

Improving Transfer for Engineering Students

Career & Technical Education Transfer Research Project

Engineering drives innovation critical for California's economic growth and productivity. Yet a recent Governor's Office report projects a shortfall of 40,000 engineers in the state by 2014. One way to address the demand for engineers is to increase the number of community college students who successfully transfer into and complete baccalaureate programs in Engineering. However, research produced by the Research & Planning Group (RP Group) suggests that the current **Engineering transfer pipeline is long and leaky—offering several opportunities for improvement.**

The RP Group's CTE Transfer Research Project is funded by the James Irvine Foundation and the California Community College's State Chancellor's Office.

What can we do to expand the number of community college students who enter the Engineering transfer pipeline? How can we increase the percentage of students who succeed in transferring into Engineering programs? How can we make students' journeys more efficient—shortening their time to transfer and accelerating their completion of a baccalaureate degree? These questions drive the **Career and Technical Education (CTE) Transfer Research Project**, a two-part study of transfer between California's community colleges and baccalaureate-granting institutions in occupational majors.

This brief offers highlights from the RP Group's research on how California's community college students currently prepare for transfer in Engineering and what supports and impedes their success. The RP Group invites Engineering stakeholders—representatives from community colleges, four-year institutions and industry—to review and respond to the research findings with questions and ideas for action. In this spirit, we couple key research findings with discussion prompts that can be used to frame this dialog.

What Does the CTE Transfer Research Project Include?

The RP Group's research design investigates students' experience at the beginning, middle and end of the Engineering transfer pipeline, including the following:

Understanding Students' Preparation for Transfer. Using the California Community Colleges' course classification system, the RP Group collaborated with the State's Chancellor's Office to (1) identify the current infrastructure of CTE courses

The RP Group is a nonprofit organization working to build a community college culture that views planning, evidence-based decision-making and institutional effectiveness as key strategies for student success.

and programs, and (2) determine how students use this infrastructure to prepare for transfer in occupational majors. We specifically studied the enrollment patterns, transfer rates and destinations of 255,000 learners engaged with CTE programs, including 1,237 students taking Engineering courses.

The RP Group is also documenting the experience of students beginning their transfer journey through surveys and interviews with 37 learners enrolled in an *Introduction to Engineering* survey course at a Bay Area community college. Moving forward, we will regularly interview 16 of these students to track their progress as they travel along the path to transfer.

The RP Group's study includes:

- Analysis of the transfer path taken by 4,200 students who ultimately completed a bachelor's in Engineering
- Surveys and focus groups with transfer students (178 and 48 respectively) currently enrolled in Engineering degree programs
- Surveys and interviews with 37 students intent on transferring in Engineering

Documenting the Experience of Students Post-Transfer. Additionally, the RP Group gathered the perspectives of recent transfer students now pursuing their baccalaureate in Engineering, targeting students enrolled at the University of California (UC), California State University (CSU) and private non-profit institutions receiving the most transfers in this discipline. Over 178 students completed surveys and 48 attended focus groups to discuss the factors that facilitated and complicated their journey to transfer. We also asked these successful transfer students what advice they had for those who wished to follow in their footsteps.

Backward Mapping the Journey of Baccalaureate Achievers. Finally, the RP Group collaborated with Cal-PASS to backward map the path taken by approximately 4,200 transfer students who ultimately achieved a bachelor of science (BS) in Engineering between Fall 1996 and Spring 2009. We included in our sample students who completed at least 12 transferable units at a California community college and who had at least two years of university course data available prior to degree completion. We performed analysis of completers' demographics, coursework prior to transfer including their first English and math class, units accumulated pre- and post-transfer, number of community colleges attended and support services like financial aid and the impact of these factors on time-to-transfer and time-to-degree.

What Does the Research Say?

Results from these research components cumulatively suggest that **all parts of the Engineering transfer pipeline could be strengthened to improve students' transition to and ultimately, completion of a bachelor's degree.** This result can be achieved through increased access to the pipeline; improved success among those pursuing transfer in Engineering; and reductions in the time-to-transfer and time-to-degree.

Increasing Access

Demographic information gathered on transfer students who achieved their BS in Engineering found that 40% were Asian and 31% were White while only 14% were Latino and 3% were Black. As a reference, 15% of California community college students were Asian, 31% were

White, 29% were Latino, and 7% were Black in Fall 2009. Further, only 17% of BS degree completers in Engineering were female.

In examining the initial placement of community college Engineering transfer students, our study of degree completers found virtually no students who started in basic skills coursework. Interestingly, our survey results indicated otherwise as **one-third of respondents reported starting in developmental math or English**. The discrepancy may be due to changing trends in learners' need for remediation, as the survey engaged those currently in the transfer pipeline while the quantitative analysis investigated the paths taken by past students. We will continue to investigate this and other explanations to the basic skills discrepancy in coming months.

