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PCR Request FB 11-13

Establish a UH Engineering Consortium and Create the Pre-Engineering and Lower Division Engineering and Physical Sciences Program Numbers of Students in Engineering and Physical Sciences

Additional Data

Administrative Issues

- The PCR is led by Dean Crouch of UH Manoa College of Engineering, but it is a UH System wide proposal.
- The PCR directs funds at the Community Colleges and the College of Natural Sciences at UH Manoa as well as the College of Engineering at UH Manoa. A significant component of this PCR addresses lower division Mathematics. As such the Dean of the College of Natural Sciences at UH Manoa will be a key voice in the direction of funds, as will the Vice Chancellors for Academic Affairs at UH Manoa and the Vice Chancellors for Academic Affairs at each Community College. However, the use of these funds would ultimately be directed by the Dean of the College of Engineering.
- The PCR arises from a coalition of faculty and administrators led by Dean Crouch that has been meeting with UH System's assistance to address the issues of the PCR.
- The PCR is ultimately directed at workforce development and economic development in Hawaii through graduates from UH in engineering and the physical sciences.
- The PCR focuses on all lower division students (potentially all students in the community colleges and all lower division students at UH Manoa, UH Hilo and UH West Oahu), studying in the Engineering and Physical Sciences and specifically at enhancing retention and success of those students.
- The PCR concentrates on Engineering and the Physical Sciences programs because the curricula, while different, are sufficiently the same for a coordinated approach.
- The PCR complements the efforts throughout the UH System, focused at students in courses leading to the typical lower division engineering and physical science at UH Manoa
- The PCR directly address Native Hawaiian and Part Native Hawaiian students though enhanced mentoring by Native Hawaiian or Part Native Hawaiian staff, instructors and faculty.
- The PCR directly addresses disadvantaged students through enhanced learning mechanisms.
- The cost of achieving the goals of the PCR would be far greater without sharing efforts across UH Manoa and the Community Colleges.

Data that supports the PCR though workforce demand

- It has been predicted that from 2009 to 2015 in areas of engineering represented in the UH Manoa College of Engineering there will be 153 positions available annually requiring a Bachelor's degree. There will be an additional 33 jobs available annually in other areas of engineering and also requiring a Bachelor's degree, so that there will be a total of 186 positions available annually. (Data from Economic Modeling Specialists Inc. (EMSI))
- It is estimated that at least 40% of the students graduating from the College of Engineering find positions on the mainland so at most 90 of the positions cited above are being filled by students graduating from the College of Engineering.
- Recently Hawaii commissioned an important study "Innovation and Technology in Hawaii: An Economic and Workforce Profile". Specifically this report has four main partners: Hawaii

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Science and Technology Institute and Council, Center for Regional Economic Competitiveness, State of Hawaii Department of Business Economic Development and Tourism. There were eleven co-funders of the project including the University of Hawaii System and the State of Hawaii Legislature 2006. This report contains many useful statistics about the technology sector in Hawaii and points to the significance of the technology sector for Hawaii's future. It would be difficult to condense all of these statistics into this report, but amongst others, contains the following statistics:

- Overall, Hawaii's public and private technology sectors employed 31,106 people in a total of 1,964 establishments in 2007. There were 23,985 technology workers employed by private-sector establishments, and an estimated 7,121 workers by public-sector entities.
- 4,784 technology-related jobs were located on the neighbor islands in 2007. This represented 17 percent of total technology sector employment.
- Hawaii's private technology sector contributed about \$3 billion to the state's economy in 2007, a figure that represented 5 percent of the state's total \$61 billion economy.
- **In 2007 Hawaii's science and technology companies and government entities generated 5.4 percent of Hawaii's total worker earnings 3 (\$2.1 billion)**
- Hawaii's private technology sector employment grew 3.3 % annually between 2002 and 2007, while the overall technology sector employment grew at an annual rate of 2.9% outpacing the state's overall 2.5% economic growth for the same period.
- Employment projections suggest that the private technology sector is likely to grow at about 2.1 percent annually during the coming decade, 61% faster than the rest of Hawaii's economy.
- STEM occupations are expected to demand about 1,650 new workers per year (to fill vacant positions as well as newly created jobs. About 77% of those jobs will require postsecondary education and about 17% more will require at least one year of on-the job training and work experience.
- Workers in Hawaii's private technology sector earned an annual average of \$63,623, or 38% more than the average worker in Hawaii, or about \$1,500 more per month in total earnings than the average worker. When public sector workers are included, the average earnings were \$68,935, which is 50% higher than the statewide average.

