STRATEGIC ACTION PLAN

SUBCOMMITTEE ON EXCELLENCE IN RESEARCH AND CREATIVE ACTIVITY

Draft Final Report, January 22, 2010

Chair: Jerome S. Schultz, Distinguished Professor of Bioengineering
Vice Chair: John Andersen, Professor of Psychology

Committee Members:

- Christopher Abani, Professor of Creative Writing
- Richard Arnott, Professor of Economics
- David Bocian, Vice Provost, Academic Personnel
- Mitch Boretz, Technical Communications Specialist, BCOE
- Xuemei Chen, Professor of Botany And Plant Sciences
- David Lo, Professor of Biomedical Sciences
- Garrett Milliron, Graduate Student
- Chun Ning (Jeanie) Lau, Professor of Physics
- Rollanda O'Connor, Graduate School of Education
- Alex Raikhel, Professor of Entomology
- Dylan Rodriguez, Professor of Ethnic Studies
- Wendy Saltzman, Professor of Biology
- Yunzeng Wang, Professor of AGSM
- Yushan Yan, Professor of Chemical And Environmental Engineering
- Francisco Zaera, Professor of Chemistry

Staff Support

- Robert Daly, Strategic Academic Research And Analysis

TABLE OF CONTENTS

EXECUTIVE SUMMARY: RECOMMENDATIONS

1. Planned and Selective Growth of UCR:

- Recruit 170 faculty with a high funding profile over the next ten years to enhance total research funding to a level of $250 million per year.
- Increase doctoral student enrollment by 1500 over the next ten years.
- Increase University-wide programmatic cluster hiring.

2. Improving the Environment for Promoting Research at UCR:

- Establish an Academy of Research Scholars with a threefold purpose:
  (1) to advise the Chancellor and Executive Vice Chancellor regarding research growth and development,
  (2) to serve as a resource to faculty for research planning and grant writing, and
  (3) to aid in the development of interdisciplinary, center, and training grants.
- Modify Call to recognize research leadership, interdisciplinary efforts, and successful grant funding.
- Time release from teaching for faculty to compensate for research activity.
- Encourage mid-career faculty to embark on a more intensive research effort.
- Support early-career faculty in building a strong research foundation.
- Enhance support for Institutes and Centers with a high likelihood of becoming self-sustaining and use these organizations as catalysts for greater research support and innovative research and education activity.
- Stimulate interdisciplinary research projects.
- Increase support for training grants.

3. Overarching Research Themes:

- Cultural Diversity, Social Transformation, and Global Community.
- Cyber-Technologies and Communications.
- Brain Plasticity Science and Applications.
- Genomics.
- Energy Efficiency and Sustainable Development.
- Beyond Silicon - Phenomena, Materials and Devices.

4. Management of the Research Enterprise

- Enhance research management in Office of Research.
- Increase UCR's contact with funding agencies.
- Establish and maintain a searchable database of faculty expertise.
- Increase the resources available to initiate interdisciplinary collaborations.
- Provide support resources for major proposals.
- Establish an Office of Interdisciplinary Programs.

5. Structural Changes in the College of Natural and Agricultural Sciences

- Separate the College of Natural and Agricultural Sciences into three separate Colleges: Agriculture and Natural Resources, Life Sciences, Physical and Mathematical Sciences

INTRODUCTION

One of the goals of the Strategic Plan 2020 is for UCR to attain the profile of an AAU university. Among the characteristics of the AAU universities are the research funding and doctoral and post-doctoral training that are listed as Phase I and Phase II indicators.

SUMMARY OF AAU INDICATORS

Phase I Indicators
>> Competitively funded federal research support
Membership in the National Academies (NAS, NAE, IOM)
National Research Council faculty quality ratings
Faculty arts and humanities awards, fellowships, and memberships
Citations

Phase II Indicators
>> USDA, state, and industrial research funding
>> Doctoral education:
Number of postdoctoral appointees
Undergraduate education

The charge given to the Committee on Excellence in Research and Creative Activity relates most directly to the characteristics indicated by >>.

- Make recommendations about how best to develop and strengthen research and creative activity, including core research and interdisciplinary research initiatives.
- Identify overarching areas of research excellence for strategic investment, areas that align with the national interest and funding opportunities and transcend departmental and college boundaries. Place a particular focus on areas essential for AAU membership, such as competitively funded federal research support.
- Identify means of significantly increasing grant and contract support for UCR research, including major multi-investigator grants, so as to make the campus less dependent on state funding. Identify mechanisms to better support faculty in seeking extramural funding and to coordinate proposals for major center/initiative grants.

It should be noted that there are many other ad hoc rating schemes for ranking university standings, each with its own range of criteria for ranking. For example the ***Center for Measuring University Performance*** issues a report annually for the Top American Research Universities by their rank on nine different measures: Total Research, Federal Research, Endowment Assets, Annual Giving, National Academy Members, Faculty Awards, Doctorates Granted, Postdoctoral Appointees, and SAT/ACT range.

The National Research Council and *US News & World Report* are other institutions that publish university rankings.

One common element of most of these reports is the inclusion of research funding and graduate education. In this report we give a heavy emphasis to these two factors.

1. RESEARCH PROFILE BUSINESS/FINANCIAL PLAN

1.1 Current Status of Research Funding

The basis of tabulations of research funding data from various institutions varies. At UCR data reported annually by the Office of Research are the awards for that year. Since some agencies make separate awards for each year of a grant and other agencies make one award for the entire period of the grant, the award trends can appear to be quite irregular as shown in Figure 1.

Figure 1: Awards by Source, Fiscal Years 2004 - 2008

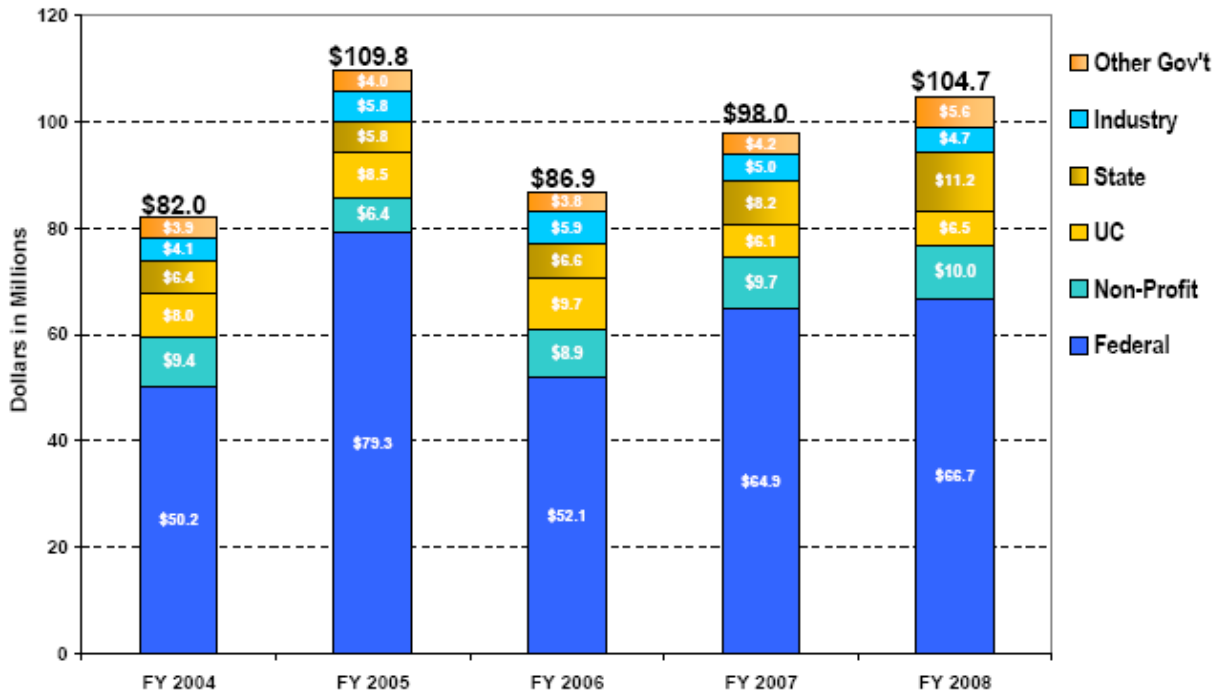

Figure 1. *UCR contract and grant activity. Source: Office of Research annual report.*

AAU prefers to consider expenditure data rather than award data. Expenditure trends for UCR are shown in Figure 2.

However, one can obtain a reasonable comparison of research funding for UCR and selected AAU universities as shown in Table 1. (Please note that several sources were used to generate information throughout this report that could be used compare UCR with other universities. Thus there may be an appearance of non-uniformity or discrepancies among tables, as different periods of time or criteria may have been employed by the different agencies that collected these data.)

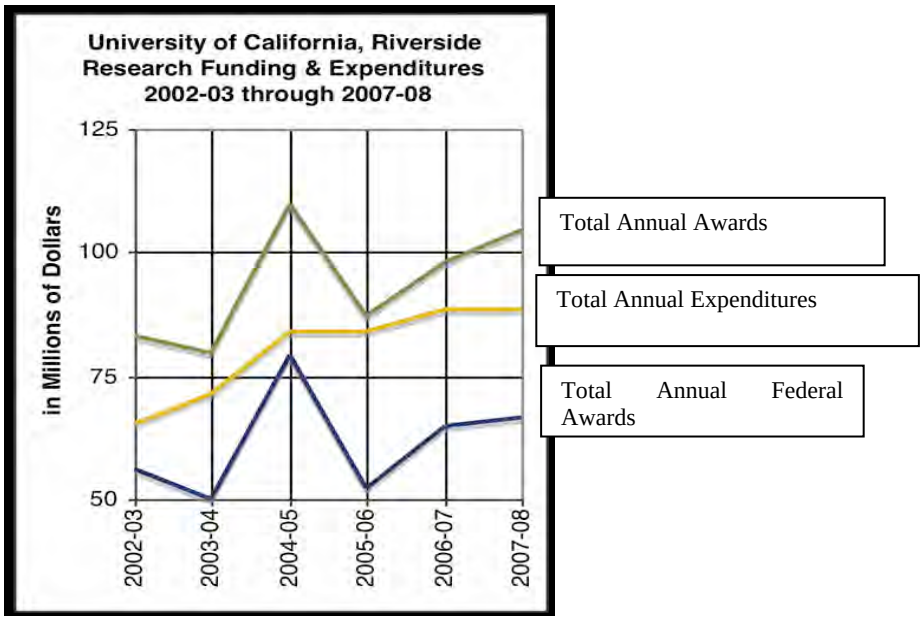

Figure 2. *Research funding and expenditures. Source: University of California, Riverside Accountability Profile 2009 (www.universityofcalifornia.edu/accountability/documents/accountabilityprofile09_ucr.pdf).*

Table 1
Total funding and funding per faculty for UCR, in 2008, and for comparison AAU Universities from NSF, 2007 Report (More Details in Table S1)

	UCR, 2008	Comparison AAU Ave	Comparison AAU Stdev
Total Funding ($)	$104,700,000	$247,451,222	$181,551,371
Number of Faculty	726	999	415
Funding ($)/Faculty	$144,000	$243,342	$133,476

It is clear from these figures that UCR funding would need to at least double (in today's dollars) to be comparable with these AAU campuses.

- UCR ranks 5th out of 10 in funding per faculty in the AAU group in Table S5 (found in Appendix 1).
- UCR ranks 115th in R&D Expenditures among all U.S. universities (2007 NSF Survey).
- UCR is ranked 34th in R&D Expenditures among U.S. universities without medical school (2007 NSF survey).

The funding patterns for the various colleges at UCR are shown in Table 2.

Table 2
Grant award data, UCR, 2008
UCR EVC Office, Strategic Academic Research & Analysis, Oct 2009

	Number of Awards	Amount ($)
CHASS (+English Comp/Writing)	43	4,503,787
CNAS	500	56,482,491
Engineering	205	28,756,648
School of Management	2	22,500
Grad School of Education	15	4,596,302
Biomed Sciences	12	2,893,923
Others	36	7,417,311
TOTAL	813	104,672,962

1.2 Plan for Enhanced Research Funding

One element that would improve the UCR funding profile would be an increase in funding dollars per faculty. As shown in Table 1 UCR funding per faculty is about 40% below the average of these AAU universities. If per-faculty funding at UCR could be enhanced to be comparable with AAU faculty ($243K), the total projected annual funding would be about 725X$243,000 = $176,000,000. Even with this major improvement (not seen in recent history, Figure 3), UCR would still fall far short of our intended goal of about $250,000,000 in today's dollars.

