resolution remains unknown. Thus, significant research is needed. In summer 2007, the UC campuses together submitted a $600 million proposal to the California Public Utilities Commission for a Climate Solutions Institute, intended to be the focal point for research on energy, policy, climate applications and related research to help California meet the goals of AB32, which commits the state to major reductions in carbon emissions. Research and education at the intersection of energy, climate applications, environmental sustainability and technology management will be a strong growth area for coming years and decades, and represents an opportunity for UC Merced. Other UC campuses are not far ahead of UCM in this area, and we can develop visible, well-respected programs in a relatively short time.

Universities across the nation are either considering or developing academic programs in sustainability, with energy and climate being the central themes. An SoM focus in this area can help faculty and students who develop technical solutions to put these in a business context. Entrepreneurship will be a key ingredient of a focus area in energy, climate, and sustainability at UCM. It is expected that sustainability could be an undergraduate focus area in the SoM, as well as a graduate degree track.

Energy, climate, and sustainability management position

This founding and leadership position requires a tenured faculty member at the full or associate professor level. Preference should be given to someone with a strong foundation in engineering or science, but with a track record of research in management or policy. Areas of interest for the founding faculty member include energy management, carbon management, sustainable infrastructure or climate applications. The person could initially attract graduate students through the Environmental Systems graduate group; though in the longer term, a more management-oriented graduate group should be formed.

2.3.4.5 Biotechnology Management

According to the National Science Foundation, the need for biotechnology workers is out-pacing the rate at which US universities are producing graduates. Biotechnology, loosely defined, incorporates techniques that leverage the characteristics of living systems for products or services. Because universities cannot satisfy industry's demand for new PhD graduates, attracting and retaining trained employees is increasingly a serious challenge. This problem specifically impedes, for example, the drug development process. In shortest supply are trained biologists to make discoveries, research engineers to develop the discoveries, and managers to plan and execute clinical trials.

Management programs designed to teach the requisite knowledge and skills for life science commercialization are therefore needed. Instead of creating another generic program in which students learn broadly about marketing, we can specifically train our students in growth areas to ensure their own marketability upon graduation. In particular, we have a unique opportunity because of Prop 71, a California statewide ballot measure passed in 2005, providing $3 billion in funding for stem cell research at California universities and research institutions (other states are considering similar legislation). Because we have this jump-start to address this burgeoning and rapidly growing field, we can develop a unique certificate program to specifically train our students in the requisite skills to help realize the long-heralded potential of stem cell research. We can develop a unique Biotechnology Management Track and an eventual major by piggy-backing on the research strengths of our biomedical scientists and engineers.

Biotechnology Management Position

This hire would be able to fit into several graduate groups, including BEST and QSB and bring unique and industry relevant research to UC Merced. This faculty member will not only teach our students the basic science and lab skills, but also the ethical, legal, and financial ramifications of their decisions. They will be taught about strategies and can attain real world practice through commercialization of existing research projects here.

2.3.4.6 Center for Entrepreneurship

Whether under a School of Management, engineering or jointly administered, a Center for Entrepreneurship would have a number of core features. We have already implemented an entrepreneurial aspect to Service Learning, by encouraging students to develop innovations to address the needs of their clients. The scope of the projects includes not only the engineering aspects, but also issues associated with a real nascent venture, including: opportunity recognition, intellectual property issues, competitive analyses, team formation and management, and fund-raising/financial management. This semester we are also introducing our first entrepreneurship course, BioEntrepreneurship (Eng 108, Eng 208). Other areas to pursue under an Entrepreneurship Center include:

- provide courses on product design and development
- educate students about intellectual property /enable ease of tech transfer
- build and support cross-disciplinary teams for technology and product development
- offer internship and fellowship opportunities with start-up companies, industry leaders, and venture capital firms
- offer students consulting opportunities
- provide real-world entrepreneurs as mentors (we are assembling a board of high-profile mentors)

- train our engineering and life science students in the business aspect of innovation and management
- promote industry connections and involvement with this campus
- offer incubation of companies that are developed from this campus
- stimulate and promote new industry in the San Joaquin Valley area

By teaching both the technical and entrepreneurial skills in parallel, we will uniquely arm our students to be competitive in today's workforce. By offering the opportunity to implement these skills in a real-world environment, we are providing the experience critical to become successful or "seasoned" entrepreneurs. Finally, by developing an interdisciplinary, nurturing, and entrepreneurial-promoting environment, we will offer our students and faculty the greatest probability of success with respect to their ventures.

2.4 Request for School of Engineering Faculty Positions for 2008-09

The 13 faculty FTEs being requested by the School of Engineering for the next faculty hiring cycle are shown in Table 8 as pink shaded cells corresponding to AY 08-09. They are ranked in order of priority within the major, and ranked by order of priority within the School of Engineering in Table 9. The faculty of the School of Engineering as a whole ranked the FTE requests shown in Table 9 and approved the ranking and adoption of this Strategic Plan in a vote taken at the January 15, 2008, SOE faculty meeting. Of 23 faculty eligble to vote, 18 voted YES, 0 No, with 5 absent. FTE requests were triaged into 3 categories - critical hires required for existing large enrollment majors to deliver the curriculum; high priority additional hires necessary to sufficiently staff majors, focused on UC Merced research pillars; and regular priority additional hires necessary to sufficiently staff majors. Within each category, FTE lines are listed with equal priority. The faculty of the School of Engineering recognizes that under the present fiscal conditions, we are unlikely to be allocated all the requested hires. However, we feel it imperative to articulate the reality of our hiring needs. Descriptions of major specific positions are presented in Sections 2.4.1 through 2.4.5, Cross-engineering positions (shared by more than one engineering major) are presented in Section 2.5 and cross-school positions are presented in Section 2.6. Filling our current positions and these 13 new positions would bring our total engineering faculty FTE to 55.5.

Bioengineering

To deliver the BIOE major in its currently proposed, we need to cover 26 specialist credits. 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 major includes 4 existing and 2 approved FTEs who are realistically available to deliver the above mentioned 26 specialist BIOE 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 we do not have the minimum number of faculty FTEs to deliver the major. In addition, we have initiated BEST (Biological Engineering and Small-scale Technology) graduate group in the fall semester of 2007. We also need to provide two required graduate courses and sufficient advanced elective classes (3-5) for BEST students.

Three future FTE directions have been identified by the faculty in BIOE (listed in the priority order).

1. Tissue Engineering

2. Physiological Modeling

3. Single Cell Quantitative Measurements

2.4.1 Bioengineering: Tissue Engineering

The field of tissue engineering is an emerging and ambitious area of research in which scientists seek to build devices that would replace diseased tissues/organs with their biological equivalents, thus completely restoring tissue/organ functionality. This area has been termed Tissue Engineering and/or Regenerative Medicine. The area of tissue engineering is, by nature, cross disciplinary in that it employs cell culture methods combined with appropriate materials, scaffolding architecture, technologies for cell delivery, and nutrient transport strategies while also synergizing with nanobioengineering by employing the use of small nanoparticles or nonocomposite scaffolding materials. For this reason, the tissue engineer would also be expected to contribute significantly to our undergraduate program in Materials Science.

