

Office of the President

TO MEMBERS OF THE COMMITTEE ON LONG RANGE PLANNING:

DISCUSSION ITEM

For Meeting of January 20, 2010

ANNUAL ACCOUNTABILITY SUB-REPORT ON THE RESEARCH ENTERPRISE

This second **Annual Accountability Sub-Report on The Research Enterprise** contributes to the series of reports that the Committee on Long Range Planning has established in order to:

- review key areas of the accountability framework in more detail;
- discuss strategic choices that need to be made by UC in those areas;
- inform the Board's deliberations about important policy and budget questions; and
- achieve a richer understanding of UC as a system and of campus distinctiveness.

Research is the main factor that distinguishes the University of California among California institutions of higher education, for example compared to the California State University system. UC's research opportunities are the most important factors in recruiting star faculty, postdoctoral scholars and graduate students. The overall reputation of each campus depends largely on perceptions of the quality and quantity of its research. UC is designated as the research arm of the state of California.

In fiscal year 2008-9, a total of \$4.9 billion research expenditures accounted for 25 percent of UC's total budget. This \$4.9 billion total is comprised of \$3.9 billion direct support, \$0.7 billion indirect cost recovery, and \$0.3 billion of unreimbursed costs. Under-recovery of indirect costs places an additional burden on the campuses that exacerbates the problem of decreasing state support for UC.

The National Science Foundation (NSF) Research and Development (R&D) Survey allows U.S. research universities to compare their research expenditures across disciplines and across institutions. **Slide 4** shows UC's research expenditures per faculty member compared to five top private and public research universities considered as peer institutions. Expenditures are a measure of research productivity mainly in the science, technology, engineering, and mathematics (STEM) fields, but largely ignore the contributions of the social sciences, arts, and humanities. By this measurement, the UC campuses with medical schools are comparable to their public and private counterparts, and the UC campuses without medical school lag in research expenditures per faculty member compared to their private peers.

UC's total R&D expenditures closely follow the trend for all other academic institutions over the past three years (**Slide 5**). UC's performance by this broad productivity measure is average in comparison with its peers.

The number of research publications per researcher is another broad indicator of research productivity (although not quality) that is often used as a comparison with peer institutions (**Slide 6**, and supplemental slides 18, 19). Publication data are indicators that include the research outputs of social sciences, arts and humanities as well as the STEM fields.

Slide 5 shows total research publications for 2008 normalized to the number of faculty. UC campuses appear to be competitive with their peer public institutions and lag behind some private peers. System-wide, UC has shown an increase in publications over the past 5 years (supplemental slide 19).

These widely used indicators reflect a measure of research productivity, but they do not reflect research quality. Based on the first two indicators presented, UC's research productivity is similar to its public and private peer institutions but not outstanding.

UC does much better in measures aimed at discerning the quality of research. Quality is measured by the impact of research, through citations to important papers, winning prestigious prizes, and elections to societies honoring researchers who make important discoveries and contributions to scholarship. The Shanghai Jiao Tong University Academic Ranking of World Universities (ARWU) attempts to combine several measures of research quality to establish relative preeminence of research universities (**Slide 7**). This ranking uses several criteria for quality, including (1) quality of research education based on accomplishments of alumni, (2) quality of faculty, and (3) research impact in the literature, all measured per capita. By weight, 80 percent of these criteria measure research outcomes (**Slide 8**).

In 2009, seven of the ten UC campuses placed in the top fifty research universities in the world (**Slide 7**), including one (Berkeley) in the top three, and three others (UCLA, UCSD, and UCSF) in the top twenty. No other university system in the world contains as much quality by these measures as the University of California. A comparison between the rankings of quality and the relative rankings by either per capita research expenditure or per capita publication rate shows the inadequacy of these latter two productivity indicators as a measure of research quality.

The researchers who make UC a great public research university are outliers among their peers, and the impact of their research depends on the quality of their ideas rather than the amount of research support or number of publications they generate. Their research leads to breakthroughs that garner awards such as the Nobel Prize, the Fields Medal for Mathematics, and the MacArthur Foundation "Genius" Prize (e.g. **Slide 2**). The Shanghai Jiao Tong University ranking measures these outliers, which is why our campuses appear so highly ranked on this index, and yet appear to be average by the other indicators shown.

The challenge, then, in measuring the true performance of the UC research enterprise lies in identifying indicators that will allow us to measure these outliers and to predict whether UC is in danger of losing its status as a preeminent research university. We are looking into ways to

incorporate these measures of research quality into future accountability indicators to demonstrate the remarkable return UC gives the state of California for its investment in UC.

Slide 9 shows changes in the ARWU rankings between 2004 and 2009. Berkeley, UCLA, and Irvine increased their rankings, while San Diego, San Francisco, and Davis dropped. These changes may not be statistically meaningful, and UC's overall system impact remains unchallenged. It is noteworthy that the only public university in the top ten is a UC campus.