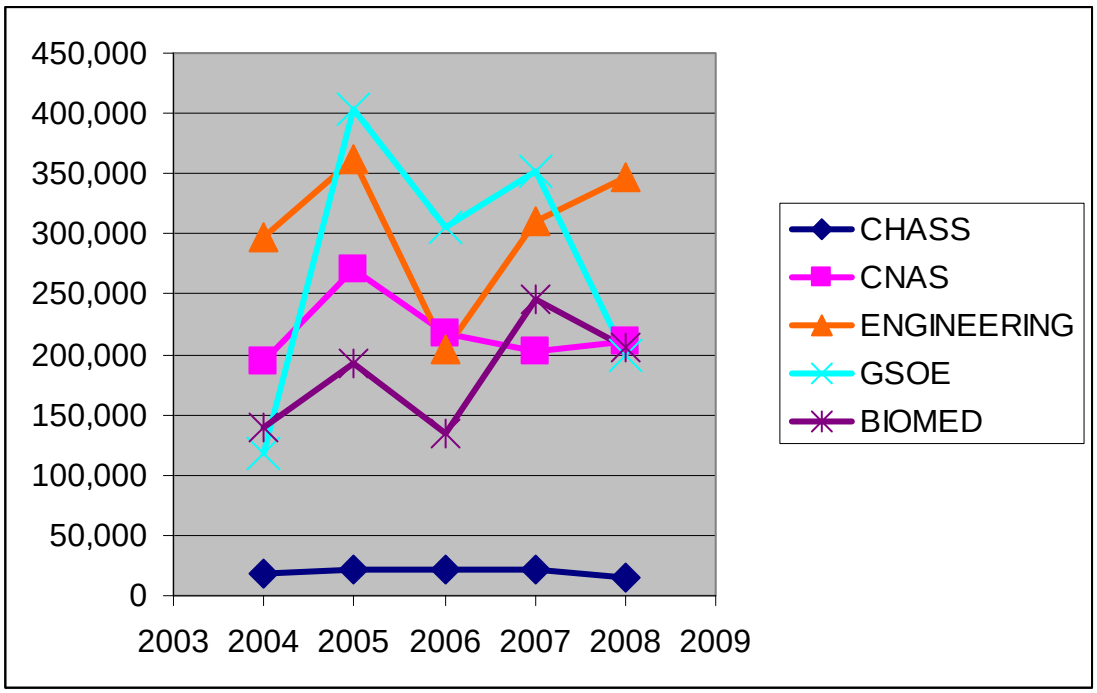

Figure 3. *Funding per Faculty at UCR, 2004-2008. (More details in Table S3)*

Our conclusion is that to achieve a funding pattern similar to the AAU comparison universities UCR will need to increase the number of the faculty who have consistent and strong capabilities to attract external funding.

One projection of faculty hiring for UCR suggests increasing our faculty count by about 170 over the next ten years. We tested a model that assumes a linear addition of 17 faculty per year over a ten-year period. We assumed an average initial complement of $600,000 (typical for hires in science and engineering, which account for about 80% of the total extramural funding at UCR). An estimated average academic salary of $90,000 plus 20% benefits brings the total cost per faculty per year to $108,000. We assumed that the annual initial research funding for these individuals would be about $300,000 per year in 2011. Of course the salary, IC, and capacity for research funding would vary among disciplines.

Funding productivity of faculty at UCR has improved by about 2.5% per year (Table S3 in the Appendix). We assume that with the research incentives mentioned below an improvement rate could increase to 5% per year. This translates to an average 50% increase in funding per faculty over a ten-year period – that is, an average of $450,000 per year per faculty in this cohort by 2020.

In Figure 4, the black line represents projected yearly total funding by 725 faculty including a 5% per year increase in funding amount. The pink line represents total funding added by 170 faculty (17 per year) with the funding characteristics mentioned above and also a 5% per year increase in funding. These assumptions lead to a prediction that the UCR campus annual funding in 2020 would be close to the target of $ 250,000,000 per year. The orange line shows the additional annual funding that was projected for the School of Medicine, which during this period would be in its start-up phase – thus the rather modest expected research income of about $25,000,000 per year.

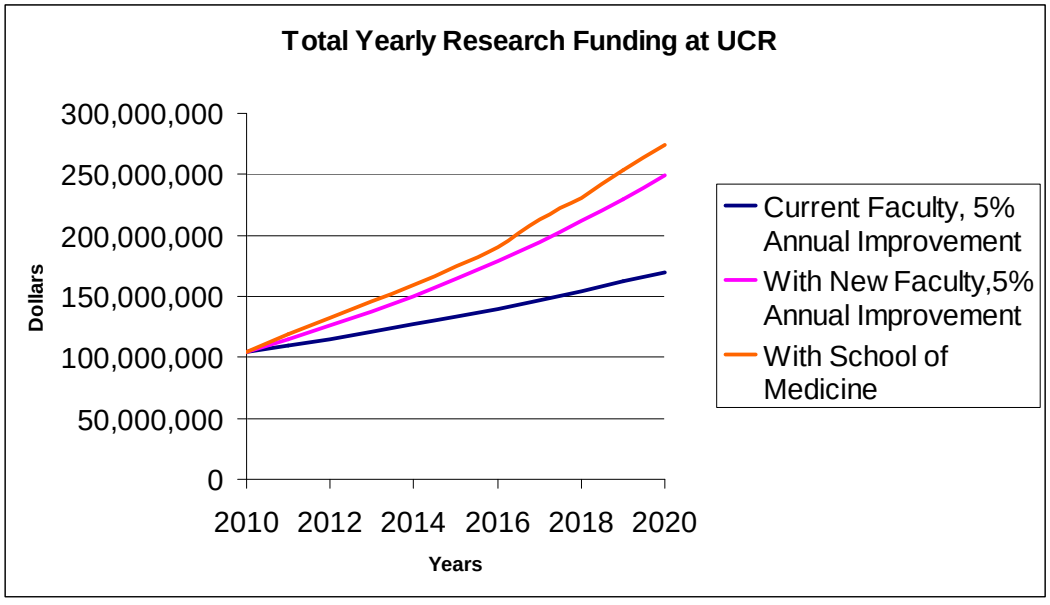

Figure 4. *Projections for increasing research funding through faculty growth and improved productivity.*

We also used this model to estimate the cumulative investment required for the new faculty cohort and the cumulative additional amount of external funding brought to UCR by these

faculty. As can be seen in Figure 5, the total cost of this investment over a ten-year period would be about $200,000,000, not counting associated costs of facilities, equipment, and support staff. The total cumulative additional research funding by this hypothetical cohort of faculty over this period would be about $350,000,000 (this includes approximately $125,000,000 of indirects).

This Committee recognizes that there is not uniform enthusiasm across campus to achieve an AAU profile in research funding. Please see the Dissent statement in the Appendix.

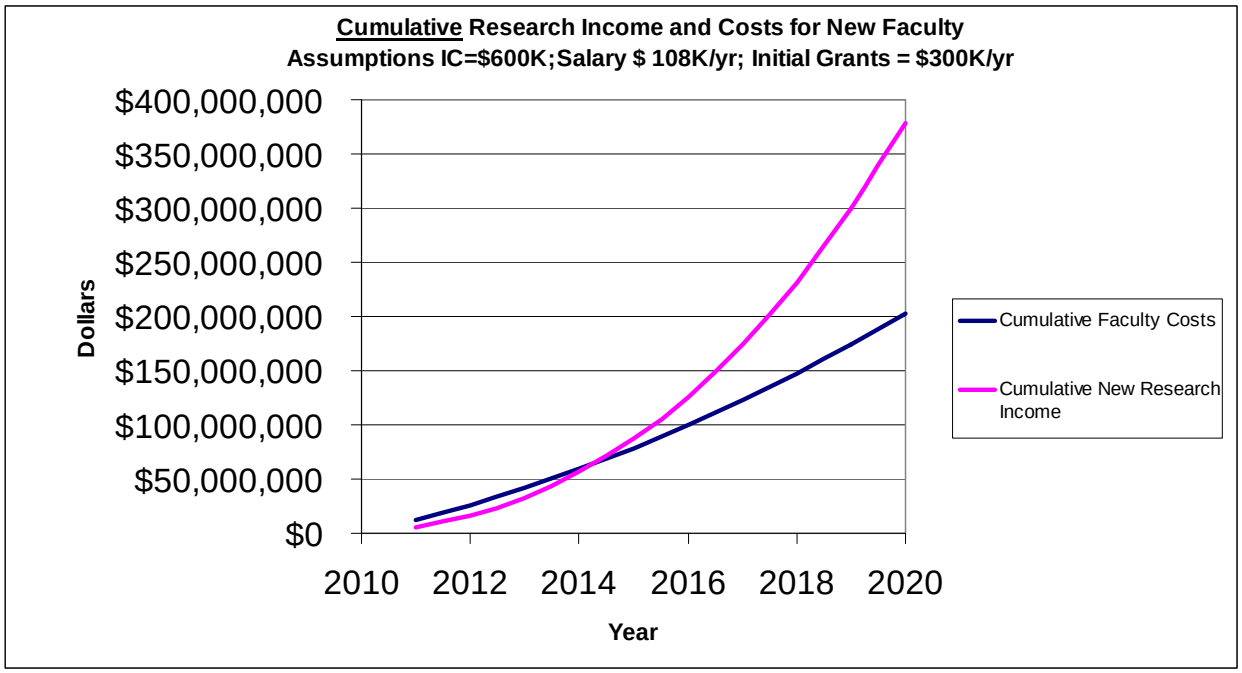

Figure 5. *Projected investment and return on increased faculty size.*

1.3 Recommended Guidelines for New Faculty Hiring

To maximize the impact on extramural research funding, the hires need to be made selectively in research-active disciplines such as education, science, and engineering (Figure 3). Consideration should be given to encourage these individuals to facilitate the creation and growth of research centers (see Sections 2.4 and 4.3.2). A suggested strategy is to target some cluster recruitments to maximize effectiveness in impacting the profile of the university. Hiring of high-profile individuals such as National Academy members should be a priority.

The table below from a recent NSF report shows the pattern of total funding (federal and non-federal) in science and engineering (S&E) by different disciplines that amounted to $51 billion in 2008. This data are not restricted to AAU universities, but reflects all universities. Although UCR departments do not map directly in the same categories as the NSF data, this type of information may provide some metrics for the evaluation of UCR programs. Non-S&E expenditures amounted to about $2 billion in 2008 or about 4% of S&E funds; stating it another way, about 96% of federal funding goes to science and engineering. Non-S&E funds included education ($803 million), business and management ($325 million), and humanities ($254 million).

Table 3
U.S. research funding by discipline, FY 2008.
http://www.nsf.gov/statistics/infbrief/nsf09318/

(Millions of current dollars)		
Field	FY 2008	
All S&E R&D expenditures	$51,909	
		Percent of all funding
Environmental sciences	2,800	5.4
Atmospheric sciences	422	0.8
Earth sciences	956	1.8
Oceanography	1,051	2.0
Environmental sciences, nec	371	0.7
Life sciences	31,215	60.1
Agricultural sciences	2,994	5.8
Biological sciences	9,769	18.8
Medical sciences	17,271	33.3
Life sciences, nec	1,180	2.3
Mathematical sciences	621	1.2
Physical sciences	3,933	7.6
Astronomy	537	1.0
Chemistry	1,486	2.9
Physics	1,604	3.1
Phys &Ast	2,141	4.1
Physical sciences, nec	307	0.6
Psychology	929	1.8
Social sciences	1,940	3.7
Economics	398	0.8
Political science	337	0.6
Sociology	403	0.8
Social sciences, nec	801	1.5
Sciences, nec	1,046	2.0
Engineering	7,957	15.3
Computer sciences	1,468	2.8
Aeronautical/astronautical engineering	538	1.0
Bioengineering/biomedical engineering	604	1.2
Chemical engineering	658	1.3
Civil engineering	922	1.8
Electrical engineering	1,708	3.3
Mechanical engineering	1,159	2.2
Metallurgical/materials engineering	643	0.0 1.2
Engineering, nec	1,725	3.3

nec = not elsewhere classified
S&E = science and engineering
Note: Percentages are calculated on unrounded data

Some present weaknesses in UCR's pattern of extramural funding:

- Low percentage of funding from NIH of about 13% (UCR Office of Research 2008 Annual Report).
- Negligible federal funding from the Department of Agriculture. This is to be contrasted with other Comparison AAU Universities with agricultural stations (Iowa State, Texas A&M, Missouri), which get a third or more of their total funding from such source.
- Few large grants, in particular extramural support for research centers and multidisciplinary research.

1.4 Plan for Enhancing Doctoral Program

UCR's graduate student enrollment falls significantly below the Comparison AAU universities (Table 4). A sizable amount of this disparity can be attributed to the larger number of professional programs leading to the master's degree at AAU universities. Nevertheless, doctoral and post-doctoral training are key components of the AAU profile.