The Tissue Engineering position could also compliment and synergize with the research of a number of faculty in the areas of Stem Cells, Vascular Tissue Engineering, Biomaterials, 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 Program at UCM.

2.4.2 Bioengineering: Physiological Modeling

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 human level. Systematic modeling incorporating various engineering concepts such as optimalization, 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 a interdisciplinary field between engineering and biology, BioE has a strategic advantage in engineering to address this unique challenge and opportunity.

Current most faculty members in bioengineering at UCM are in experimental-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 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 can not be addressed from the view point of a single discipline.

The space need for this position is expected to be dry lab space around 400 sq ft. This faculty member is expected to teach undergraduate classes in bioengineering and graduate classes in BEST graduate group.

2.4.3 Bioengineering: Single Cell Quantitative Measurements

Recent developments in optical techniques (particularly laser manipulation, quantitative fluorescence microscopy, ultra-small volume sampling and analysis, incorporation of optically useful probes, and optical approaches to determining the rates and equilibria of intracellular processes) clearly indicate the enormous potential of in vivo single cell studies for our understanding of cell physiology. Single-cell detection technology should allow researchers to target individual molecules within the cell, track where they are going, and record changes--all without significantly interfering with cellular physiology. Due to its highly multidisciplinary nature, single-cell detection technology presents a unique opportunity for Engineering at UCM. Our unique campus environment is an ideal location to cultivate single-cell detection technology. This research area will apply tools in optics, microfabrication, microelectronics, nanotechnology and analytical chemistry to small volume detection inside an individual cell. The development of such technology enables many research and industrial applications such as single-cell manipulation, high throughput screening, improved diagnosis tools, single-cell genomics and proteomics. This research area represents an outstanding opportunity to involve faculty members in natural sciences, optical physics, bioengineering, materials science and engineering, mechanical and electrical engineering in a cross-disciplinary project. It is proposed that this position will be designated at the rank of full professor.

This position would compliment and synergize with the research of a number of faculty in many areas of research. We also expect that this faculty hire would contribute to our growing needs in developing assays or tools for analyzing single cells. Single cell analysis is a much needed tool for the advancement of many fields including Systems Biology. Therefore, this cross-school position compliments the growing needs for graduate programs such as BEST or Quantitative and Systems Biology.

Computer Science Engineering

We request a minimum of 3.5 full FTE positions to be assigned to CSE. After ample internal discussions the CSE faculty unanimously agreed on the following prioritized list for the 2008-2009 strategic plan.

2.4.4 Computer Science Engineering: Instructor with security of employment.

We request one instructor to permanently teach the undergraduate courses CSE5, CSE20 and CSE21. These introductory courses attract large number of students and are time consuming to teach and prepare for research faculty. A dedicated experienced instructor is the best option in order to optimize the resources needed to offer these classes. An additional duty of

the instructor will be to coordinate and supervise the content of the other lower division CSE courses, i.e. CSE30 and CSE31. In recent semesters lower division CSE courses have been offered by temporary instructors, often hired under time pressure. The persistence of this situation hinders the development of a strong undergraduate CSE program, due to the fluctuations in content and possible lack of coordination deriving from this situation. The role of the instructor will be therefore critical to improve our existing curriculum. Considering that the three aforementioned courses are not specific to the CSE major, but are rather taken by all engineering students (CSE 20 & 21), or from the other schools (CSE 5), we propose that this position will be counted as a 0.5 FTE against CSE.

2.4.5 Computer Science Engineering: Senior position complementary to existing CSE faculty with research emphasis in CS.

This position is needed to broaden the CSE program both for teaching and research. We recently successfully hired two junior faculty members in the areas of machine learning and intelligent systems. With the goal of creating a very strong research group within a few selected domains instead of growing in all directions, this position will aim to the same domains targeted in the past, i.e. AI/Graphics, Systems, and Data Analysis/Data management. The current searches are still somewhat broad, and there is a possibility that not all of the target domains of the current searches will be covered successfully or sufficiently by the candidate hired. If there is sufficient coverage, however, the new core research areas that will be targeted include languages, compilers, operating systems, computer networks, embedded systems, and algorithms. Considering the current composition of the CSE faculty, i.e. 6.5 assistant professors, it is imperative to hire a senior faculty member in the CSE program. Two searches for senior faculty members are open at the moment. With this additional senior position the CSE group will reach a viable distribution of ranks. The space needs for this new position are expected to be similar to those of the current CSE faculty; a modest level of dry lab space for several computer and/or experimental research workstations. The exact space needs will depend on the rank of the position.

2.4.6 Computer Science Engineering: Senior position complementary to existing CSE faculty with research emphasis in EE.

This position is needed to build the Electrical Engineering undergraduate major under planning. Moreover the graduate study area formerly called Computer and Information Systems has been recently renamed Electrical Engineering and Computer Science. This new position will therefore be instrumental not only to jumpstart the undergraduate program in Electrical Engineering, but also to strengthen the graduate program being developed at the moment. Considering the current situation in Electrical Engineering, i.e. one open search with broad scope, we feel the new search should be broad as well. Targeted areas should include the following: systems,communication, signal processing, wireless technology and networking, RF hardware, control, circuits and sensors The space needs for this new position will depend both on the rank and on the research area of the selected candidate.

2.4.7 Computer Science Engineering: Senior position complementary to existing CSE faculty with research emphasis in EECS.

This position will be instrumental to bridge possible research and teaching gaps between Electrical Engineering and Computer Science. Possible research topics include, but are not limited to, embedded systems, robotics, sensor networks and the alike. The space needs for

this new position will depend both on the rank and on the research area of the selected candidate.

2.4.8 Computer Science Engineering: Media Arts and Technology (MAT) (Cross-school)

Media Arts and Technology (MAT) is an interdisciplinary area that fuses emergent computer science and engineering, and digital art research, practice, production, and theory. MAT offers the opportunity for working at the frontiers of art, science, and technology, where new art forms are born and new expressive media are invented. The highly crossdisciplinary nature of this exciting field, and the direction being taken at UC Merced with key faculty hires within the School of Engineering and the School of Hunamities, Social Sciences, and Arts, suggest that this is an excellent opportunity for innovation at UC Merced.

Environmental Engineering

2.4.9 Environmental Engineering: Junior or Senior Hire Environmental Microbiology.

We recommend an open-rank search in, with a research focus on any of several areas, e.g. environmental remediation, environmental contributions to infectious disease or characterization of microbial communities in natural and engineered systems. Last year both the SoNS and SoE strategic plans identified environmental microbiology as a critical hire in order for UCM to achieve national competitiveness in a number of research areas. Leading environmental research programs in the nation include a strong core subgroup of environmental microbiology and microbial ecology, typically 2-3 investigators. Environmental microbiology was deemed critical for emerging research strengths in global change ecology, in biocomplexity, bioremediation, and in climate and watershed science. This position would provide critical synergy with the successful candidates in ecology currently being searched in SoNS, particularly in the microbial ecology area. This individual is necessary for creating the kind of modern undergraduate environmental engineering program that will attract the best and brightest students to this field, for undergraduate teaching in environmental engineering and for accreditation of the degree. The ES graduate group also identified the position as important for recruiting graduate students and offering appropriate courses. CAPRA recommended the position.