Data that supports the PCR from student demand indicators

➤ **Enrollment**

- The total number of engineering, pre-engineering and physical science undergraduate students enrolled in UH Manoa was 1377 in Fall '10 or roughly 15% of UH Mānoa student
- The total number of undergraduate engineering and pre-engineering students in UH Mānoa increased from 806 in Fall '06 to 938 in Fall '10
- The total number of undergraduate physical science students at UH Mānoa decreased from 517 in Fall '06 to 439 in Fall '10
- The number of students in the pre-engineering program at Mānoa increased rapidly from 0 in '06 to 224 in '10
- Kapi'olani Community College's new Associate of Science Degree in Natural Science which prepare students to transfer to four-year institutions for science degrees had 43 majors in 2009 and 113 majors in 2010

➤ **Undergraduate Degrees Granted at UH Manoa**

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Total number of degrees granted in physical science and engineering during the year '05 - '06 was 191 and during the year '09 - '10 was 206. Engineering degrees increased by 32 in engineering from 118 in '05 - '06 to 150 in '09 - '10. Physical sciences degrees decreased by 24 in science from 81 in '05 - '06 to 56 in '09 - '10

➤ **Graduate Programs at UH Manoa**

- The total number of graduate degrees granted in the physical sciences increased from 15 in '05-'06 to 30 in '09-'10. The total number of engineering graduate degrees remained approximately the same at 43 in '05-'06 to 41 in '09-'10.
- In the physical sciences programs graduate enrollment increased from 137 in '06 to 147 in '10. In the engineering programs graduate enrollment increased from 177 in '06 to 242 in '10.

➤ **Transfer Students**

- Transfers from UH CCs account for ~ 52% of the total transfers in UH Mānoa but ~70% of the credit hours transferred, with the average hours transferred per student from a UH institution at around 62 or nearly 4 semesters. However few transfers from UH community colleges have earned associates degrees.
- The number of transfer students in engineering and pre engineering at Mānoa increased from 176 in '06 to 318 in '10. The number of transfer students in physical sciences at Mānoa decreased from 185 from '06 to 142 in '10

Indicators of some of the challenges that the PCR addresses.

➤ **Pipeline of Engineering and Physical Science Students in Hawaii Compared to the Best Performing State.**

- Out of 100 9th graders in Hawai'i only 43 enter college and only 26 enter sophomore year and only 13 graduate on time. So for students pursuing physical science and engineering programs at UH, only 6 students enter college, only 4 enroll as sophomores and only 2 are graduating on time.
- For the best performing state in the US out of 100 9th graders 86 enter college, 60 enter sophomore year and 42 graduate on time. So for students pursuing a physical science and engineering program, in a university comparable to UH in that state, there would be 13 students entering college, 9 enrolling as sophomores and 6 graduating on time.

The PCR would assist more students pursuing an engineering or physical sciences program remain in their intended program.

➤ **Time to Degree**

- The average time to degree for transfer students into engineering program at UH Manoa is 6.47 years assuming 2 years in an AA degree. This compares with an average of 5.32 years on for students entering the UH Manoa engineering program directly.
- The average time to degree for transfer students into a physical science program at UH Manoa is 6.52 years assuming 2 years in an AA degree. This compares with an average of 4.84 years for students entering a UH Manoa physical science program directly.

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The PCR would assist in decreasing the time to degree for students pursuing engineering and physical science programs entering UH Manoa directly and as transfers from UH Community Colleges.

➤ **Passing Rates in Pre-Engineering Courses**

The pass rates at UH Mānoa for critical Mathematics courses are: Math 135 ~42%; Math 140 ~56%; Math 241 ~59%; Math 242 ~68%. At the Community Colleges the pass rate for Math 135 ~57%, for Math 140 ~55%, for Phys 271 ~75%, for Phys 272 ~71%, Chem 161 ~57%, and Chem 162 ~60%.

The PCR would assist in increasing the pass rates in the critical pass rates, especially for courses where the current pass rate is less than 70%.