Table 4
Student and faculty numbers for UCR, in 2008 and projected to 2020, and for Comparison AAU universities (More Details in Table S1)
UC Accountability Report, May 2009

	UCR, 2008	Comparison AAU Ave	Comparison AAU StDev	UCR 2020 Projection
Enrollment*	17,367	19,866	8,782	18,824
Faculty	726	999	415	896
Student/Faculty	23.9	20.0	4.0	21.0
Grad Students	2,188	4,050	2,013	3,682
% Grad Students	13	30	10	19
Grad Students/Faculty	3.0	4.1	1.7	4.1

*For UCR, this is a 3-qtr-average. For the other AAUs, it's most likely fall enrollments

Current planning considerations in the student population size and composition are addressed, at least in part, by a recent growth plan from the Office of the Executive Vice Chancellor, which projected a flat population of undergraduate students and selective growth of the graduate student population by approximately 1,500 shown in last column of the table.

However, the estimated population in 2020 from that projection would still leave UCR with a projected proportion of graduate students of 19%, far below that of the Comparison AAU Universities (30%). Selective growth in the graduate student population needs to be continued well beyond 2020.

One concern is the need to find funding for the new graduate student population. At present, only approximately one-third of graduate student cost comes from extramural sources (Table 5).

Table 5
Source of funding for graduate students, UCR
UCR Academic Planning & Budget, 2008
http://sara.ucr.edu/files/grad/Graduate Student Financial Support 2007-08.pdf

Unit	Student Headcount	Intramural Funding ($)	Extramural Funding ($)	Total Funding ($)	% Extramural
CHASS (+English Comp/Writing)	711	15,134,999	4,976,620	20,111,619	25
CNAS	745	15,890,727	8,030,794	23,921,521	34
Engineering	358	6,229,784	4,343,157	10,572,941	41
School of Management	126	1,532,408	485,223	2,017,631	24
Grad School of Education	212	826,958	2,618,857	3,445,815	76
Biomedical Sciences	15	234,495	285,944	520,439	55
TOTAL	2,167	39,849,371	20,740,595	60,589,966	34

It is worth noting that the percentage of funding for graduate students coming from extramural sources at UCR is in line with that of other UC campuses, as shown in Table 6.

Table 6
% extramural funding for graduate students, UCR vs. other UC Campuses, 2007
(More details in Table S2)
UCR EVC Office, Student Fees Source, 2009

	Riverside	UC Wide	StDev
Non-UC-Funds	20,740,595	271,972,509	78,695,116
UC-Funds	39,849,371	464,860,755	134,018,457
Total	60,589,966	736,833,264	212,600,514
% Extramural	34.2	36.9	10.0

We have made a preliminary estimate of the contribution of the proposed additional 170 research intense faculty to the support of the doctoral student population. Our model assumes a linear increase in the population of students seeking Ph.D.s of 150 students per year for the next ten years. We assume that these students graduate with their doctorates after five years in residence. We also assume that each of the newly recruited faculty supervises and supports five doctoral students at an annual cost of $30,000 each. For this cohort we assume that two-thirds of the graduate student support comes from faculty generated extramural funds ($20,000 per student per year, and $10,000 from University sources). Figure 6 shows the results of this analysis.

These somewhat optimistic assumptions estimate that about 55% of the additional 1,500 doctoral students could be supported by the new faculty. We presume that the balance of these additional doctoral students would be supported by current faculty (about one additional student per faculty), especially if there is an enhancement of all faculty research funding by 50% by 2020 as suggested in our financial model above.

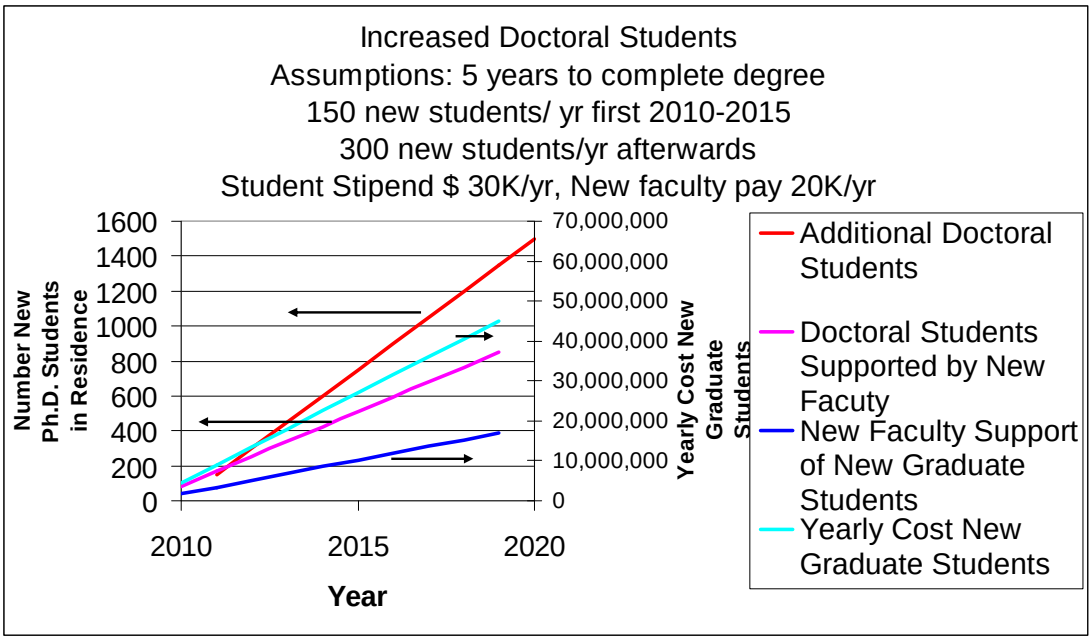

Figure 6. *Scenario for growth in the number of graduate students based on an increase in the number of research-intensive faculty members.*

2. STIMULATION OF AN ENHANCED RESEARCH CULTURE

Our committee has been charged with developing methods for stimulation of an enhanced research culture at UCR.

We visualize the following issues critical for developing an enhanced research enterprise:

(1) Encouraging mid-career faculty to embark on a more intensive research effort.

(2) Supporting early-career faculty in building a strong research foundation.

(3) Increasing University-wide programmatic cluster hiring.

(4) Enhancing support for Institutes and Centers, and increasing the contribution of these organizations to the research enterprise.

(5) Stimulating interdisciplinary research projects through UCR seed funding.

(6) Increasing support for training grants.

(7) Establishing an Academy of Research Scholars.

Each of these is discussed in turn in the following subsections.

2.1 Encouraging Mid-career Faculty to Embark on a More Intensive Research Effort

One of the challenging problems facing nearly every university is re-involvement of some mid-career faculty to more intensive research and creative efforts. Many mid-career professors can become discouraged by rapid developments in their disciplines, which can affect their success in obtaining extramural funds. The University should find ways for engaging these faculty

members in more aggressive fundable research activities through assistance and higher level of accountability. Undoubtedly, this is a sensitive issue as it is related to many well-established members of the faculty who had been successful in their fields. In the opinion of this Subcommittee, there are several essential steps the University should make to accomplish this goal:

a) Funds should be made available to mid-career faculty for taking courses or visiting the most advanced laboratories (departments and/or individuals) in their fields for re-tooling intellectual and technical skills.

b) Utilization of sabbatical leave for re-tooling faculty's intellectual and technical skills. Sabbatical leave is a privilege given to University faculty members for this purpose. Regrettably, too often it is not used efficiently. Tighter accountability should be implemented in developing proposals for sabbatical leaves. We recommend establishment of departmental or college-level committees for consideration of such proposals and accomplishments of sabbaticals. Faculty should be encouraged to take advantage of the intellectual and research richness of Southern California during this time of budgetary constrains to achieve their sabbatical goals.

c) The Office of Research has developed seminars in grant writing, a tool that is useful for faculty at large. However, in addition to staff members currently involved in conducting these seminars, these seminars should include a panel of researchers who have a long track record in obtaining grants from NIH, NSF, DOE and other agencies. Mid-career faculty should be encouraged to participate in these seminars in order to re-tool their grant writing skills.

d) It is imperative to put more emphasis in merit and promotion evaluations on the professor's ability to obtain funds from competitive sources as a benchmark of national or sometimes international recognition. Although award sizes can vary dramatically from one field to another, competitive peer reviewed awards serve as a very sensitive indicator of one's standing as a researcher and scholar. As a rule, other metrics of excellence in creativity and research are tightly linked to and depend upon one's ability to obtain competitive awards.

   There was strong consensus among members of the subcommittee (including a former CAP member) that the merit and promotion evaluation does not sufficiently consider the importance of successful grant funding. As a result several members of the subcommittee noted that faculty who are successful in securing competitive peer-reviewed funding receive little consideration of this accomplishment when a file is reviewed. This creates an environment in which faculty who receive grants do not believe their efforts are acknowledged and faculty who do not pursue grants see grant funding as a factor not given much consideration for advancement. Indeed, the current statement regarding the evaluation of grant funding in the Call, (p. 8),

   > "In particular, successful competition for extramural grants, especially at the national level and through a peer reviewed process, may be taken as an indication of peer evaluation of the quality of the research program"

   was viewed as <u>not adequately highlighting</u> the importance of securing major grants.

   The subcommittee felt strongly that a greater positive emphasis of successful grant funding in the evaluation process would increase the likelihood that current faculty would submit grants and that new junior faculty would consider submitting grants. The subcommittee recommends that the Call be revised to indicate that securing a major peer reviewed grant would be considered, **at a minimum**, as equivalent to a major publication and that securing a competitive grant could be used as the basis of off-scale salary or an acceleration assuming other areas of review are sufficiently strong.

At the same time, however, the University must be cognizant of the degree of difficulty involved in obtaining some grants, especially if we are committed to growth in interdisciplinary research efforts. If success in securing grants is the only criterion, we will breed an ultraconservative faculty that does not pursue major funding opportunities. A professor who wins every grant that he or she proposes is probably not aiming high enough. Hence, the Call should also recognize leadership in pursuit of major funding opportunities that involve considerably more time and effort, and lower probability of a win, than typical single-investigator or small-team awards. This is discussed further in Section 2.5.

e) Being in a major research university system, UCR faculties have substantial portions of their appointments allocated for research and scholarly activities. Thus, more emphasis should be placed on securing funding that supports research, scholarly activities, and students in merit and promotion evaluations.

2.2 Support for Early-career Faculty in Building a Strong Research Foundation

a) The first year after hiring is critical for a young professor to establish her/his research or another scholarly program. The University should institute a rule of reducing teaching of new hires for the first year. This practice exists in some departments, and it does bring a very positive outcome as a long term investment in our new talents.

b) Mentorship of early-career faculty is of paramount importance for their long-term success. Unfortunately, this practice is applied inconsistently throughout the campus. The University and Colleges should implement a policy requiring departments to appoint mentors from a pool of well-established faculty members who are prominent in their fields.

c) Similarly to mid-career faculty, funds should be made available to early-career faculty for short-term trips for taking courses or visiting most advanced laboratories (departments and/or individuals) in their fields for enhancing intellectual and technical skills.

d) Bridge funds should be made available to early-career faculty to overcome possible interruption in their research programs. This practice will pay off as an investment for the future of the University.

e) The development of incentives to increase the level of extramural funding per faculty is essential. In addition to modifications of the Call, particular effort needs to be placed on increasing the submission of large grants (from NIH by 50%, from the U.S. Department of Agriculture by 100%). These incentives should include the following measures:

e.1) Returning a meaningful fraction of indirect cost generated by grants to the Principal Investigator and the department or Center that the PI is affiliated with. Several members of the subcommittee noted that few if any indirect cost funds are returned to the department and no funds are returned to the PI. The return of indirect cost funds to the PI is a practice common at many research institutions and can serve many purposes. For example, funds returned to the PI can reward faculty for successful grant writing and be used as bridge funds when a PI is between grants.

e.2) Creating a mechanism for the review of department success in grants/contracts for new FTE lines. The assignment of new FTE lines from central administration to the Colleges/Schools and then to the departments is based on a number of factors such as quality of the research program, teaching need, and programmatic issues. One issue not given much consideration is the

grant funding prospects of the FTE line and the success of new hires in securing funding. Given limited resources it seems prudent that the campus consider these issues in the allocation of new FTE lines, particularly in the physical, life and social sciences and engineering. This could be addressed by requiring departments, when requesting new FTE lines, to include a discussion of funding prospects of the FTE line. This information could be useful in two ways. First, this information could be used by Deans in the decision making process of allocating new FTE lines in a particular year. Second, this information could serve as institutional memory and feedback in the decision making process by allowing Deans to check on the success of grant funding by hires in previous years when evaluating future requests from departments. Such a mechanism should not be the sole factor in the decision to allocate FTE lines. However, the implementation of this type of review should, over time, increase grant activity on the campus.