2.4.10 Environmental Engineering: Junior or Senior Hire in Ecohydrology and Ecological Engineering.

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 and across the Western U.S.

Materials Science Engineering

"Materials Sciences" has been identified previously as a cross-School priority, and "Materials Technologies" as a priority within Engineering. A nanoscale trend is also emerging as an area of interest that intersects MSE, BIOE, ME, ChE, Life Sciences, Physics and Chemistry, as well as SNRI (forest fire generated nanoparticulates) and the Energy Program (quantum dot photovoltaics and nanostructured fuel cells/batteries). MSE and BIOE, in particular, are building a strong research program in bionanotechnology, as evidenced by the continued development of the Biological Engineering and Small-scale Technologies graduate group. Bionanotechnology is a research area of great current interest that encompasses fields such as tissue engineering, nanoscale/microscale electromechanical systems, biosensing, and bio-inspired nanoscale materials synthesis and processing. Funding for it by granting agencies ranging from the National Science Foundation to the Department of Defense, and private industry, is rapidly growing; and it strongly contributes to the strength in biomedicine that UC Merced is building.

Faculty in MSE are also contributing to the proposed research theme in free radical biology. Reactive oxygen and nitrogen species (which includes free radicals, such as superoxide and nitric oxide) play essential and ubiquitous roles in biology. An interdisciplinary group composed of faculty and students in QSB and ES has formed a center that focuses on the role of oxidants and other electrophiles in both damage to organisms and in normal physiology. The present and proposed work includes studies of redox cycling in the environment, environmental and health hazards of nanotechnology, photobleaching of coral, how Hepatitis C infection is modulated through redox signaling, how elephant seals avoid oxidative stress that results from extreme environments, how growth factors act through redox signaling, and understanding the recognition of oxidants important to inflammation with the goal of designing anti-inflammatory pharmaceuticals. In particular, since MSE has a research concentration in nanoscale materials, its faculty contribute important nanoscale materials characterization and chemistry expertise to this effort.

MSE as a discipline intersects many areas of environmental interest. These include: (a) new, energy-efficient, cost-effective routes to raw material extraction and recovery (the FFC Cambridge process for material production, http://www.msm.cam.ac.uk/djf/FFC_Process.htm, demonstrates the revolutionary impact that MSE can have in this regard); (b) the effect of changing ozone levels and climate on the durability of construction materials; (c) materials use in energy conversion, distribution and storage; (d) materials for communication and transportation infrastructure; (e) whole life-cycle design with recyclable materials. Given its existing "green" credentials and continuing aspirations, UC Merced can (should!) become an international leader in sustainable materials technologies.

Faculty in MSE are developing innovative experiences in undergraduate education, a key component of our goals to put UC Merced at the forefront of 21st century materials technology. A recent grant awarded by the National Science Foundation will enable us to offer undergraduates the opportunity to learn microfabrication techniques and practical

nanotechnology, and to extend the experience to students (= potential recruits) from Merced College.

Undergraduate students at UC Merced have expressed considerable interest in MSE. Freshman seminars have been oversubscribed and, consistently, very well attended. Numerous conversations with students suggest a chicken-and-egg situation in which students are drawn to the subject, but are reluctant to declare MSE because they perceive that there are not yet sufficient FTEs to deliver the major. We also anticipate that some students (those who find themselves less mathematically inclined but who have strong conceptual and spatial skills) will migrate from ME and also EE to MSE. This has been the experience at many established universities; ME or EE recruits the students to campus, and MSE helps to keep them there. In this way, an active MSE program strengthens the ME/EE programs and boosts retention.

From the point of view of delivering the approved major in MSE, which has been designed to meet ABET accreditation standards, a "core" of 26 specialist credits needs to be covered, and there are also some technical electives that MSE should contribute to the "pool" of courses that are presented to students in MSE, BIOE, ME and Chemistry. A bare minimum of 5 FTEs is needed to run the major based on these teaching and accreditation requirements. The proposal for a minimum of 5 FTEs allocated to this major is also consistent with the original plans that formed the basis for approving the major. There are currently up to 4 approved FTEs (Professors Viney, Leppert and Lu, and a fourth hire currently open) associated directly with this major. Two are at the senior level and two at the junior level. However, Viney and Leppert continue to be very heavily involved in other programs that are essential to the success of the School, including the Engineering Fundamentals course ENGR45 (Introduction to Materials), General Education, Engineering Service Learning, the Center Of Integrated Nanomechanical Systems (COINS), and the Imaging and Microscopy Facility. Therefore, we are requesting an FTE (emphasis: complex materials) at the Senior level.

We are also keen to capitalize on the unique opportunities afforded by the already strong economics program and the nascent School of Management at UC Merced. Specifically, we would like to emulate the successful program at Oxford which allows the very top students in Materials (as assessed after the freshman year) to major in Materials, Economics and Management (MEM). The approximate coursework composition is 60% Materials, 20% Economics and 20% Management. The Oxford program recognizes that captains of industry in Europe's and Asia's more successful economies are not lawyers or accountants, but PhD engineers or scientists. Graduates of the program are highly sought after. We envisage that such technical representation in the highest levels of industry will become increasingly necessary as manufacturing based on – and producing – complex technologies increases. It will be especially relevant in the context of UC Merced, which is expected to perform the dual roles of inventing technologies and encouraging local entrepreneurship to implement the inventions. Accordingly, we propose hiring an FTE (at the level of assistant or associate professor) who can thrive at the intersection of engineering and entrepreneurship.

2.4.11 Materials Science Engineering: MSE-6: Complex Materials

An FTE in complex materials will contribute strongly to both our teaching and research missions. The person hired will have an accreditable background in materials and be able to deliver essential courses that are core to the discipline, plus technical electives. On the research side, Merced would benefit from enhanced expertise in new materials that meet

nanodevice fabrication, or high temperature material for use in energy conversion, or nanomaterials with novel physical, chemical and mechanical properties. A hire in any one of these areas will considerably strengthen at least two of the research focus areas targeted for strategic development by the School of Engineering: Energy and Materials Technologies, and Nanoscale Systems. A hire who (our preferred choice) *combines* experiment and modeling could enhance the collaborative opportunities for an additional two of the areas targeted by SOE: Computational Sciences and Engineering, and Modeling Sciences. The term "Complex Materials" reflects the fact that simultaneous control of multiple properties requires molecular order to be controlled simultaneously at multiple length scales. Depending on the area of expertise of the person hired, it is likely that he or she may also contribute to strategic research efforts in Environmental Science and Engineering or Biological Engineering.

We propose a hire at the Senior level for this position. Laboratory needs will be unexceptional, and will depend on the area of the strongest candidate who emerges from the search. Space use efficiency will benefit from our ongoing efforts to develop shared facilities for nanofabrication and characterization.

Mechanical Engineering

The mechanical engineering (ME) undergraduate major was launched during Fall 2006 accepting only freshman students. The plan is to start accepting transfer students for 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 this major before they complete their degree. There is increasing evidence that ME will become one of the most popular engineering majors at UC Merced. For instance, out of 300 freshman students accepted in engineering for fall 2007, 53 students (17.7%) chose ME. Last year, a significant fraction of the undeclared students decided to enroll in ME, so we expect a similar trend for this year.