➤ **Enrollment in Critical Pre-Engineering Courses at the Community Colleges**

The following is a list of representative enrollments in critical pre-engineering courses at the Community Colleges. Other than Kapiolani and Leeward Community Colleges the enrollments in these classes are either small or the course is not offered:

MAT 140: HAW 10, HON 86, KAP 152, KAU 15, LEE 133, MAU 42, WIN 33

PHYS 170: HAW -, HON -, KAP 50, KAU 5, LEE 9, MAU 7, WIN 8

PHYS 272: HAW -, HON -, KAP 33, KAU 6, LEE 16, MAU 7, WIN 0

CHEM 161: HAW -, HON 22, KAP 375, KAU -, LEE -, MAU 19, WIN 24

CHEM 162: HAW -, HON 9, KAP 136, KAU -, LEE -, MAU 14, WIN 11

The PCR would assist in ensuring that all the pre-engineering courses are offered through distance learning on a regular schedule. Thus it is envisioned that more students at all community colleges would begin enrolling in these courses and eventually pursuing programs in engineering and the physical sciences.

➤ **Retention within Engineering and Physical Sciences at UH Manoa**

- For students entering the engineering program, after three years of an entering class in '04 only 45% of the students were retained in engineering, while 70% were retained into the university.
- For students entering a physical science program, after three years the entering class in '04 only 28% of the class was retained in a physical science program, while 68% were retained into the university.

The PCR would assist in increasing the retention rate within program for students pursuing engineering and physical sciences programs.

Community College Involvement and Impact

- The PCR addresses the fiscal challenges that many Community Colleges experience in attempting to offer courses that give their students the opportunity to successfully transfer to UH Manoa in engineering and the physical sciences.
- The UH Manoa Colleges of Engineering and Natural Sciences and all the UH Community Colleges play an essential role in this PCR, and many of the PCR goals will be unsuccessful if the PCR is not a coordinated effort across all coalition partners.
- One essential goal of the PCR is to implement and offer a network of distance learning courses and modules across the coalition partners so that each required course or pre-requisite for the

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engineering and lower division physical sciences curriculum can be accessed as needed without each individual institution having to offer the course or module.

- The PCR will clearly lead to substantial cost savings as compared with a similar program in which each coalition partner was funded to offer all of the pre-engineering and lower-division physical science courses.
- The PCR enables consortium members to share in many activities aimed at more effectively addressing emerging training and teaching needs in engineering and the physical sciences. For example in the area of renewable energy and areas associated with the Naval Shipyards.

Role of Innovation

In addition to providing a network of distance delivered courses, the PCR will implement innovative teaching, learning and retention activities:

- Mathematics Emporium – already an effective emerging tool for teaching remedial mathematics. A few community colleges in the UH System have begun small efforts with expansion to lower division mathematics courses underway.
- Enhanced specialized advising through Consortium relationships helps students make more judicious curricula choices leading to fewer redundant courses and faster graduation
- Specialized activities to enable UH community college students become familiar and comfortable with UH Manoa before embarking on their transfer
- Cyber mentoring – allows students throughout the UH System to seek mentors easily through the web.
- Programs that directly link Community College students to UH Manoa prior to their transfer to UH Manoa.

Implications of Successful PCR Implementation

- While this PCR addresses engineering and the physical sciences, the results and techniques could be ported to other disciplines.
- This PCR does not change the upper division offerings at UH Manoa.
- The effects of this PCR would be to prepare more students for the upper division programs at UH Manoa in engineering and the physical science resulting in the desired enhanced numbers of graduates ready for the Hawaii work force.
- Additional resources will ultimately be required to deal effectively with added students numbers in engineering and physical sciences programs.
- The PCR will lead to more Hawaii students entering graduate programs at UH, not only in the Colleges of Engineering and Natural Sciences, but also Colleges such as SOEST, CTAHR, IfA, JABSOM.
- This PCR is entirely consistent with and supportive of the effort to improve the US's competitiveness in industry focused on engineering and the physical sciences as documented in major reports like the National Academies "Rising Above the Gathering Storm". See the National Academies publications:
http://www.nap.edu/openbook.php?record_id=12999&page=R1 and
http://www.nap.edu/catalog.php?record_id=11463 .
- The continuing efforts of Federal legislation in support of the "America Competes Act" (see <http://thomas.loc.gov/cgi-bin/bdquery/z?d111:H.R.5116> for the current reauthorization bill that passed) provides a Federal response to many of the workforce issues addressed by this PCR and specifically the National Academies report "Rising Above the Gathering Storm."