2.3 Increasing University-wide Programmatic Cluster Hiring

Cluster hiring is an effective way of enhancing existing areas of prominence and excellence. The University should establish College- and University-wide level committees to analyze areas of our current strength and to identify novel fields for future investment in cluster faculty hiring. See the Themes section below.

2.4 Enhancing Support for Institutes and Centers

Centers and Institutes can provide invaluable means of enhancing research and creative activities by cutting across departmental barriers. When they are effective, they unify faculty members with common research interests, and they create an atmosphere for attaining a synergistic critical mass in certain fields of studies. They greatly enhance the visibility of a university and its research reputation. Successful Centers and Institutes profoundly and positively influence directions in faculty hiring and make an imprint in the University future, often resulting in cluster hiring (for example, recent bioinformatics cluster hiring at the Institute of Integrative Genome Biology).

UCR has a number of excellent and very successful Centers and Institutes – and some Centers have not succeeded in building interdisciplinary teams and attracting extramural support. In general, all UCR Centers and Institutes are very poorly supported and strapped for operating funds. In many other Universities, such enterprises are supported by indirect costs generated by faculty members belonging to an Institute or a Center. In order to enhance the research culture at UCR, the administration should further nurture successful Centers and Institutes by providing management support and a significant percentage of indirect funds back to these organizations. Standards for assuring the effectiveness of this investment are discussed in Section 4.3.2.

2.5 Stimulation of Interdisciplinary Research Projects

With the ever-increasing speed and widening scope of scientific and scholarly endeavors, development of interdisciplinary, multi-investigator projects is becoming imperative for institutional success.

Cluster hiring and enhancement of support of Institutes and Centers are essential parts of building a foundation for interdisciplinary research projects on campus. As noted in Section 2.1, the current system of merit and promotion evaluations does not encourage interdisciplinary research projects. It is solely based on a system of evaluation and rewards of a scholar or a researcher in her/his individual efforts. For example, participation of several faculty members in

large projects such as genome sequencing and annotation, results of which have been published in high profile articles in *Science*, has hardly been acknowledged in their evaluations. **Higher emphasis on interdisciplinary and multi-investigator efforts should be implemented in merit and promotion evaluations.**

One way to facilitate and assist interdisciplinary research projects is to create an Office of Interdisciplinary Programs (OIP). We discuss this concept in detail in Section 4.3.2.

2.6 Encouraging and Supporting Training Grants

Obtaining programmatic grants for training graduate students and postdoctoral fellows is an important measure of institutional maturity as a research and scholarly enterprise. Training grants immeasurably increase the University's profile and visibility.

The ability to obtain training grants in large measure depends on a critical mass of faculty in a given area. Cluster hiring and assistance to Institutes and Centers on campus are imperative. Several successful examples of training grants exist on campus (i.e. NSF IGERT grant by the Center for Plant Cell Biology; the GSOE).

Despite clear institutional benefits, the burden of working with training grants rests largely on participating faculty and mostly on a principal investigator. More assistance and support should be provided by the administration in developing such proposals and managing the research activities of these grants.

The current system of merit and promotion evaluations does not encourage leadership in obtaining training grants. **More emphasis in the Call should be put in merit and promotion evaluations on obtaining and participation in such grants.**

2.7 Establish an Academy of Research Scholars

The campus currently has an Academy of Distinguished Teaching (http://distinguishedteachers.ucr.edu/) but does not have a similar Academy for research. The subcommittee recommends that the campus establish an Academy of Senior Research Scholars to aid in the development of the research enterprise. The Academy would consist of ten faculty with (1) established track records in securing external funding and (2) experience serving on grant review panels. These faculty would represent a wide range of research on the campus (e.g., two faculty from engineering, physical sciences, life sciences, social sciences, one from the business school and one from the School of Education). The members would receive an additional off-scale salary and reduced teaching load (the same compensation provided to faculty in the Academy of Distinguished Teaching). Appointments could be for a five-year period that can be extended to a second five-year term (similar to the Academy of Distinguished Teaching).

The purpose of the Academy would be threefold. One purpose will be to serve as an advisory committee to meet on a regular basis with the Chancellor and Executive Vice Chancellor regarding research growth and development on the campus. Faculty with well-established track records in funding are usually well aware of funding directions at the granting agencies in their respective disciplines. In addition, members of grant panels often are the first to hear of new funding directions at federal agencies. Academy members could use their knowledge and expertise to guide the campus in both short- and long-term growth by identifying research directions planned for growth at funding agencies. A second purpose would be to serve as a resource to aid in the development of grant writing skills for junior faculty and to aid mid-career faculty in re-engaging in grant submissions. Successful grant writing is more than simply having

a good idea. Knowing how best to convey an idea to a grant panel can be critical for success in securing funding. Academy members have this knowledge based on their own success in grant writing and based on service on grant panels. Academy members can convey this knowledge via seminars at the department and college levels for faculty submitting grants. Finally, a third purpose of the Academy would be to aid in the development of interdisciplinary, center, and training grants. Successful grant funding for centers, large-scale interdisciplinary grants, and training grants requires at least one senior professor with a well established research and funding track record to take the lead in developing the grant. Academy members represent an ideal pool of talent to take the lead in developing grants of this nature when such opportunities arise. Academy members can serve this purpose by working with Deans and the Vice Chancellor for Research in identifying faculty appropriate for a new center, interdisciplinary project or training grant and take the lead in developing the proposal when new RFPs (requests for proposals) are announced.

3. POTENTIAL UNIVERSITY-WIDE RESEARCH THEMES

The committee considered various approaches to identify potential themes that could serve as main thrusts for the next decade. We reviewed groups on campus with substantial research efforts as well as national and local priorities.

Some of the topics considered were:

- Advanced personalized learning
- Bio-nanotechnology
- Carbon electronics
- Carbon sequestration
- Clean water
- Closing the educational opportunity/achievement gap
- Computational sociology (psychology, economics, computer sciences, statistics)
- Continental philosophy
- Diabetes and metabolic syndrome
- Diversity and organizational effectiveness
- Earth sciences
- Energy conversion and storage
- Enhanced virtual reality
- Ethnic discourse
- Evolution of complexity
- Evolutionary biology
- Influence of ethnic, race, and cultural traditions on social interaction and dynamics
- Materials science and engineering
- Medieval culture
- Neuronal-glial interactions
- Plant/insect genomics
- Reverse-engineering of the brain
- Secure cyberspace
- Social/personality psychology
- Special education
- Spintronics and 3D-electronics
- Supply chain management and logistics of enterprise system technologies

- Surveillance and security (engineering, computational sociology group)
- Sustainable development of urban communities
- Sustainable energy, e.g. solar
- Systems neuroscience
- Vector biology

We have selected six themes that have the potential to be campus-wide efforts in the next decade. We believe these themes have the following characteristics:

a) Current research strengths on the campus aligned with this theme.

b) Departments and/or colleges that currently have expertise in this theme.

c) Applications and policy implications of this research theme.

d) Significant external funding opportunities for this research theme.

e) Internal resources for investment in this research theme.

The implementation of these themes will depend on efforts by the University administration, divisional and college deans, but most importantly by the campus faculty with interests in these topics. Direct implementation in support of these themes will involve many components, including the use of cluster hires to bridge gaps in interdisciplinary aspects of the topics, divisional investment in facilities and instrumentation for certain types of experimental research projects, and administrative support for centers and their generation of multi-investigator project proposals. As with any enterprise dependent on active engagement by a self-governing faculty, participation by faculty will shape the implementation of these goals, and may also identify and build on additional themes of importance to the campus and community.

3.1 Cultural Diversity, Social Transformation, and Global Community

UCR is uniquely equipped to address how new forms of global community are confronting the unprecedented economic, cultural, and political challenges wrought by globalization. Democratic, progressive, and radical social movements are disrupting old political orders while creating the possibility of empowerment for historically subordinated and dispossessed peoples. Traditional cultural norms and mores are being challenged by the forces of global communication and the homogenizing force of the mass media, fostering tensions that are stimulating a rapid and diverse growth of creative cultural and artistic work. Disciplinary and interdisciplinary research in the humanities and social sciences is directly addressing how changes in global power relations are transforming old social equilibria, generating heightened socio-political conflict while also forging new institutions and political alliances.

UCR offers a symbiosis of scholarly work that addresses the theme of Cultural Diversity, Social Transformation, and Global Community in multiple ways. Faculty members in CHASS are producing nationally significant work in the overlapping interdisciplinary fields of race, ethnic, gender, and cultural studies. UCR's proximity to several Native American tribes (encompassing both reservations and urban communities) is increasingly reflected in the work of faculty across the University. The nationally recognized Rupert Costo Chair in American Indian Affairs, the California Center for Native Nations, and scholars throughout CHASS provide a model of research excellence in this area. The new School of Public Policy has chosen as its themes social policy issues related to global health, as well as access and diversity in higher education, and critical policy issues that transcend traditional administrative units such as the environment and immigration. The faculty in the Graduate School of Education focus a major strand of their research on closing the educational opportunity/achievement gap between poor and affluent

students and between English Learners and native English speakers. These are all vital research areas for a minority-serving institution like UCR.

In recent years, the campus has hosted multiple postdoctoral students supported by nationally competitive fellowships, including the Ford Foundation Fellowship and the UC President's Postdoctoral Fellowship. Faculty in the humanities and social sciences have won numerous other grants, fellowships, and awards through the NSF, NEH, Mellon Foundation, Ford Foundation, Rockefeller Foundation, and other major funding bodies. By strategically investing in the excellence of UCR's *intellectual and (inter)disciplinary* diversity, the campus can distinguish itself statewide and nationally as a place of critically engaged and socially grounded interdisciplinary and multi-disciplinary research.

3.2 Digital Technologies and Communications

Digital technologies have been a major driver of the California economy, and UCR increasingly is being recognized for its strengths in wireless communications, networks, robotics, and social media. In 2009, UCR was selected to be the home of the new UC Multicampus Research Center titled UC Light (Ubiquitous Communication by Light, 2010-2014). Two UCR professors are part of the U.S. Army's latest Collaborative Technology Alliance for networks and security, in collaboration with a consortium of universities and companies. Highly interdisciplinary work in data mining, involving Computer Science, Anthropology, Nematology, and others, has won multiple awards from the National Science Foundation over the past two years. Collaborations between Computer Science, Electrical Engineering, and the Department of Media and Cultural Studies have been proposed to investigate the societal implications of our increasing reliance on digital technologies. Intelligent systems for protecting public safety, for securing computer networks, and for performing domestic and industrial tasks will continue to be a great need and a great opportunity for innovation in California. Significant funding from defense agencies, the National Science Foundation, and U.S. high-tech companies is expected to remain strong for several years.

3.3 Brain Plasticity: Science and Applications

An important discovery in the field of neuroscience is that the brain is capable of changes in the function and connections of neurons from childhood throughout adulthood. This finding, broadly defined as plasticity, suggests that rather than remaining static the brain can improve function, change with learning, and recover from declines in function due to disease, injury or normal aging. UC Riverside currently has several labs conducting research on various aspects of brain plasticity including neuronal-glial interactions, neuronal and glial responses to infection and inflammation, cortical plasticity due to injury, cortical plasticity in aging neural systems, and changes in cognitive systems due to learning. A strength of plasticity research at UC Riverside is that several different methodologies are used that include measuring single cell neuronal activity, assessing biochemical changes in neurons, describing the structure of neuronal connections, and behavioral measures of cortical changes. In addition, faculty at UC Riverside are involved in off-campus collaborations using structural and functional imaging. The labs span several colleges (CNAS, CHASS, GSOE) and include faculty in Biomedical Sciences, Cell Biology and Neuroscience, Psychology, and the School of Education. Current plasticity research at UC Riverside is funded by grants from NSF, NIH and the U.S. Department of Education. Research on plasticity has a wide range of applications from medical (treatment of brain injury and disease; recovery of declines in cortical processing due to normal aging) to educational (development of behavioral training and protocols for learning) and grant funding at NSF and NIH has been targeted for growth in this area. This is a rapidly developing field in neuroscience and related fields; increased investment in faculty lines and research infrastructure (e.g., wet

labs, MRI facilities, and expansion of vivarium facilities) will aid in developing UC Riverside as a national leader in research on plasticity and brain function.