Although there are some fundamental topics that relate to mechanical engineering, such as mechanics, design, manufacturing, strength of materials, transport phenomena, controls, etc., we emphasize that this discipline adapts and grows as new technologies emerge. Cutting-edge research in biological systems, nano- and micro-scale devices, sustainable energy systems, intelligent systems and controls, complex systems, supercomputing, mechatronics, and national defense issues is currently being done at top mechanical engineering departments around the world.

In order 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 university.

Currently, ME provides service to other majors by teaching a number of engineering fundamentals courses that include: ENGR 50 (Statics), ENGR 57 (Dynamics), ENGR 151 (Strength of Materials), ENGR 130 (Thermodynamics), ENGR 120 (Fluid Mechanics), and ENGR 135 (Heat Transfer). This year, ME will also be teaching ENGR 155 (Engineering Economic Analysis). This situation increases dramatically the teaching load of ME faculty.

Concerning graduate studies, the Mechanical Engineering and Applied Mechanics graduate group was approved in May of 2007. This multidisciplinary research group 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 variety of research topics, a number of graduate courses taught by MEAM faculty serve graduate students from different disciplines. This also increases the teaching load of ME faculty. For instance, the following courses, offered by ME faculty, have been taken by graduate students from MEAM and/or other programs: ES 235 (Heat Transfer), MEAM 201 (Advanced Dynamics), ME 210 (Linear Controls), and MEAM 251/ES 237 Viscous Flows.

There are currently three FTE positions filled in mechanical engineering, Professor Diaz, Professor Sun, and Professor Coimbra, denoted ME-1, ME-2, and ME-3, respectively. The excerpts of the CAPRA report to the EVC dated May 20, 2006 indicated "*two additional FTEs for ME are highly recommended, one at the senior Level.*" Out of these two recommended positions, only one was authorized as a result of the AY 2005-06 academic strategic plan, denoted ME-4 in Table 8. A senior faculty has been selected out of an outstanding pool of candidates and his case has been recently approved by CAP.

The memorandum date July 20, 2007 from Keith Alley authorized one additional FTE for ME, denoted ME-5. A search is already underway to fill out this position at the senior level in the area of complexity and energy systems. This position will expand the current areas of research available in the program, help with teaching courses at the undergraduate and graduate level, and help with the starting of the Energy Institute at UC Merced. One more Cross-Engineering FTE was authorized, denoted BIOE-7/ME-8, in the area of multi-scale modeling. The job description has already been posted on UCM website.

A total of seven desired positions have been identified and described below in descending level of priority for the major.

1. Bio control
2. Computational Engineering
3. Bio-Inspired Mechanics
4. Nonlinear Analysis
5. Energy (with emphasis in Fuel Cells or Hybrid Systems)
6. CFD
7. Mechatronics

The requested positions can be described as:

- ME-6: Senior/junior position complementing existing ME faculty
- ME-7: Senior/junior position complementing existing ME faculty

The program is also requesting ***two security-of-employment instructors***. One will concentrate on the engineering fundamentals courses and the other on ME electives.
The description of the requested FTE positions is as follows:

2.4.12 Mechanical Engineering: ME-6: Bio-Control

Mechanical Engineering sees a need for an FTE working on research in one or more areas of the emerging domain of Bio-Control. 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, the design and construction of self-assembled structures, bio-mimetic surfaces, sensors and actuators that will allow external control of

biological and bio-technology systems. Mechanical Engineering and the MEAM Graduate Group see such a hire as necessary to position the campus competitively in this promising area of research. The undergraduate program in Mechanical Engineering will benefit with courses such as mechatronics (ME 142), vibration and controls (ME-140), and the capstone design (ME-170). The graduate program will benefit with courses in the particular areas of research of this FTE. Natural synergies with other programs include Bio-Engineering, Computer Science and Engineering, and Applied Mathematics. The space needs are expected to be adequate for a senior/junior level position in the wet lab area.

2.4.13 Mechanical Engineering: ME-7: Computational Engineering

This senior/junior position is an important and strategic area of research in ME and it is intended to strengthen the actual capabilities of ME faculty. It will cover, but will not be limited to, the development of numerical schemes to treat problems in structural, fluids, and/or thermal/fluids 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 (ME 135) and CAE (ME 137). 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. The space needs are expected to be adequate for a senior/junior level position in the dry lab area.

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Table 8 School of Engineering Faculty 5-year Hiring Plan.

Academic Year	ENVE		CSE		BIOE		ME		MSE		EE		ChE		EEM		CE		Cumulaive Faculty FTEs
	Name	FTE	Name	FTE	Name	FTE	Name	FTE	Name	FTE	Name	FTE	Name	FTE	Name	FTE	Name	FTE	
	Bales	1.0	Newsam	1.0	Chin	1.0	Diaz	1.0	**Viney**	1.0	**Chiao**	0.5							
	Conklin	1.0	Kallmann	1.0	McCloskey	1.0	**Sun**	1.0	**Leppert**	1.0	**EE-2**	1.0							
	Harmon	1.0	Cerpa	1.0	Khine	1.0	Coimbra	1.0	Lu	1.0	**EE 3**	1.0							
	Winston	0.5	Carpin	1.0	**(Escobar)**	1.0	**ME-4 (Fried)**	1.0	MSE-4	1.0									
	Guo	1.0	Carreira	1.0	**BIOE-5**	1.0	**(Modest)**		(Davila)	1.0									
	Rogge	1.0	Oh	1.0	BIOE-6	1.0	lex Systems	1.0	**MSE 6**	1.0									
	Ervans(x)	*0.5*	Noelle	0.5	*Multi Scale*	0.5	*Multi Scale*	0.5											
	Westerling	0.5	CSE-8*	1.0	BIOE 8	1.0	*(TBD)*												
	Chen	0.5	**CSE-9***	1.0	BIOE 10	1.0	*(TBD)*												
	Sustain	1.0	CSE-10(x)	0.5	**BIOE 11**	1.0	ME 6	1.0											
	ENVE 11	1.0	***CSE 11***	**1.0**			ME 7	1.0											
	ENVE 12	1.0	**CSE 12**	**1.0**															
			CSE 13	1.0															
AY 05-06	5.5		6.0		4.0		2.0		2.0		0.5		0.0		0.0		0.0		20.0
AY 06-07	7.0		6.5		4.0		3.0		4.0		1.5		0.0		0.0		0.0		26.0
AY 07-08	7.0		7.5		5.0		4.0		4.0		1.5		0.0		0.0		0.0		29.0
AY 08-09	10.0		12.0		9.5		7.5		5.0		2.5								46.5
AY 09-10	12.0		15.0		12.5		9.5		6.0		3.5								58.5
AY 10-11																			0.0
AY 11-12																			0.0

Underlined (x) denotes cross-School hire - *Italics* denote cross-engineering hires - (Paranthetical) entries denote individuals under consideration - **Bold** denotes senior FTE