Another measure of research impact is the number of new products resulting directly from innovations in the university. **Slide 10** shows the number of UC inventions that have been licensed allowing companies to develop products benefiting California and the world. UC licenses a large number of Plant Licenses that may not generate much revenue but do contribute to the CA agricultural enterprise. UC licenses and options have steadily increased over the past five years and track the national average. UC's share of income from these licenses has been similarly increasing (**Slide 12**). It is important to keep in mind that this commercial income is a very small portion of our research budget; UC's policies are specifically designed to create products that benefit society and not to return a profit to UC.

Companies sponsor research at UC to make use of our cutting edge facilities and world-class researchers. Sponsored research had been steadily increasing at UC, though due to the economic recession it decreased in 2009 (**Slide 12**).

UC technologies are also an important source of job creation in California through new companies that bring products to market. UC technologies formed the basis for 47 start-up companies in fiscal year 2008-9. As companies increasingly reduce their internal capacity to conduct early-stage R&D, they will turn to universities to conduct that research and UC can benefit from strong relationships with California companies (**Slide 12**).

Graduate students and postdoctoral scholars are critical to the UC Research Enterprise. They conduct the majority of the basic research critical to the production of new knowledge. UC trains 12 percent of the nation's graduate students who are, in turn, well-prepared to work in California's knowledge-based industries. The UC System grants more PhDs in the Physical and Life Sciences than any of our competitors. (Note: Physical Science and Engineering is presented on the secondary axis.) An NSF report on migration patterns of Scientists and Engineers showed that the post-doctoral period is one of the least mobile periods in their career, suggesting that UC-trained graduate students are likely to stay in California (A. Sanderson and B. Dugoni *Interstate Migration Patterns of Recent Science and Engineering Doctorate Recipients* NSF 02-311, February 2002, **Slide 13**).

Supplemental Slides

Throughout this presentation we will benchmark UC campuses against the ARWU top five private research universities (Harvard, Stanford, MIT, Caltech and Columbia) and the top five public universities (University of Washington – Seattle, University of Wisconsin – Madison, University of Michigan – Ann Arbor, University of Illinois at Urbana – Champaign and University of Minnesota – Twin Cities).

Slide 17: Continuing to recruit excellent graduate students is an important part of ensuring the future success of the UC research enterprise. The Office of the President Department of Student Affairs surveys admitted graduate students every three years to understand how they make the decision whether to enroll at UC. Approximately 50 percent of admitted graduate students surveyed in 2007 chose to enroll at UC over a non-UC Institution. The most frequently cited non-UC Institutions are also highly prestigious institutions indicating UC's stiff competition for graduate students, though UC's competitors vary greatly by discipline.

Slides 18 and 19: An examination of the number of publications by broad discipline shows that campuses vary in the number of publications by discipline. STEM disciplines, as previously mentioned, tend to publish more frequently than non-STEM disciplines. Campus strengths are also revealed in this data. For example UC Santa Barbara and Santa Cruz, publish highly in the physical sciences where they possess strong departments. In the future, we hope to develop this indicator include citation rates which would help to evaluate the quality as well as quantity of research publications.

Slide 20: 95 percent of American Recovery and Reinvestment Act (ARRA) awards received by UC came from National Institutes of Health (NIH), NSF, and the Department of Energy (DOE). As of November 2009, UC had received \$736 million in ARRA funding. DOE funding to the UC system was primarily directed to Lawrence Berkeley National Laboratory (\$212 million, as of November) and is not shown on this graph. UC campuses were successful in competing for ARRA awards from NSF and NIH, though some of our comparators did better. The University of Washington, for instance, received \$11 million to support the Northwest Genomics Center.

Slide 21: Breaks down UC's actual direct and indirect research expenditures by campus, grouping the medical and non-medical campuses together for easy comparison. The left graph shows that medical school campuses generally have higher research expenditures than non-medical school campuses. More than half of each campus's research expenditures come from Federal sources. In the right graph, federal expenditures are further disaggregated and it's clear that the Department of Health and Human Services (HHS) provides the bulk of research funding to the medical school campuses. Focusing on non-HHS funding, non-medical school campuses such as UCSB and Berkeley are comparable to UCLA and UCSD in non-HHS expenditures.

Next Steps for UC Research Accountability

The challenge will be identifying indicators that will allow us to measure the outliers at UC campuses and to predict whether UC is in danger of losing its status as a preeminent research university.

In the coming year, UC will continue to experience decreased investment from the State of California. Tracking the impact of that decreased investment on the indicators we have identified here as well as identifying additional indicators such as research infrastructure and equipment investment will be important. In a period of decreasing State support for UC, we must continue to find ways to support UC faculty and trainees to maintain and enhance UC's preeminent research enterprise.

(Attachment)