3.4 Genomics

Despite the fact that ten years have passed since the sequencing of the human genome, remarkable new discoveries continue to be made on the complexities of gene regulation. Genetic elements are found to be surprisingly mobile within the genome, and small nucleic acids such as microRNAs (miRNA) have been found to regulate an extraordinarily large proportion of genes. Studies at UC Riverside are at the leading edge of genomics research, with UCR researchers consistently publishing high-impact papers in genomics, especially from well-recognized groups in Plant Biology and Entomology. Genomics researchers at UCR are housed in a number of departments within CNAS, BCOE, and the Division of Biomedical Sciences, supported by funding from the NSF, NIH, USDA, and numerous foundations. Their studies have been greatly aided by an impressive infrastructure associated with the UCR Institute for Integrative Genome Biology that includes state-of-the-art high throughput sequencing services, proteomics, and microscopy facilities, and an established Bioinformatics group. Related studies in the University's Stem Cell Center will also take advantage of the newly constructed Stem Cell Core Facility. Additional investments in interdisciplinary faculty research positions can continue to build on existing synergies across disciplines and also reinforce natural connections with the new School of Medicine. For example, as the network of genomics researchers grows, UCR will be able to contribute to clinical studies on topics of importance to the Inland Empire community, including the emerging field of Genome-Wide Association Studies (GWAS) in areas such as Type 2 Diabetes and metabolic disease.

3.5 Energy Efficiency and Sustainable Development

The fates of economies and civilizations depend to a large degree on their access to energy. Today, world energy demand is rocketing, traditional energy resources are becoming depleted, and the need to curb carbon emissions is taking on new urgency. UCR is at the forefront in addressing these critical issues by investigating solar energy, hydrogen fuel cells, biomass energy, and technological and policy approaches to reducing demand.

The Federal government, industry, and many other countries are investing heavily now to develop ways of providing energy systems that are clean, safe, and sustainable – that is, meeting the energy needs of today without impairing the ability of future generations to meet their own needs. Through interdisciplinary centers and interdepartmental teams involving engineering, the physical sciences, and the social sciences, UCR is playing an increasingly prominent role in developing the materials and systems for providing clean, sustainable energy and for making the best use of our available resources.

In energy supply, UCR's greatest contributions are in solar electricity (the direct conversion of the Sun's light or heat to electricity) and solar fuel (the conversion of renewable resources such as biomass to ethanol or other liquid fuels or photocatalytic splitting of water to hydrogen). Sustainable energy is a rapidly rising and dynamic field, and UCR has significant strengths and collaborative relationships to continue its rise to prominence.

UCR is particularly strong in materials science and engineering – the fields where the most significant barriers to producing affordable renewable energy must be overcome. For example, affordable photovoltaic energy (i.e., solar electricity) requires either less expensive or more efficient cells, or both, as well as advances in energy storage and transportation. The same is true for hydrogen and fuel cell technology. With the new Materials Science and Engineering (MSE) program, the new MSE building, and with our capacity to grow, UCR is well positioned to

address the basic and applied research needs in these areas. By contrast, other UC campuses are emphasizing translational scientific and engineering work in renewable energy: studying the potential impacts of innovations that other organizations have produced rather than tackling underlying challenges.

Complementing the work in BCOE, CNAS, and CE-CERT in energy technology is the Center for Sustainable Suburban Development's commitment to assist in the enlightened development of the Inland Empire. As part of this commitment, it is hosting a multicampus research initiative to forecast the effects on transportation, land use, and the environment of alternative policies aimed at reducing energy demand and improving environmental quality in the LA Metro Area. Thus, UCR has a broad spectrum of expertise to lead the way in developing, assessing, and implementing technology for clean, sustainable energy.

3.6. Beyond Silicon – Phenomena, Materials and Devices

The explosive advance of information and electronic technology in the past four decades has been driven by the relentless push towards miniaturization of silicon-based devices. Yet, as the device sizes approach sub-10 nm scale, the traditional silicon-based technology is rapidly approaching its physical limits, and is expected to hit a "red brick wall" in the next ten to twenty years, as outlined by the International Semiconductor Roadmap. Thus, the grand challenge faced by the global electronic industry and scientific community is to define the next generation of devices, which will necessarily be based on new materials and innovative devices, as well as novel phenomena and properties that emerge in the nanometer scale. In the long term, "beyond silicon" technology is expected to revolutionize the information and electronics sectors, with continued support from government and industry that are committed to maintaining U.S. leadership in this revolution.

At UCR, this intrinsically interdisciplinary area has engaged close collaborations between faculty members in Physics, Chemistry, Materials Sciences, Electrical Engineering, Mechanical Engineering, Chemical Engineering, and Bioengineering, which have resulted in extremely productive research. Thus far UCR has achieved recognition in various sub-fields of beyond-silicon electronics: for instance, in spintronics that aims at manipulating and storing the spin degree of freedom instead of charges, in 3D electronics that extends the electronic structures and functions into the third dimension, and in carbon nanoelectronics that focuses on devices based on carbon instead of silicon. Achievements of UCR faculty in this area have been recognized by federally funded research centers, partnership in Materials Research Science and Engineering Centers, and nationally competitive honors such as the CAREER awards, Young Investigator Awards, Sloan Fellowship and the American Physical Society's McGroddy Prize. In the next decade, UCR will strategically align with the national trend of the rising needs for beyond silicon technology to achieve prominence with a significant impact on local economies.

4. MANAGEMENT OF THE RESEARCH ENTERPRISE

4.1 Research Infrastructure

UCR's success in capturing large, interdisciplinary funding opportunities can be enhanced through changes to our research support infrastructure and our culture. This section discusses attributes of an effective research enterprise and recommends actions that can better-position the campus to identify opportunities early, form teams, win major awards, and enhance our stature.

It is important to note that that research support extends far beyond the units reporting to the Vice Chancellor for Research. While this section addresses some aspects of the Office of Research and related organizations, we must consider the appropriate distribution of resources, responsibilities, and autonomy among the Office of Research, Extramural Accounting, the departments, and research centers. We also wish to point out that we attempted to benchmark UCR's Office of Research against those at other UCs. Because of widely divergent structures, apples-to-apples comparisons are virtually impossible, and we caution the reader to avoid the temptation to look at inappropriate metrics such as headcount vs. number of proposals submitted or dollar amount of awards administered.

4.2 Attributes of an Effective Research Enterprise

4.2.1 Performing the Essential Functions Effectively

UCR's research support infrastructure must do four things well to position our research community for success in organizing major research undertakings and capturing the funding to undertake them. They are (1) research development, (2) pre-award proposal administration, (3) award negotiation and post-award administration, and (4) technology and knowledge transfer. Table 7 summarizes key functions within each of these areas and suggests metrics that UCR can use to evaluate the effectiveness of the operation.

Table 7.
The components of research support infrastructure and metrics for assessing their effectiveness.

Research Development	
Function	**Metrics**
1. Stay abreast of funding trends and communicate them to the deans, faculty, departments, and research centers, ensuring that all principal investigators are aware of relevant opportunities.	Faculty who participate in peer review or have other contacts with funding agencies report on what they have learned about trends and future opportunities. This information is captured and disseminated to research development personnel on campus. Evidence of success will be a measurably increased proportion of funding from Agency Program Announcements (PA), Requests for Proposals (RFP), Requests for Applications (RFA).
2. Facilitate and support the establishment of intramural teams of PIs capable of leading efforts for major research or training funding opportunities.	Vice Chancellor-Research and Deans travel to meet with program officers regularly to obtain information about upcoming funding opportunities and priorities. Associate Deans of Research take a leadership role in the establishment of intramural teams.

3. Provide resources to support the proposal effort, to include academic and/or staff support for research, release time for PI if appropriate, writing, editing, compiling required materials, final packaging, and submission. 4. Provide resources toward required cost sharing and other institutional commitments. 5. Provide course or committee release time for successfully funded efforts to enable the PI's to manage the work and personnel for the research.	UCR anticipates major opportunities, selects the opportunities that are the highest priority (because of probability of win and desirability of win), and takes timely action to commit resources to these pursuits. Evidence of success will be significantly increased numbers of multiple investigator proposals (e.g., P01 Program Project Grants, Centers), especially those crossing Departmental and Divisional boundaries. Vice Chancellor-Research and/or Deans provide support for PIs who agree to take on major projects. Since support can be in the form of administrative support for proposal production, one metric can be the number of proposals. Evidence for a particularly successful effort can also include quantification of the numbers of proposals involving faculty who had not submitted research proposals in the preceding two years. Listserves are established so faculty with similar interests can exchange ideas and establish collaborations, leading to interdisciplinary collaborations that are positioned to win funding. Searchable databases are maintained to facilitate searches for funding by faculty, researchers, postdocs, and students. Formal and informal methods, including interdepartmental seminars, "brown bag" lunches, teas, or other events, are established to facilitate contacts across departments and disciplines, leading to interdisciplinary collaborations that are positioned to win funding. An office with the capability to accumulate a database on interdisciplinary projects and investigators should be created so interactions among interested investigators can be streamlined. This office should also have the ability to provide administrative support for the production of new interdisciplinary and interdepartmental proposals. Every PI learns of every relevant opportunity as soon as practical after it is released. PIs do not receive redundant announcements for the same opportunity.

Pre-Award Proposal Administration	
Function	**Metrics**
1. The E-CAF system is fully implemented for all UCR proposals. Upgrades are considered to make the approval process more functional and to add searching functionality. Upgrades to the cost-sharing module are implemented. 2. Assure that PIs, departmental support staff, and Office of Research staff know and understand the	100% use of E-CAF to process and archive proposals. Promptly after submission of a proposal (<1 week), the final version is archived in E-CAF and the E-CAF is archived. All UCR proposals are submitted on time and without flaws that could lead to their rejection or return without review. UCR is free of scientific misconduct. Smooth and mutually respectful operation of the proposal process. At present, there is some ambiguity about OR's lead times. This should be clarified with explicit documentation of responsibilities among investigators, OR staff, department staff,

processes for preparing, approving, and submitting proposals, including legal, ethical, and organizational requirements, and the mechanics of preparing and submitting each proposal. 3. Office of Research and the research enterprise agree on lead times required for proposal review and submission.	and approvers. 100% compliance with departmental, OR, and sponsoring organization lead times (recognizing that emergencies do come up and should be accommodated if possible). Explicit guidelines on proposal format requirements should be available as guidance documents. An explicit listing of responsibilities should be provided to explain what aspects of the process are performed by the Office of Research and what are the investigator's or department analyst's responsibility. All proposals are submitted on time. All cost sharing requirements are satisfied and clearly documented. (Improvements to E-CAF will facilitate this.) Proposal demonstrates a sincere commitment by the institution to the success of the project (not quantifiable).

Award Negotiation and Post-Award Administration	
Function	**Metrics**
1. Handle awards are promptly, courteously, and professionally, without exception. 2. Apply appropriate discretion and flexibility in negotiating awards. In 2006, *Inc*. magazine listed UC Berkeley as one of the "five universities you can do business with." UCR and UC Berkeley have the same rules, but we are considered to be a difficult campus to work with. We need to change this. 3. Operate an accounting system that makes it easy for PIs and departments to see their account balances, track expenditures, and make financial forecasts.	All incoming awards are acknowledged on the day they are received, with formal documentation of coordination between OR, Accounting, and the awardee's department. All awards are either accepted or marked up for negotiation within a reasonable number of days – say, one week. Negotiations are initiated via telephone, not e-mail, to facilitate prompt conclusion of negotiations. Status of negotiations is documented in such a way that the PI and the PI's department can check progress. The accounting system is accessible, up to date, accurate, and easy to understand. Success in these efforts will be quantifiable as a significant increase in UCR-industry collaborative funding for research and development projects, and increases in patent applications for UCR technology licensed by industry.

Technology and Knowledge Transfer	
Function	**Metrics**
1. Serve the interests of the University, the State of California, and our researchers by facilitating the dissemination of knowledge, the licensing of technology for commercialization, the hiring of our alumni into jobs and internships, and the establishment of new businesses based on UCR innovations.	Successful outreach to university faculty will be quantified by significant increases in Technology Disclosure filings, and increased numbers of patent applications filed. Metrics should include numbers of patents actually awarded and licensed, funds generated, new companies started.

4.2.2 Campus Culture

4.2.2.1 Faculty. An effective and successful research university encourages faculty to work together on innovative ideas, and it supports the faculty in pursuing those ideas. Our committee found several examples of ways to facilitate informal contacts that lead to creative ideas. Among them:

- Interdepartmental seminar series, so faculty and students who otherwise might not come into contact are together.
- Distinguished lecture series that attract faculty from multiple departments.
- Teas, coffee hours, mixers, barbecues, or happy hours to facilitate informal contact.

Basically, our perspective is that a winning proposal is born before the solicitation that can fund it has come out. Creative and collaborative people must have time to know one another and develop their ideas; rarely does a group of strangers come together to win a major grant. If UCR can provide sufficient opportunities for people to get together and understand one another, the good ideas will germinate. We will have something to bring to program officers on our trips to Washington, and we will be positioned to respond effectively when the right funding opportunities arise.