	Future FTE
FTE	**Current searches**

Table 9 Prioritized FTE Request List for AY2007-2008 SOE Strategic Plan

Priority	Name of Position	Level (Lecturer/Assistant/Associate/Full)	Primary Major Conribution (Current or Planned)	Secondary Major Contribution (Optional)	Primary Graduate Group	Secondary Graduate Group (Optional)	Estimated Start-up cost	Estimated Space Needs	Special needs and strategic considerations, if any
Critical	Bio-control	junior/senior	ME	BioE	MEAM	BEST	$ 500,000.00	750	Wet Lab
Critical	Computer Science	senior	CSE		EECS		$ 450,000.00	500	Dry Lab
Critical	Complex Material	senior	MSE	BioE	BEST	MEAM	$ 400,000.00	750	Dry Lab
Critical	Computational Eng	junior/senior	ME	CSE	MEAM	EECS	$ 550,000.00	500	Dry Lab
Critical	Tissue Eng	junior	BioE	MSE	BEST	QSB	$ 550,000.00	750	Wet lab
High	Environmental Microbiology	junior/senior	Enviorn Eng	BioE	ES	QSB	$ 450,000.00	500	Wet Lab
High	EE	senior	CSE	ME	EECS	MEAM	$ 450,000.00	500	Dry Lab
High	CS/EE position	senior	CSE	ME	EECS	MEAM	$ 450,000.00	500	Dry Lab
High	Bio-Inspired Mech	junior/senior	ME	MSE	MEAM	BEST	$ 550,000.00	750	Dry Lab
High	Physiological modeling	junior	BioE	ME	BEST	QSB	$ 550,000.00	400	Wet lab
High	Ecohydrology & Ecological Eng	junior/senior	Enviorn Eng	BioE	ES	BEST	$ 400,000.00	500	Wet Lab
Regular	Single cell measurement	senior	BioE	ME	BEST	QSB			
Regular	Media art	senior	CSE		EECS				cross-school
Potential Security of Employment Positions (SOE)									
1	CSE	potential SOE	CSE						
2	ME	potential SOE	ME						
3	ME	potential SOE	ME						
Management School Related Positions									
1	Natural Resource Management	senior							
2	Entrepreneurship	junior/senior			BEST				
3	Technology Management	senior							
4	energy, climatic & sustainability	junior/senior							
5	biotech Management	junior/senior			BEST				

2.4.14 Cross-School Hire

Last year, SOE proposed several cross-school positions. Some of these positions were endorsed by CAPRA and recommended as cross-school positions. However, SOE did not receive some of these FTE allocations from the Provost. The faculty of SOE was not able to identify the rationale for these irregularities. Without a transparent policy for cross-school FTE allocations, SOE faculty has decided to request only one cross-school FTEs this year.

3 Strategic Planning Framework

Section 2 of this plan began with a justification for the request for 13.5 faculty FTEs to be hired into the School of Engineering during the AY 2008-09 academic year, bringing our total faculty to 42.5 Engineering faculty FTEs as shown in Table 6. The discussion then shifted to the impact that this increment in faculty resource would have on the further development of our academic programs, and most importantly, to a listing of the specific faculty FTEs by research area and cross-School synergies that would result—presented in Section 2.4. Similarly, Section 2.5 presented a list of 2 Cross-Engineering hires that would further enhance the programs of the School of Engineering, but more important, would further provide opportunities for strategic multidisciplinary research opportunities across UC Merced. To the extent possible, these proposed positions have been discussed to various degrees, with our colleagues in our sister schools.

3.1 Revisiting the Strategic Faculty Hiring Framework

The strategic value of the faculty hires proposed in Section 2—both intra-School and cross-Schools hires—are presented in Table 10, which is an expanded and updated version of the hiring framework proposed last year. The columns of Table 10 represent the emphasis areas within Engineering sub-disciplines being developed at UC Merced, with each column corresponding to a strategic research opportunity shaping specific faculty hires; present, current, and future. The rows of Table 10 list more comprehensive cross-Schools research areas that have been discussed, and than have emerged as a result of the faculty hiring process over the years. These columns are deliberate in their inclusion of priority cross-School strategic research areas, but are themselves grouped within the six priority research areas set forth in Section 1: (1) Energy and Materials Technologies, (2) Biological Engineering, (3) Nanoscale Systems, (4) Environmental Science and Engineering, and (5) Computational Science and Engineering, and (6) Modeling Sciences.

3.1.1 Energy and Materials Technologies

The early energy emphasis at UC Merced focuses on solar energy. Both **optics and materials** play a key role. The use of advanced optics techniques, and nonimaging optics in particular enable the generation of high temperature for power and heat, as well as efficient photovoltaic power through concentration. Advanced materials are critical across all solar energy technology. These areas of optical design and material science span a range of disciplines from applied mathematics (optical design) to condensed matter physics (photovoltaic materials) to engineering (thermal and electrical components and systems).

Mechanical and electromechanical systems are integral to virtually any kind of engineering system, with rapid growth now being observed at the micro and nano levels. Examples of such systems include transportation systems, energy production and control systems, environmental management systems, and an increasingly important area of bioengineered systems. Not only will it be essential for the School of Engineering to have a very strong research and education foundation in these key engineering areas, but this foundation will also be invaluable for the cross-disciplinary framework that we seek to establish across our university. As we develop a program in medical research and technological development, bio and electro-mechanical research innovation will be extremely important.

Table 10 Revised strategic cross-School hiring strategy for AY 2007-08 from the School of Engineering.

Strategic Faculty Hiring Planning Matrix--This matrix is intended as a framework for displaying the structure of faculty hiring within the School of Enigneering at UC Merced. The left column presents the strategic research priorities within Engineerring. Each area is further categorized by potential cross-School priority areas. The columns to the right reflect research emphasis areas grouped by disciplinary categories, also reflecting our current and future undergraduate majors. Entries in the table correspond to current, pending, and desired future faculty hires.

Current and Planned Undergraduate Majors witin the School of Engineering

Strategic Research Priorities within the School of Engineering	Strategic Cross-School Research Opportunities	ENVE						CSE					BIOE					ME					MSE						EE							
		Hydrology	Microbiology	Water Quality	Air Pollution	Environmental Sustainability	Energy water & resource management	Networking	Data Base Mining/Informatics	Robotics/Autonomous Agents/AI	Graphics/Multimedia	Architecture/Systems	Bioelectronics	Biomaterials Engineering	Cellular Bioengineering	Tissue Bioengineering	Bioprocess Eng	Energy and Environment	Computational Mechanics	Complex and Intelligent Systems	Multiscale Phycics and Modeling	Bioengineering	Nanomaterials	Composite materials	Materials Synthesis	Materials characterization	Environmental Aspects Materials	Materials Processing	Microelectronics and Nano Technology	Communication Networks	Bioelectronics	Optics and Photonics	MicroElectroMechanical Systems	Signal Processing	Circuits	Linear/Nonlinear Systems, Control
Energy and Materials Technologies	Energy; including optics, material sciences					☒																	☒														
	Mechanical and electromechanical systems												▢		▢		☒			▢					☒							☒					
Biological Engineering	Human biology, health and enviroment, including management and policy														☒					▢																	
	Regenerative medicine													▢		☒																					
Nanoscale Systems	Nanotechnology												☒			▢								▢		☒		▢									
	Human dimesions of engineering and science																										▢										
Environmental Science and Engineering	Atmospheric & climate sciences, air resources			☒	☒		▢																														
	Energy, Water & Environmental sustainability, including policy	☒		☒		▢	☒																														
	Remediation		▢																																		
	Ecological Engineering	▢																																			
	Geography and spatial analysis and global change						☒	☒	☒			▢																									
Computational Science and Engineering	Cognitive and computational sciences								☒	▢	☒																										
	Media arts and Technology										▢																										
	Cyberinfrastructure and system							☒	▢	☒	▢	▢							▢															▢			
Modeling Sciences	Management and decision sciences					▢	☒																														
	Mathematical sciences, applied mathematics, and applied statistics								☒						▢		▢	☒	▢	☒	▢	☒															
		10						12					9.5					8					6						2.5							