These faculty must have incentives for taking on the extra work that a major proposal requires. The largest funding opportunities have extremely low win rates; a professor who wants to maximize funding would be better off trying to win more small and medium-sized awards than to pursue a major center. Therefore, UCR should have mechanisms in place that (1) lighten the load on the PI, so the work is worth the time, and (2) *send an unmistakable message* that the campus is committed to this undertaking. This can involve commitments from the Chancellor, Vice Chancellor-Research, deans, and departments/centers for cash cost-sharing on the proposal, lab space and equipment, staff support for the proposal, and course relief during the proposal effort and running the funded research. This is discussed more fully in Section 4.3. The current program in OR provides funds for a PI to visit agency officials to discuss prospective funding, and also a program to provide some cash support for staff or services on a proposal (such as the assistance of a graphic artist). These resources are helpful and

appreciated, but they probably are not sufficient to rise to the level of showing true campus commitment to winning major opportunities.

4.2.2.2 Staff/Institutional. Administering Government contracts and grants is requiring increasing levels of effort. Audit standards have tightened (e.g., SAS 114), training and documentation requirements are growing (e.g., the training in responsible conduct of research required under the America COMPETES Act), and the American Recovery and Reinvestment Act (ARRA) requires the Office of Research and each Principal Investigator to produce frequent (and sizable) reports. UCR has automated some proposal functions through E-CAF and PAMIS in recent years, but it is clear that automation alone will not keep up with the growing administrative demands. The first challenge to address, therefore, is an adequate size and configuration of staff to assure that UCR can properly administer the money it wins.

Next, we must change the culture that has given UCR the reputation of a campus that is difficult to work with. As we note in Table 6, UC Berkeley made *Inc.* magazine's list of "five universities you can do business with" (http://www.inc.com/magazine/20060201/views-opinion.html). UCR and Berkeley play by the same rules, but it is apparent that UCR does not approach questions with the same can-do attitude that Berkeley applies. The Office of Research in particular must adopt a posture that its mission is to get to yes – to find ways to meet sponsor requirements on proposals, and to find ways of coming to terms with sponsors on agreements. The Office of Research can play an incredibly constructive role in UCR's relations with the organizations that provide our funding. There is room for improvement here, as the *Inc.* article shows.

On a related note, it would be appropriate to re-examine UCR's approach to training on contract and grant matters. The Office of Research offers a year-long training program for departmental staff involved in award administration. UCR also provides significant training to Office of Research staff through webcasts and other means. The net effect of some of this training, however, has sometimes been paralysis: Knowing the risks and potential pitfalls of an issue can make the contract/grant officer reluctant to go forward. Clearly, the staff members must be knowledgeable about their work and the risk of errors. However, it is essential that they be trained and empowered to find appropriate and acceptable ways to mitigate risks and go forward.

4.3 Enabling More Aggressive Research Pursuits

4.3.1 Examples of Best Practices

As mentioned in Section 4.2.1, the campus must send an unmistakable signal of its commitment if we want to change the culture and achieve greater success in capturing major funding opportunities. Our committee contacted other successful UC campuses and reviewed other resources to look at measures that are helpful along these lines. They include the following:

- **Seed funding and cost sharing.** Once researchers have succeeded in finding common interests and identifying promising ideas for collaborations, they should have resources to get started on working together. Preliminary collaborations help to refine the ideas and establish a track record that will appeal to a funding agency. The only formal campus program available now is a small fund from the Vice Chancellor for Research that supports limited preliminary work or a conference. Separately, when a formal proposal is under way, the campus should provide high-quality cost sharing (cash, faculty lines, space, equipment) to meet its obligations and demonstrate genuine commitment.
- **Release time.** To varying degrees, professors can get release time so they can work on major proposals. Examples we have seen include course relief granted by a department

chair or dean; sabbatical leave; and appointment as a faculty "research coordinator" to identify and pursue funding opportunities. Faculty members clearly respond to course relief as an incentive to take on a major project.

- **Proposal specialists.** Research Development is an up-and-coming concept in U.S. academic institutions. In 2009, a new organization, the National Organization of Research Development Professionals (NORDP), was established, and it already has held its first national conference. Staff from UC Irvine and UC Merced have taken on leadership roles in NORDP. Campuses have many different configurations and roles for proposal specialists. At UCR, three specialists are resident within individual colleges (Mitch Boretz in BCOE, MaryAnn Doherty in CHASS, and Alan Paul in CNAS), and a fourth, Jane Schultz, serves this role campus-wide. At other UCs, "strike teams" of proposal specialists can be assigned to a specific proposal for a period of weeks to help the principals complete their proposals. There is no one right way to configure these assets, but it is likely that NORDP will produce knowledge about best practices that can help us when we are ready to make greater investments. Implicit in NORDP's establishment, too, is that competition will get tougher: More universities are investing in specialists whose job is to make proposals better.
- **Other staff support (e.g., administrative, graphic artist, research assistant).** During a proposal effort, faculty can benefit from support of administrative staff, support staff such as graphic artists, and help from research assistants. Again, the Vice Chancellor for Research has a small fund available for this purpose.

4.3.2 The Role of Centers

A significant issue to consider is the role of centers in stimulating interdisciplinary research success. UCR has a number of centers that receive central funding from the Vice Chancellor for Research (see http://or.ucr.edu/VCR/Centers.aspx), but we have seen little production from several of them in terms of catalyzing new ideas or attracting extramural funding. By contrast, UC Santa Barbara bases much of its research enterprise on a center structure: More than half of all UCSB proposals are generated through centers rather than departments. The centers have the expertise to support proposals by faculty from multiple departments; to prepare proposals that conform readily to campus and sponsor requirements; and to administer awards effectively.

What we propose is an **Office for Interdisciplinary Programs** (OIP), based formally within the Chancellor's Office, but in fact to be dependent on the active efforts of a few faculty across campus divisions. A few administrative positions would be needed to help coordinate a central office to handle proposal production, updated files from participating faculty, and grants administration for awarded multi-investigator grants. Grants administration support should be legitimately drawn from indirect cost recovery of awarded grants, so the more speculative investment would only be in a position to coordinate proposal production. Any proposal drawing faculty from more than one department would be a candidate for support from this Office. As the OIP gains experience and efficiency, the rate of successful proposals will increase.

A unique aspect of this Office is that it will depend on the part-time efforts of a few key faculty with experience in Interdisciplinary research and an eagerness to draw together faculty already highly engaged in research. For the present, the emphasis here is on research rather than educational programs, but this emphasis is temporary, reflecting the need to generate fundable research proposals. Educational programs will indirectly benefit as research programs gain the resources to support additional graduate students and postdoctoral fellows. Training programs at UCR generally aim to support graduate education, but an office able to support larger interacting groups of successful research programs should also be able to help new training

grant proposals include postdoctoral positions. This should be done in part through the development of an office for postdoctoral fellows, to help enhance their opportunities for social and scientific interactions, and to provide more organized venues for discussing career options.

Recruitment of the few faculty to support the OIP would begin with those faculty who have already shown an enthusiasm for interdisciplinary research programs, and who have active research programs funded by Federal agencies and/or foundations. There should be a goal to include at minimum one person from CHASS, BCOE, CNAS, and Biomedical Sciences. Since the positions are not compensated, a relatively informal organization would be proposed, but with monthly meetings to discuss strategies, and to recruit groups of faculty to organize centers or proposals. One of the faculty would nominally be required to be responsible for overseeing the administrative staff performing the proposal production and grants administration purpose. These services should be advertised to faculty.

The OIP would not depend on a standing list of affiliated faculty, and would only comprise researchers participating in the production of multi-investigator proposals, or in projects already funded by these efforts. There would be no obstacle to any interested faculty to using the Office's experience and administrative staff to produce new projects. In the course of using the OIP, faculty would of course begin to build a central database that could benefit any new proposals as they come along.

Likely benefits:

- The organization and operation of the proposed OIP would take advantage of existing networks of engaged researchers on campus, and help grow this network to introduce faculty across disciplines that might not otherwise have opportunities to interact. Such a personal approach would be far more effective than simply producing a database of faculty with only a limited description of research interests. The dependence on personal interactions would also focus the building of interdisciplinary projects on those researchers already predisposed to seeking complementary research approaches.
- Recent discussions on building for the future of UCR in the face of limited resources have also raised the notion of hiring new faculty in areas of strategic focus ("cluster hires"). Such new faculty would be recruited through the help of interdisciplinary committees, and the hired new faculty would be given the opportunity to choose their home departments. The OIP would be an ideal source of input on topics for focus areas, and for helping to identify interested faculty to serve on the committees for recruiting and hiring these new faculty.

In sum, the proposed OIP is envisioned to provide a setting where the dual strengths of a relatively small campus environment are combined with the great diversity of research already active within all of the campus Divisions. Several faculty have already proved that traditional academic silos are only vague imaginary constructs, and that new strategies can be built by integrating the existing strengths across campus.

4.4 Structuring the Research Support Framework

As we noted earlier, there is no one "right" way to organize research support operations, and no bright lines among best practices at other institutions. Further, Vice Chancellor Louis told us that one of his previous institutions (University of Minnesota) once reorganized its research administration operation and then went back to the previous configuration a few years later.

We do not advocate change for the sake of change. Nor, however, do we have the answer to how to deploy our resources for maximum effectiveness. These questions should be considered in arriving at that answer.

- What is the right staffing level for research administration in light of increasing Government requirements for fiscal administration and reporting?
- How do we position our staff? For example, should the Office of Research have control over Extramural Accounting (or vice versa)? Should we establish trans-departmental centers to administer research, after the UCSB model? If so, will departments have to give up staff to the centers? How much authority and responsibility should be resident in the Office of Research and how much in the departments or centers?
- How do we provide automated resources that can help our faculty and staff operate more efficiently and effectively? Are our current systems (PAMIS, accounting) sufficient?

4.5 Recommendations

Based on our committee's research and discussions, we have arrived at the following recommendations. This does not represent the totality of what we need to improve UCR's ability to capture greater support for large, interdisciplinary efforts; answering the questions in Section 4.4 will have quite a bit to do with that. Rather, these recommendations are things that UCR should implement regardless of how those questions are answered.

- Increase UCR's contact with funding agencies through regular trips by the Chancellor, Vice Chancellor for Research, and Deans. Capture and disseminate the knowledge gained from these trips, and the knowledge gained from faculty participation in peer review panels, and use this knowledge to position UCR for future funding opportunities.
- Expand opportunities for faculty from multiple departments and disciplines to get to know one another formally and informally (e.g., interdepartmental lecture series, coffees/teas/mixers).
- Establish and maintain a searchable database of faculty expertise.
- Increase the resources available to initiate interdisciplinary collaborations (e.g., research seed funding, conferences/workshops).
- Provide incentives for faculty to lead major research programs. Modify the merit and promotion system to recognize leadership of interdisciplinary efforts.
- Provide support resources for major proposals, consisting of some mix of staff support, proposal specialist support, research assistant support, and graphic artist support.
- Send an unmistakable message of institutional commitment to these initiatives by supporting the proposal team with support staff and possibly course relief, and by providing high-quality cost sharing on the proposals.
- Monitor and apply best practices in research development through engagement with the National Organization of Research Development Professionals (NORDP). Encourage at least one UCR research development professional to take an active role in the organization and provide funds for this person to attend its annual conference.
- Re-examine UCR's approach to training Office of Research contract and grant officers and departmental staff. Emphasize the importance of "getting to yes" while conforming to all requirements.

- Re-examine the configurations of research administration. One particular recommendation is to consider separating pre-award from post-award functions, so awards can be handled more promptly. In the current configuration, contract and grant officers always must place deadline-driven proposals ahead of pending awards.
- Examine the productivity of UCR's centers. For those that do not produce interdisciplinary collaborations and/or external funding, identify ways to improve their performance or terminate them so resources are available for other undertakings.
- Examine PAMIS, accounting systems, and other resources for contract and grant support to identify ways that they can make operations more efficient and effective.
- Expand an existing proposal workshop series (presented by Jane Schultz, Mitch Boretz, MaryAnn Doherty, and Alan Paul) to include presentations by senior faculty aimed at junior faculty to address how to win funding from specific agencies.
- Consider cluster hiring to establish a core of UCR faculty in a field that will produce major research funding.
- Establish a can-do culture in UCR's research enterprise.

5. STRUCTURAL CHANGES IN THE COLLEGE OF NATURAL AND AGRICULTURAL SCIENCES (CNAS)

5.1 Evaluation of the Current Structure of CNAS

Committee members felt that the present structure of CNAS is too big and groups many Departments with widely different interests. Grouping all those Departments together in one single structure has made CNAS more removed and less attuned to the needs of individual Departments.

Three groups of Departments with clear differences in goals and structure can be identified within CNAS. They display significantly different profiles in both research and teaching. This is highlighted by the data in Tables 8 and 9.

Table 8
Source of funding for research in CNAS by department.
UCR Academic Planning & Budget, 2008

	Expenditures	% Indirect	% Fedl	%State&Local	%Pvt
CNAS	32,161,045	24	68	10	21
Division of Agriculture and Natural Resources					
Entomology	6,006,436	18	53	23	23
Environmental Sciences	2,335,775	12	49	41	10
Nematology	1,239,133	12	17	2	81
Plant Pathology & Microbiology	2,416,595	18	39	3	58
SUB-TOTAL	11,997,939	16	46	20	34
Division of Life Sciences					
Biochemistry	2,132,099	41	73	17	10
Biology	2,023,533	28	96	1	2
Botany and Plant Sciences	3,750,615	28	64	3	33
Cell Biology & Neuroscience	1,431,765	39	89	1	10
SUB-TOTAL	9,338,012	33	77	17	18
Division of Physical and Mathematical Sciences					
Chemistry	3,568,021	27	81	5	14
Earth Sciences	1,223,335	28	70	0	30
Mathematics	185,609	46	97	0	3
Physics and Astronomy	3,413,437	26	98	0	2
Statistics	71,617	34	80	0	20
SUB-TOTAL	8,462,019	27	87	7	11

Table 9
Teaching load in CNAS by department.
UCR CIRS Teaching Loads-Depts'08-09

	Faculty Head-count	# Courses	Enroll-ment	Total Units	Course/ Fac	Units/ Fac
CNAS	245	3,129	60,363	219,449	12.8	896
Division of Agriculture and Natural Resources						
Entomology	25	177	1,557	5,949	7.1	238
Environmental Sciences	21	117	1,573	6,139	5.6	292
Nematology	5	14	77	219	2.8	44
Plant Pathology & Microbiology	14	75	419	1,554	5.4	111
SUB-TOTAL	65	383	3,626	13,861	5.9	213
Division of Life Sciences						
Biochemistry	13	227	3024	9205	17.5	708
Biology	21	247	9366	33136	11.8	1,578
Botany and Plant Sciences	31	228	961	3703	7.4	119
Cell Biology & Neuroscience	15	58	1323	5097	3.9	340
SUB-TOTAL	80	760	14,674	51,141	9.5	639
Division of Physical and Mathematical Sciences						
Chemistry	27	535	13448	38453	19.8	1,424
Earth Sciences	15	124	3028	12015	8.3	801
Mathematics	23	282	12977	57140	12.3	2,484
Physics and Astronomy	27	436	7347	24798	16.1	918
Statistics	8	85	2846	13570	10.6	1,696
SUB-TOTAL	100	1,462	39,646	145,976	14.6	1,460

Clear separations are seen along the lines of the existing division within CNAS:

- In contrast with the rest, the Departments in the Division of Agriculture and Natural Resources receive most of their funding from non-Federal sources – principally from state and local governments and from private sources. Their research is typically more applied, and directed toward specific problems in agriculture. They have light teaching loads, and a different structure of hiring.
- The remaining departments can be grouped according to their research focus into Life Sciences and Physical and Mathematical Sciences. The two groups are comparable in size and research funding, but have different emphases in their teaching responsibilities. The Division of Physical and Mathematical Sciences includes most of the "service" departments and has a higher teaching load, mostly because of the large lower division undergraduate courses they serve. It also has a larger graduate program. The Division

of Life Sciences, on the other hand, has a larger undergraduate student population (more majors, Table S4), and therefore larger upper division undergraduate classes.

These differences have been already recognized in the recent rearrangement of CNAS, at which point Division Deans were appointed. However, the resulting structure kept the College together under the supervision of one central Dean. This has resulted in an ill-defined distribution of responsibilities, and an additional layer of administration.

A full split into three independent Colleges along the lines already identified would make any decision making process more straightforward, and the Deans more responsive to the needs of the Departments.

5.2 Recommendation

- Split the College of Natural and Agricultural Sciences into three separate Colleges along the existing Divisional lines. Eliminate one layer of administration.

APPENDIX A

Miscellaneous Statistics for UCR Departments, 2008
: Publication data from ISI Web of Science, 2008; Funding data from Office of Research 2008 Report; Ranking from US News and World Report Ranking 2008

Unit	Faculty Headcount	Articles	Articles/ Faculty	Citations/ Article	H-Index	Funding ($)/ Faculty
CHASS	309	155	0.5			12,382
Anthropology	16	3	0.2	0.00	0	0
Economics	23	25	1.1	0.40	2	258
English	25	1	0.0	1.00	1	5,015
Ethnic Studies	11	1	0.1	0.00	0	0
Hispanic Studies	8	1	0.1	0.00	0	0
History	28	8	0.3	0.00	0	518
Philosophy	22	11	0.5	0.36	1	5,741
Political Science	18	1	0.1	3.00	1	35,243
Psychology	30	91	3.0	3.86	6	89,335
Religious Studies	11	0	0.0	0.00	0	0
Sociology	22	13	0.6	0.46	2	5,888
CNAS	245	1420	5.8			230,541
Biochemistry	13	48	3.7	5.92	9	248,938
Biology	36	155	4.3	3.75	11	199,040
Botany and Plant Sciences	31	136	4.4	3.85	12	233,690
Cell Biology & Neurosci	15	57	3.8	5.21	9	218,111
Chemistry	27	281	10.4	4.62	12	418,992
Earth Sciences	15	61	4.1	2.79	7	165,472
Entomology	25	156	6.2	1.78	6	290,880
Environmental Sciences	21	153	7.3	2.97	9	208,571
Mathematics	23	61	2.7	1.03	4	21,993
Nematology	5	18	3.6	1.33	3	281,807
Physics and Astronomy	27	204	7.6	5.50	15	182,398
Plant Pathology & Microbiol	14	69	4.9	4.28	9	258,957
Statistics	8	21	2.6	1.29	3	1,563
Engineering	83	235	2.8			346,466
Bioengineering	8	26	3.3	3.12	5	69,302
Chemical/Environ Eng	12	32	2.7	2.36	6	876,581
Computer Science & Eng	24	44	1.8	2.82	5	241,989
Electrical Engineering	23	84	3.7	3.51	8	236,748
Mechanical Engineering	16	49	3.1	2.12	6	138,385
School of Management	29	20	0.7	0.90	2	776
Grad School of Education	22	11	0.5	0.73	1	208,923
Biomedical Sciences	14	44	3.1	4.45	8	206,709

Graduate Program Rankings in the US, US News and World Report, 2008

	Rank	Score	Total Schools	No	Rank %
Biology	68	3.2		253	27
Chemistry	48	3.2		197	24
Computer Science	65	2.6		151	43
Earth Sciences	60	2.8		105	57
Mathematics	70	2		167	42
Physics	64	3		167	38
Engineering	62			198	31
Education	54			278	19
Economics	>54			131	
English	41	3.3		150	27
History	71	2.8		145	49
Political Sciences	51	2.5		117	44
Psychology	66	3.2		240	28
Sociology	41	3		113	36
Business	>55			426	

Table S1
Student and Faculty numbers and Funding metrics for UCR against AAAU Comparison Group
UC Accountability Report, May 2009; Funding by Area in bottom half of Table S1 comes from the NSF Report, and corresponds to 2007

	UCR, 2008	Iowa State	Stony Brook	Syracuse	Texas A&M	Tulane	Arizona	Kansas	Missouri Columbus	Oregon	Average
Enrollment	17,367	20,444	14,847	13,156	36,580	6,491	28,442	20,822	21,484	16,529	19,866
Faculty	726	1,215	629	840	1,712	405	1,329	1,157	1,104	597	999
Student/Faculty	23.9	16.8	23.6	15.7	21.4	16.0	21.4	18.0	19.5	27.7	20.0
Grad Students	2,188	3,440	3,505	2,060	7,816	1,040	6,087	3,747	4,181	4,576	4,050
% Grad Students	12.6	22.8	48.6	39.6	23.7	35.8	24.2	30.0	26.6	18.9	30.0
Grad Students/Faculty	3.0	2.8	5.6	2.5	4.6	2.6	4.6	3.2	3.8	7.7	4.1
Total Funding 2007	128,243,000*	217,158,000	268,282,000	36,396,000	543,888,000	137,107,000	531,753,000	202,129,000	228,654,000	61,694,000	247,451,222
Funding/Faculty	176,765	178,731	426,521	43,329	317,692	338,536	400,115	174,701	207,114	103,340	243,342
Funding by area											
Environmental sciences	15074	7051	24042	3194	112571	670	13265	14235	1977	2662	19,963
Life sciences	68274	111538	107738	2600	188462	122855	275212	146357	169206	26694	127,851
Math and computer sciences	3355	13558	12787	8510	15257	1560	6824	1034	3615	3452	7,400
Physical sciences	8390	11026	33050	6159	39200	2619	152825	9131	8452	13089	30,617
Psychology	2517	855	8664	5403	2931	441	5645	729	6832	7896	4,377
Social sciences	2332	17234	5190	2613	11729	3689	19747	10504	12635	6941	10,031
Sciences, nec	1585	3542	40200	1	9304	0	0	1738	0	0	6,087
Engineering	26716	52354	36611	7916	164434	5273	58235	18401	25937	960	41,125
Rank	115	79	67	189	22	110	23	84	76	157	

* This figure is from NSF and differs from the data in Figure 1 from UCI Office of Research

Table S2
% Extramural Funding for Graduate Students, UCR vs. Other UC Campuses, 2007
UCR EVC Office, Student Fees Source, 2009

	Berkeley	Davis	Irvine	Los Angeles	Merced	Riverside	San Diego	Santa Barbara	Santa Cruz	Universitywide
Non-UC-Funds	69,564,150	35,544,832	24,707,156	51,289,712	175,827	20,740,595	43,447,569	24,987,587	11,126,941	271,972,509
UC-Funds	111,417,499	65,500,109	49,753,536	88,268,745	2,109,136	39,849,371	50,255,783	42,407,559	22,910,163	464,860,755
Total	180,981,649	101,044,941	74,460,692	139,558,457	2,284,963	60,589,966	93,703,352	67,395,146	34,037,104	736,833,264
% Extramural	38.4	35.2	33.2	36.8	7.7	34.2	46.4	37.1	32.7	36.9

Table S3
Number of Students and Faculty and Funding Metrics for UCR
Faculty Headcount data from UCR EVC Office, 2008; Funding data from UCR Office of Research 2008 Report

Unit	Faculty Headcount					Funding ($)				
	2004	**2005**	**2006**	**2007**	**2008**	**2004**	**2005**	**2006**	**2007**	**2008**
CHASS (+English Comp/Writing)	261	257	264	286	310	4,589,983	5,606,579	5,582,042	6,337,608	4,503,787
CNAS	236	237	242	247	249	45,726,800	64,285,231	52,483,168	49,923,526	52,413,761
Engineering	66	68	74	79	83	19,611,540	24,595,127	15,071,032	24,527,833	28,756,648
School of Management	35	26	21	23	27	0	0	0	525,000	22,500
Grad School of Education	22	19	18	20	23	2,577,819	7,656,101	5,505,751	7,033,199	4,596,302
Biomed Sciences	14	14	13	13	14	1,954,865	2,687,671	1,747,618	3,200,404	2,893,923
CNAS+Eng+Biomed	316	319	329	339	346	67,293,205	91,568,029	69,301,818	77,651,763	84,064,332
TOTAL	634	621	632	668	706	74,461,007	104,830,709	80,389,611	91,547,570	93,186,921

Unit	Funding ($)/Faculty					2004-2009 Yearly Average Growth, %
	2004	**2005**	**2006**	**2007**	**2008**	
CHASS (+English Comp/Writing)	17,586	21,815	21,144	22,159	14,528	-3.5
CNAS	193,758	271,246	216,873	202,120	210,497	1.7
Engineering	297,145	361,693	203,663	310,479	346,466	3.3
School of Management	0	0	0	22,826	833	
Grad School of Education	117,174	402,953	305,875	351,660	199,839	14.1
Biomed Sciences	139,633	191,977	134,432	246,185	206,709	9.6
CNAS+Eng+Biomed	212,953	287,047	210,644	229,061	242,960	2.8
TOTAL	117,446	168,810	127,199	137,047	131,993	2.5

Table S4
Student Distributions Across Departments in CNAS
UCR Strategic Academic Research & Analysis, 2008

Unit	Students-Undergrad	Students-Graduate	Students-Total
CNAS	4,378	749	5,127
Division of Agriculture and Natural Resources			
Entomology	28	40	68
Environmental Sciences	135	30	165
Nematology	0	0	0
Plant Pathology & Microbiology	0	12	12
SUB-TOTAL	163	82	245
Division of Life Sciences			
Biochemistry	758	69	827
Biology	860	7	867
Botany and Plant Sciences	24	47	71
Cell Biology & Neuroscience	182	23	205
SUB-TOTAL	1,824	146	1,970
Division of Physical and Mathematical Sciences			
Chemistry	137	113	250
Earth Sciences	19	37	56
Mathematics	239	68	307
Physics and Astronomy	67	96	163
Statistics	15	52	67
SUB-TOTAL	477	366	843

Table S5
Federal Funding per Federal Agency for UCR and the Comparison AAU Universities, 2006
NSF Database, http://webcaspar.nsf.gov/TableBuilderIndex.