- Engineering faculty (first 20)
- ☒ Engineering faculty already hired
- ▢ Joint (cross-school) faculty hires or joint hires requested
- ▢ Joint (cross-engineering) faculty hires or joint hires requested
- ▢ Current faculty searches
- ▢ To be requested; need to be distributed into the matrix

3.1.2 Biological Engineering

Human biology, health and environment—including management and policy focuses on improving human health through an understanding of physical, chemical and biological processes, interpreted through the design-based and problem-solving skill set of engineering. The influences of physical and social environment on health, and strategies for influencing these environments positively, are included. Objectives include significant health-care cost reduction, development of methods for earlier and more accurate diagnosis, possible therapeutic interventions, and effective preventive measures for patients at high risk.

Regenerative medicine refers to technologies that repair or replace diseased, damaged or defective tissues or organs. This focus area represents an emerging multidisciplinary field involving biology, medicine, chemistry, physics, materials engineering and bioengineering. It is expected to revolutionize the current therapeutic measures by restoring tissue and organ function that are affected by the natural aging process or diseases.

3.1.3 Nanoscale Systems

At nanometer length scales, the physical and chemical properties of matter are dictated by quantum phenomena. **Nanotechnology** aims to exploit these material properties directly, as well as in the context of novel machines and electronic devices that operate on a very small scale, comparable to or smaller than the scale of functional devices found in nature. Also included, is the design and exploitation of self-assembling molecular systems and nanoscale devices to produce macroscopic objects with precisely controlled specifications. The effects of nanoparticles on human health and the environment will require careful, extensive attention.

The **human and ethical dimensions of science and engineering innovation** will be increasingly important in the future for new areas of social concerns such as bioengineered systems, environmental and energy systems, and virtually all biomedical and medical technology areas.

3.1.4 Environmental Science and Engineering

This strategic research priority builds on existing faculty strengths to gain a competitive edge in the areas of (1) **atmospheric sciences, climatology and air resources**, (2) e**nergy, water, and environmental sustainability**, and (3) **geospatial analysis and global change.** Research opportunities associated with this research priority are abundant from both a regional and global perspective. Specific research topics for the first area may encompass air pollution chemistry, air quality characterization and management, and other topics critical to human and environmental health. The second area encompasses the science, technology and management of these resources that are critical to global economy and life itself. The third area encompasses the analysis of large spatial data sets, such as those generated through remote sensing technologies, to observe changes in land use, vegetative canopy and other environmental properties in response to drivers such as climate change.

3.1.5 Computer Science and Engineering

Cognitive science and engineering is the interdisciplinary study of mind and intelligence, embracing philosophy, psychology, artificial intelligence, neuroscience, linguistics, and anthropology. Cognitive and Computation Sciences refers to all the computational aspects of

these domains and ultimately aims to create computer models and algorithms able to reproduce intelligent behavior in intelligent systems. Example of covered domains include: image processing, computer vision, artificial intelligence, statistical and machine learning, neural networks, computational neuroscience, nonlinear dynamics, nonlinear control theory, robotics, behavioral animation, virtual reality, human-computer interaction, etc.

Media Arts and Technology (MAT) is an interdisciplinary area that fuses emergent computer science and engineering, and digital art research, practice, production, and theory. MAT offers the opportunity for working at the frontiers of art, science, and technology, where new art forms are born and new expressive media are invented. The highly cross-disciplinary nature of this exciting field, and the direction being taken at UC Merced with key faculty hires within the School of Engineering and the School of Hunamities, Social Sciences, and Arts, suggest that this is an excellent opportunity for innovation at UC Merced.

Recent trends suggest that inexpensive networked video sensing elements will be pervasively deployed in our environment. Already, they are embedded in devices such as computers and mobile phones and they are mounted in public spaces such as malls and airports. In many ways, this trend could prove beneficial to society, in that information collected by sensors could be shared for the better good. Harnessing the power of these emergent sensory environments will hinge on our ability to build applications capable of gathering, interpreting and storing data from distributed sensors and to provide scalable mechanisms for managing the networks and systems resources that these applications consume. We anticipate the design, implementation, and testing of a state-of-the-art signature facility for this purposes—the UC Merced Sensorium.

The UC Merced Sensorium would catalyze fundamental advances in image and video computing, network protocols, and resource management to deal with unique spatio-temporal constraints of sensor networks in general and of video sensor networks in particular. It will also contain hardware and software for image, audio, and video capture and processing; motion capture; visualization; interactive display; digital preservation; and innovative internet interaction. When fully developed, the Sensorium educational and research infrastructure will be composed of a sensor network of video cameras spanning several areas, networked processing units, and a terabyte database, managed together to satisfy queries using those generated by mobile users within this environment. It will support a number of undergraduate and graduate courses, including

- Multimedia Systems (undergraduate)
- Arts and Technology (undergraduate)
- Computer Networks (undergraduate)
- Operating Systems (undergraduate)
- Digital Image Processing (undergraduate)
- Digital Audio Processing (undergraduate)
- Digital Video Processing (undergraduate)
- Databases (undergraduate)
- Computer Vision (undergraduate)
- Computer Graphics (undergraduate)
- Programming Languages (undergraduate)
- Embedded Systems (undergraduate)
- Real Time Systems (graduate)

- Advanced Computer Networks (graduate)
- Sensor Networks (graduate)
- Distributed Systems (graduate)
- Computer Animation and Simulation (graduate)
- Advanced Digital Image Processing (graduate)
- Advanced Computer Vision (graduate)
- Advanced Databases (graduate)
- Data Mining (graduate)
- Motion Planning and Cognition (graduate)
- Security and Privacy (graduate)
- Visualization (graduate)

The Sensorium will serve a variety of constituents including faculty in computer science, electrical engineering, art and cognitive science. It will be a core facility for the proposed interdisciplinary program in Multimedia Arts and Technology. Through hosting classes, seminars, and performances, it may also provide opportunities for synergies between the campus and local community.

The term "**cyberinfrastructure**" was coined by a National Science Foundation (NSF) blue-ribbon committee. In general, the term refers to systems that facilitates the development of new applications, allows applications to interoperate across institutions and disciplines, insures that data and software acquired at great expense are preserved and easily available and empowers enhanced collaboration over distance, time and disciplines. It also includes effective management of distributed resources (data and facilities). Some other names in use for such systems are co-laboratory, grid community/network, virtual science community and e-science community.

3.1.6 Modeling Sciences

Modeling sciences refers to the broad array of disciplines used throughout math and science disciplines, including **mathematical modeling** and **operations research**, **applied mathematics and statistics**, **decision sciences**, and **quantitative analysis and reasoning**. From the initial discussions of building at UC Merced a culture of multidisciplinary research and education, there has been considerable interest in establishing a broad foundation of modeling and modeling technologies as a framework for this synergy across the current and future Schools. This framework would encompass and promote strong synergy among a broad spectrum of academic disciplines, including simulation modeling, optimization modeling, statistical and inferential modeling, and perhaps physical modeling. It was argued early on in our development that an emphasis on modeling and modeling technologies could be valuable at all levels and across virtually all domains. Even our initial discussions about general education considered a strong component of modeling as a means to improve personal decision makinge and proeuctivity. Indeed, the *Decision-making* guiding principle of General Education at UC Merced was an artifact of that early discussion.

While the emphasis on this as an area of synergy between and among Schools has not remained central in discussions of cross-Schools priorities, it remains a priority within the School of Engineering, and will very likely re-emerge as a top priority because of the successful development of programs across Schools, including Cognitive Science, Economics, and Management within the School of Social Sciences, Humanities, and Arts; Quantitative Biology and Ecology within the School of Natural Sciences, and virtually all

disciplines within the School of Engineering. This is an ideal focus area for attracting cross-School multidisciplinary faculty hires, and while it will certainly remain a cross-cutting area for research and scholarship—rather than an area "owned" predominantly by one School—it is very consistent with the foundational vision behind UC Merced.

3.2 Strategic Faculty Hiring

The entries in Table 10 each correspond to a faculty FTE, either one already filled, one currently being recruited, or one being proposed within this strategic plan. Blue cells in the table correspond to the initial allocation of 20 faculty for the school of Engineering—those blue cells marked with X indicate positions already filled. Cells shaded yellow ☐ indicate positions that have been authorized for recruitment currently in process. Cross-School hires are denoted by cells having a bold border ☐ regardless of color, while cross-Engineering hires are denoted by cells having a double border regardless of color, either current faculty or anticipated hires. And cells shaded orange ☐ denote FTEs requested for AY 2007-2008.

The table thus reflects, for each faculty hire or potential faculty hire, the synergies that will result within and among Engineering disciplines, as well as between and among Schools having shared strategic research areas.

4 Space Planning and Management

4.1 Space Challenges at UC Merced

The growth of academic programs within the School of Engineering at UC Merced depends in part on the availability of space in the form of research facilities, faculty, student, and "professionals" office space; teaching labs; essential support facilities such as conference and meeting rooms; and other support space such as administrative offices and other space for scholarly activities. The space in the Science and Engineering Building is of course finite, and the second Science and Engineering Building (SE2) will not be available for the space inventory until fall of 2012. Table 2 suggests that with 20% of the student body—which will number approximately 4558 at that time—and faculty FTEs based on student numbers and student faculty ratios, the size of the Engineering faculty may be expected to be about 51 FTE at the beginning of AY 2012-13. Assuming that the School of Natural Sciences will comprise conservatively 30% of the student body[vi], and with similar assumptions about faculty numbers, NS could have as many as 70 faculty by the time SE2 is available. This means that at the time SE2 comes on line, the total faculty FTE within the combined Schools of Natural Sciences and Engineering may be as high as 121, or more than 40 - 50 FTE more than the total office space available in SE1based on the original campus planning space numbers. With the size of SE2 already set at less than 52,000 ft^2 assignable, it may be more than half full upon opening.[vii] As the original per-faculty space numbers used in planning SE1 failed to provide office space for research groups (e.g. grad students and post docs), the true demand for SE1 and SE2 space is much higher. From another perspective, this level of growth may mean that SE1 reaches capacity by 2008; four years before SE2 comes on line.

As a result, it will be imperative that space at the Castle facility be used efficiently and effectively in support of campus space needs. Future space planning and management for SE1 should be aligned with campus space planning objectives.

4.2 Space Allocation, Utilization Monitoring, and Reallocation

The School of Engineering currently occupies space in the Science and Engineering Building (SE1). In the discussion below, *allotment* refers to the designation of specific space for management and use by the School of Engineering, and *assignment* refers to the designation of space by the Dean of Engineering to individual faculty, programs, projects, etc.

4.2.1 Initial campus space allotment

The initial allotment of space by the Provost to the School of Engineering consisted of:

1. The use of 25 faculty offices;
2. A total of 32.4% of research space to support the inaugural faculty; and
3. The Deans suite of offices on the second floor of SE2.

The initial allocation of space to the School of Natural Sciences was identical, and the total area was divided up between the two schools. This initial allocation was thus intended to house the first 40 faculty, with the initial 5 faculty offices made available to each school to support other space needs with the understanding that when the building is "full," all faculty offices will be occupied by faculty only. The 5-office "buffer" controlled by each school will be correspondingly reduced to zero as the building reaches capacity.

Beyond the initial allotment of space in SE1 for faculty offices and research space, the Deans of both Schools have agreed on an additional allotment for housing all faculty and their anticipated research activities up through those faculty expected to be hired by fall 2007. This second and third rounds of allotment divided all faculty offices and research space between the two schools resulting in 33 faculty offices and 21,535 sq. ft. of research space allocated to the School of Engineering.

Following the final allocation of space, the School of Engineering is short in 6 offices and research space for 6 junior and 2 senior authorized FTEs, space will have to be assigned at Castle.

4.2.2 Initial engineering research space allocation

The allocation of space allotted to the School of Engineering has been (is being) made by the Dean of Engineering as follows:

1. Each faculty member has been assigned a standard faculty office in general proximity to their assigned lab space, and to other faculty within the School of Engineering and the School of Natural Sciences having similar or related research programs.
2. Four groups of faculty were initially identified based on disciplinary areas of research and teaching responsibilities, and corresponding research space areas were identified by the Dean and designated for ach group. The groups developed recommendations for the specific allocation of each area among members of the group, as well as common areas to be shared within the group--which may also include faculty members from outside the group. Initial faculty research space assignments were based on these recommendations.
3. Requests for use of buffer office space was considered by the Dean following issuance of priorities for the use of that space, and temporary office space assignments were made.
4. Office and research space needs for future faculty will be assigned by the Dean until all faculty offices are assigned (NOTE: at this time SE1 will have insufficient space for postdocs, instructors, lecturers, and other research staff.)

Table 11—Space assignment factors.

	PROPOSED FORMULAS		
	Research (ft^2)	PD office (75 ft^2/FTE)	GS Office (50ft^2/FTE)
Assistant	250	0.5	3
Associate	500	0.75	6
Full	750	1	9

Specific faculty space allocations were made using the general guidelines reflected by the factors contained in Table 11. For example, associate professors in the School of Engineering will be assigned an ***average***[viii] of 500 ft^2 of lab space, with an additional allocation of space for post doctoral researchers of 75 ft^2 per person, and 50 ft^2 per graduate student. It is assumed that as our program grows, associate professors will have an average of .75 post doctoral scholars per person, and an average of 6 graduate students including both Masters and Ph.D. students. Similarly, faculty at the rank of full professor will be provided an average of 750 ft2 of lab space, and additional space for an average of 1 postdoctoral associate, and 9 graduate students.