Funding Agency	UCR	Iowa State	Stony Brook	Syracuse	Texas A&M	Tulane	Arizona	Kansas	Missouri-Columbia	Oregon	AAU Average
NIH	13,776,000	16,081,000	59,272,000	6,287,000	20,059,000	65,100,000	98,812,000	66,776,000	46,816,000	22,403,000	44,622,889
NSF	21,102,000	22,193,000	27,653,000	7,859,000	21,247,000	5,409,000	48,032,000	21,954,000	19,538,000	14,199,000	20,898,222
DOE	3,324,000	3,440,000	6,468,000	1,345,000	6,015,000	2,140,000	2,870,000	1,697,000	3,172,000	3,017,000	3,351,556
DOD	12,873,000	8,979,000	4,888,000	1,671,000	3,547,000	5,302,000	10,719,000	550,000	3,015,000	1,846,000	4,501,889
Dept Education	*	3,501,000	N.A.	1,105,000	N.A.	N.A.	192,000	2,252,000	N.A.	1,762,000	979,111
Dept Agriculture	1,124,000	34,880,000	0	109,000	46,913,000	1,092,000	13,906,000	153,000	32,901,000	417,000	14,485,667
EPA	816,000	3,125,000	0	0	170,000	0	963,000	0	0	0	473,111
NASA	2,131,000	1,551,000	2,526,000	195,000	2,110,000	2,144,000	43,335,000	0	2,010,000	60,000	5,992,333
Other HHS	837,000	796,000	2,136,000	0	105,000	13,655,000	4,913,000	7,177,000	453,000	40,000	3,252,778
Others	1,586,000	5,041,000	1,356,000	407,000	8,272,000	379,000	4,916,000	2,393,000	2,285,000	634,000	2,853,667
TOTAL	57,569,000	99,587,000	104,299,000	18,978,000	108,438,000	95,221,000	228,658,000	102,952,000	110,190,000	44,378,000	101,411,222
% of Total Funding	UCR	Iowa State	Stony Brook	Syracuse	Texas A&M	Tulane	Arizona	Kansas	Missouri-Columbia	Oregon	AAU Average
NIH	24	16	57	33	18	68	43	65	42	50	44
NSF	37	22	27	41	20	6	21	21	18	32	23
DOE	6	3	6	7	6	2	1	2	3	7	4
DOD	22	9	5	9	3	6	5	1	3	4	5
Dept Education	0	4	N.A.	6	N.A.	N.A.	0	2	N.A.	4	2
Dept Agriculture	2	35	0	1	43	1	6	0	30	1	13
EPA	1	3	0	0	0	0	0	0	0	0	0
NASA	4	2	2	1	2	2	19	0	2	0	3
Other HHS	1	1	2	0	0	14	2	7	0	0	3
Others	3	5	1	2	8	0	2	2	2	1	3

* Dept . Education funding information for UCR was not available in the NSF database. UCR School of Education total funding expenditures for 2006-2007 was $4,934,924

Table S6
Research Metrics, UCR vs. Comparison AAU Universities
UC Accountability Report, May 2009 & ISI Web of Science

	UCR, 2008	Rank	Iowa State	Stony Brook	Syracuse	Texas A&M	Tulane	Arizona	Kansas	Missouri Columbus	Oregon	UCR Pro-jection 2020-2021
Students	17,367	6	20,444	14,847	13,156	36,580	6,491	28,442	20,822	21,484	16,529	18,824
Faculty	726	8	1,215	629	840	1,712	405	1,329	1,157	1,104	597	896
Federal Research Exp ($)/Fac	88,386	5	75,582	132,323	29,636	122,104	212,763	155,816	82,385	70,395	62,910	150,000
Articles/Non-Medical Faculty	2.7	4	2.0	2.9	0.9	2.6	2.9	2.8	1.1	1.7	1.5	3.0
Faculty Awards	38	8	48	22	75	54	35	97	44	51	48	
Faculty Awards/Faculty	0.052	5	0.040	0.035	0.089	0.032	0.086	0.073	0.038	0.046	0.080	0.06
National Academies Members	4	8	9	9	4	21	1	29	7	6	7	10
NAM/Faculty	0.0055	6	0.0074	0.0143	0.0048	0.0123	0.0025	0.0218	0.0061	0.0054	0.0117	0.0112
Articles	1,834	8	2,479	2,180	978	4,931	1,269	4,202	2,105	2,461	1,071	
Articles/Faculty	2.5	5	2.0	3.5	1.2	2.9	3.1	3.2	1.8	2.2	1.8	3.0
Total Citations	5,274	6	7,108	6,637	2,678	8,705	2,437	10,647	3,930	4,647	2,662	
Citations/Article	2.88	2	2.87	3.04	2.74	1.77	1.92	2.53	1.87	1.89	2.49	3.00
H-Index (2008)	20	6	24	28	17	23	17	30	20	23	18	25

APPENDIX B

DISSENT

BY RICHARD ARNOTT AND DYLAN RODRIGUEZ

The summary charge to the Committee was: “To make recommendations about how best to further develop and strengthen research and creative activity, including core research and interdisciplinary research initiatives. To identify effective means of continuing to increase grants and contracts for UCR research, with a particular focus on competitively funded federal research support. To target areas for leveraging advances in the creation of knowledge via UCR departments and research units and “bottom-up” development of interdisciplinary collaborations.”

The detailed charge included as one of the Committee’s tasks quantifying the cost of achieving the profile of an AAU university by the year 2020. Though the Committee’s discussions covered a broad range of topics, the focus was on this particular task. In order to make this charge more specific, the Chair posed the question: What would need to be done, in terms of expanded research funding, new faculty hires, and increased graduate student enrolment to bring UCR up to the current AAU average of Iowa State, Stony Brook, Syracuse, Texas A & M, Tulane, Arizona, Kansas, Missouri-Columbia, and Oregon, in terms of research funding per faculty member and the ratio of graduate students per faculty member, by the year 2020. And how much would achieving these objectives cost?

Especially given the limitations of the data available, the Committee did a sound job of answering the first question. The two main conclusions are that 170 new faculty with high funding profile (most likely in sciences and engineering) would need to be hired over the next ten years, and that doctoral student enrolment would need to be increased by over 1500 over the next ten years.

In costing out the first initiative, the Committee report assumes:

i) For new faculty hires: A linear addition of 17 faculty member per year, an average Initial Complement of $600,000 (which is typical for hires in science and engineering), salary plus benefits of $108,000 per year, and annual research funding of $300,000 per year.

ii) For existing faculty members, funding per faculty member increasing at 5% per year in response to improved incentives.

Under these assumptions, the total [undiscounted] cost over the ten-year period would be about $200,000,000 and the total [undiscounted] additional research funding would be about $350,000,000.

In costing out the second initiative, the Committee report assumes:

i) A linear increase in the doctoral student population of 150 students per year.

ii) An average of five years in residence.

iii) Each newly recruited faculty member supervises and supports 5 doctoral students at an annual cost of $30,000 each. For this group of doctoral students, 2/3 of the support comes from faculty-generated extramural funds.

These assumptions imply that about 55% of the additional 1500 doctoral students would be supported by new faculty.

iv) The balance of the additional graduate students would be supported by current faculty (about one additional student per faculty member).

W e find some of the assumptions unreasonably optimistic and some of the analysis flawed or misleading.

- The assumptions about additional research funding seem unreasonably optimistic.
- Exits are not accounted for.
- Discounting (that I would prefer an extra $ today than the same increase in purchasing power ten years from now) is ignored[1].
- There is an element of double-counting benefits. Research funds that go towards the support of graduate students do not contribute revenue to the university.

For the sake of argument, let us first accept the figures and consider the implications for 2011-12. 17 new faculty members would be hired at an initial complement cost of $600,000 X 17 = $10,200,000. The salary of these new faculty members would be more than offset by the additional research funding they bring in, for a net saving of ($300,000 - $108,000) X 17 = $3,264,000. The net cost of the new faculty would be $6,936,000. The assumed 5% increase in research funding of current faculty members would generate additional revenue of $6,412,150. Also, 15 additional doctoral students would need to be supported. Since the increase in grant revenue brought in by the current faculty and new faculty hires has already been considered, the cost of the additional graduate students would be $450,000. The total increase in cost would be $973,850.

Now let us consider the more conservative, but also in our view more reasonable, scenario in which each new faculty member needs some time to get re-established so that the research funds brought in just cover salary, and in which the level of funding of existing faculty members remains steady. The total increase in cost for 2010-11 is then $10,650,000.

These two numerical examples indicate that the cost estimates are sensitive to assumptions. Given the university's current budgetary situation, as well as the state's fiscal crisis, prudence calls for adopting more conservative assumptions than those contained in the report.

Again for the sake of argument, let us consider the implications of the more conservative set of assumptions. Where would the total increase in cost in 2011-12 of $10,650,000 come from? The best guess is that cost cutting would be done in much the same way as has been done in response to the university's current deficit – further increasing fees, further increasing undergraduate class sizes, continuing not to replace faculty who leave, and further cutting back on staff. This would have strongly adverse effects on the School of Education and the Graduate School of Management, and direly adverse effects on CHASS and the quality of undergraduate education at UCR.

[1] In some contexts, this would be inconsequential over a ten-year period. But uncertainty raises the discount rate. Given the current budgetary uncertainty, quite a high discount rate should be applied. Since most of the costs are incurred in the early years and most of the benefits received in the later years, applying a higher discounted rate increases the discounted net cost (or reduces the discounted net benefit) of hiring a new faculty member.

The Committee was asked to estimate the costs of reaching the current standard of AAU membership by the year 2020. While we disagree with some of the calculations, we do not object to this exercise *per se.* But without debate, the writers of the Committee report went the very large further step of endorsing the goal of reaching the current standard of AAU membership by the year 2020, and recommending that the costs needed to reach that goal be incurred. We cannot support these recommendations. In contrast, we interpret the results of the quantitative analysis, with our more conservative assumptions, as indicating that the goal of reaching the current standard of AAU membership by 2020 should be abandoned, since achieving it would come at an unacceptably high price, especially to undergraduates and CHASS faculty members.

We also disagree with the Committee's interpretation of "reaching the current standard of AAU membership by the year 2020". In an appendix to this dissent, we reproduce the AAU Membership Policy, which is taken from their website. While the membership indicators do indeed indicate a bias towards science[2] (less towards engineering) and towards graduate education, they nonetheless indicate that consideration is also given to faculty quality in the arts and humanities and to the quality of undergraduate education. While we broadly agree with the Committee's interpretation of what would be needed to bring UCR up to AAU standards in the sciences and engineering and graduate education, we judge that the AAU would deny membership if these standards were met at the cost of significantly reduced funding to the arts, humanities, and undergraduate education, and that it would not be in favor of the unhealthily unbalanced growth that UCR would need to pursue in order to reach the AAU science and engineering and graduate education indicators by 2020.

Let us suppose, for the sake of argument, that UCR could reach the AAU science and engineering and graduate education indicators by 2030, instead of 2020, if it were to maintain rather than reduce funding to CHASS and undergraduate education. Even under this less unbalanced growth scenario, we would not endorse the goal of reaching AAU standards by 2030, for three reasons.

1. A university should be a community of scholars. Its members should be judged on their merits as scholars. No faculty member should be treated as a second-class citizen because of his or her scholarly discipline. And no student should be treated as a second-class citizen because he or she is an undergraduate student rather than a graduate student, or the other way around. Reaching the AAU goal by 2030 would result in the arts, humanities, social sciences, business, and education being subordinated to science and engineering, and undergraduate education being subordinated to graduate education.

2. We question the goal of AAU membership generally. There are many fine universities in the US that will probably never acquire AAU membership because they have decided instead to develop their own distinctive personalities that are not consonant with the AAU goals. We would prefer that UCR acquire such a distinctive personality, for example as the nation's leading university in which the majority of faculty members are from disadvantaged backgrounds, than that it become a second- or third-tier, cookie-cutter AAU university. We also think that the AAU indicators show an unhealthy bias towards the sciences, which is inconsistent with the ideal of an egalitarian community of scholars.

3. While we have not worked out the numbers, our intuition tells us that, when the existence of a budget constraint is acknowledged, the goal of excellence in research and creative activity, as judged by national and international rankings, can be best achieved by

[2] This is partially because quality in the sciences is easier to quantify than quality in the arts and humanities.

building up departments in the arts and humanities and not in the sciences and engineering. Salaries are lower and no initial complement is needed. The university already has two arts departments that are ranked within the top ten nationally, dance and theatre. If it were to target specific areas in the arts and humanities, it could achieve international prominence in these areas at a modest cost.