The research space allocation factors were obtained from the initial planning documents for the Science and Engineering building, and the researcher (post doc and grad student) space factors were obtained from the CPEC guidelines. While it can be argued that these space

allotments are less than what might be available anecdotally at other UC campuses, the averages will likely include faculty who have very modest or no lab space allocations.

NOTE: These estimates do not include space allocations for shared core research facilities.

The estimates for the average numbers of post doctoral scholars and graduate students anticipated for School of Engineering faculty as shown in Table 13 were estimated from numbers obtained from several UC Engineering Schools as presented in Table 12. While these data were not yet obtainable for all campuses, nor broken down by faculty rank—we will be pursuing this more detailed breakdown of data in the future—they show that the factors proposed in Table 11 are generally realistic and defensible. For example UC Davis, with a total of 176 regular faculty FTE reports 80 postdocs, or approximately 0.5 postdoc per faculty member (averaged across all ranks). These data suggest that our estimates for the numbers of graduate students at UC Merced may be a bit high in comparison with other campuses, but not excessively so, and may be modified after we receive complete data from all sister campuses.

Table 12 Reported numbers of graduate students, and other academic personnel in UC Engineering Schools.

Campus	Faculty	Graduate Students[1]				Other Academic Personnel[2]					
		Masters		Doctoral		Post Docs		Instructors		Researchers	
	Count	Count	Fac Avg	Count	Fac Avg	Count	Fac Avg	Count	Fac Avg	Count	Fac Avg
Santa Cruz	66	81	1.2	193	2.9						
Santa Barbara	125	110	0.9	584	4.7						
San Diego	166	346	2.1	801	4.8						
Riverside	73	53	0.7	238	3.3	24.0	0.3	14.0	0.2	14.0	0.2
Merced	14	9	0.6	8	0.6						
Los Angeles	150	474	3.2	782	5.2						
Irvine	154	59	0.4	249	1.6	58.0	0.4	10.0	0.1		
Davis	176	334	1.9	782	4.4	80.0	0.5	20.0	0.1	16.0	0.1
Berkeley	218	235	1.1	1354	6.2			45.0	0.2		
Total	1163	1880	1.6	5448	4.7						

[1] Report to the University Wide Council on Engineering Education UCEE Fall, 2005
[2] Direct consultation with Schools

The anticipated need for additional space prior to the availability of the second Science and Engineering (SE2) building becomes evident when considering that (1) the total available space in SE1 totals slightly more than 100,000 ft^2, (2) the School of Science—having space requirements similar to those of Engineering—is likely to be on the order of 20% larger than Engineering in terms of students and faculty, and (3) this does not include the entire 1st floor of SE1, which is exclusively allocated for teaching labs: approximately 1/3 of the total assignable square footage.

Table 13 – Space Needs Planning.

Name	Offices on campus (number)	Labs Space on Campus (sq. ft.)	Total campus Space	Space at Castle (sq. ft.)	Space at other location
Current total (7/2007)	33	21,535	21535	0	0
	New FTSs space needs				
	Faculty Offices	Research Space (sq. ft.)	Sitting stations Graduate Students	Sitting stations Post Docs	Instructors offices
New space for AY08-09 hires	11	6650	28	17	3
Total for AY08-09	11	6650	28	17	3

[1] **SoE is short I 6 offices for the current authorized FTEs and research space for 6 junior and 2 senior authorized FTEs**

It should be emphasized that the estimates presented in Table 13 do not consider adequately the CPEC guidelines. Not only did the original planning for SE1 fail to account properly for the resulting size of graduate research groups, but they also failed to account for the resulting number of instructors, and other multidisciplinary research infrastructure. Using the same projections for faculty recruitment and size of graduate research groups, the use of CPEC factors would result in a much greater space requirement as reflected in Table 13. It is important for future planning activities that realistic assumptions be used during the request for, and justification of, new space.

4.2.3 Core research facilities

In any consideration of research space allocation, it is vitally important to plan for the presence of shared research core facilities on campus. Not only do these facilities contribute to the research missions of multiple faculty (typically 10-20), but they are also actively utilized in teaching and need to be placed on campus so that graduate and undergraduate students have the benefit of training on commonly-used instrumentation. This integration of teaching and research makes efficient use of space, and is pedagogically desirable and strongly encouraged by the National Science Foundation, as evidenced by the over $1M in grants received by UC Merced faculty to develop two core facilities, the Environmental Analytical Facility and Imaging and Microscopy Facility. Core facilities are generally operated on a recharge basis in order to minimize cost to the university, and for them to generate the income necessary for operation they must be on campus where they will be utilized by researchers and for teaching. Sufficient space allocation for core facilities is essential to the development of UC Merced as a research university.

4.2.4 Teaching laboratory space allotment

Recommendations for the allotment of space for teaching in the SE1 will be made to the deans of both schools by a newly formed teaching laboratory planning committee. This committee will be lead by the assistant deans of both schools, with participation from lab managers from both schools, Steve Rabedeaux, Nancy Tanaka, and, as appropriate, from the Office of the Registrar.

4.2.5 Space utilization monitoring and reallocation planning

Monitoring and assessment of the use of assigned space will be the responsibility of the office of the dean of the School of Engineering, working closely with the newly formed SoE Academic Resources Committee. Assignments of additional space to individual faculty, groups, projects, etc. will be made following careful justification and consideration. Similarly, reduction in space allocations will be made as appropriate such that the space resource serves the best interest of the School and the university.

ENDNOTES

[i] The original target was 1,000 student FTEs upon opening, which was not achieved. The actual student FTE of 875 students (total undergraduate and graduate students) is reported in Table 1.

[ii] The 10-year planning horizon was selected in part because this represents the time over which the second phase of campus construction—specifically, the second Science and Engineering building—will be complete and [probably] fully occupied. This should represent a time in the future at which a reasonably steady-state rate of student recruiting and faculty hiring will be achieved, and in particular, the time after which few if any additional undergraduate majors are likely to be added to the program.

[iii] STEM stands for Science, Technology, Engineering, and Math, and is increasing used to describe institutions of learning that emphasize these technical areas as a major mechanism for increasing participation of women and minorities in professional technical areas.

[iv] E. A. Lee and D. G. Messerschmitt, "Engineering an Education for the Future," *IEEE Computer Magazine*, Vol. 31, No. 1, January 1998, pp. 77—85.

[v] See, for example E. A. Lee and P Varaiya, "Introducing Signals and Systems—The Berkeley Approach," *The First IEEE Signal Processing Education Workshop*, Hunt, Texas, October 15-18, 2000. or E. A. Lee, "Designing a Relevant Lab for Introductory Signals and Systems," *The First IEEE Signal Processing Education Workshop*, Hunt, Texas, October 15-18, 2000.

[vi] Some estimates suggest that this number may be closer to 40% of the student body at UCM.

[vii] This depends, of course, on the space required for research labs and auxiliary uses. Planning will soon begin pursuant to the PPG for SE2, which should be complete by late spring 2006.

[viii] While actual assignments will of course depend on individual research programs, it is expected that these will represent an average over all faculty, at least until we get better projects/information.