Surveys and focus groups with both pre- and post-transfer students reveal that many **learners are motivated to begin the journey toward an Engineering degree by a personal educational goal**. Students reference “a love of tinkering with household appliances” or a “curiosity about how machines work” as driving this educational pursuit. Other top motivations cited by respondents included job/career advancement and the expectations of family and friends.

Discussion Questions:

- How important is it to diversify the composition of students who are entering the transfer pipeline so it is more reflective of the state's demographics?
- In what ways are colleges effectively collaborating with the K-12 system to increase students' preparedness for pursuit of an Engineering degree?
- What other effective practices exist to raise students' awareness of Engineering careers, the education necessary for this field and the opportunity to begin their pursuit of a degree in a community college?

Improving Students' Transfer Success

Students emphasized that having **an education plan is key to ensuring efficient and effective use of the community college system** for transfer preparation. In a survey of pre-transfer students, 69% of respondents indicated they knew the transfer requirements of their preferred transfer destination. Among these students, 92% had an education plan.

In surveys and focus groups with post-transfer students, participants underscored the importance of **meeting regularly with a counselor** to establish and update a comprehensive plan that helps learners fulfill as many required courses as possible prior to transfer. Students also suggested **using ASSIST**, an online database of transferrable and articulated courses, and **taking advantage of transfer articulation agreements and transfer admission guarantees** with receiving institutions to ensure that credits accumulated prior to transfer count toward degree completion.

Additionally, transferred students noted that **special supports can help students stay on track toward their transfer goal**. For example, the Math, Engineering, Science Achievement (MESA) program—which works to improve the success of educationally disadvantaged learners in these disciplines—provides targeted advising, tutoring and peer mentoring. Preliminary research also indicates that **introductory courses that offer a survey of Engineering careers**

as well as critical advisement on transfer planning and degree requirements can help students effectively navigate the path to transfer.

Discussion Questions:

- In an environment where budget cuts increase the ratio of students to counselors, how can we ensure that students pursuing transfer in Engineering receive effective guidance in developing detailed education plans?
- How can colleges work with industry partners to sponsor and scale programs like MESA that support students' movement through the transfer pipeline?
- How might student supports and guidance be built into introductory engineering coursework?

Enhancing the Pipeline's Efficiency

The RP Group's research indicates that **few students use the community college infrastructure of Engineering coursework to complete lower-division major preparation**. At the same time, those who complete 12 or more transferable units of this coursework or an associate degree in Engineering—referred to as **Engineering concentrators—are very likely to transfer**. Accordingly, the **transfer rate for Engineering concentrators tops all other disciplines at 80%**. However, the **number of students in this category is very small**—just over 200 per year statewide.

For students who make it to transfer, the road can be long. Data on Engineering degree completers indicate that **46% of these students took two to four years to transfer while 38% took four or more years**. Approximately 45% of these students completed 70 units or more while 24% completed 86 plus units prior to transferring.

Surveys and focus group results reveal that **multiple concerns and barriers impact students' preparation for and time to transfer**. Participants highlighted the challenge of efficiently completing pre-requisite and lower-division course work at the community college due to **over-enrollment or a dearth of course offerings at their home institution, particularly in Engineering**. Likely related, less than half of degree achievers completed their community college coursework at one institution; 29% attended two colleges, 14% attended three and 9% attended four or more. When asked why students do not leverage the CTE course infrastructure for lower-division major preparation, some respondents referenced **concerns about the transferability of credits**.

Moreover, pre- and post-transfer respondents noted that **students struggle to fulfill transfer requirements that differ among baccalaureate institutions**. To illustrate, a sample review comparing the transfer requirements in Mechanical Engineering for a UC and a CSU show significant variation. While both institutions called for 13 units of math pre-requisites, the CSU required 47 units of major preparation while the UC asked for 63 units.

This investigation also indicates that **financial concerns can delay students' transfer progress** and factor into their decision-making. Pre-transfer students ranked balancing work and school as the most serious obstacle to transfer and rated affordability and the availability of financial aid as

key factors in their transfer decision. Post-transfer students also ranked the cost of attending a four-year institution and the need to work to support themselves or families as top challenges.

An analysis of enrollments indicates that students who transfer with fewer units spend more time at a baccalaureate-level institution completing their Engineering degree. At the same time, **students who transfer with many units (86+) are just as likely as those who transfer with fewer units to take two to three years to complete their baccalaureate** and almost as likely to take three to four years to do so.

One explanation for this finding relates to students' course selection as many survey and focus group participants stated that they **took unnecessary or wrong courses while enrolled in a community college**. Both pre- and post-transfer students reported mistakenly following the Intersegmental General Education Transfer Curriculum (IGETC), believing it to be required for transfer in Engineering and resulting in unnecessary delays in their time-to-transfer. Surveys also showed that 40% of students who transferred to the UC and 50% who transitioned to the CSU had to take three or more lower-division major preparation courses post-transfer—clearly delaying their time to degree completion. Similarly, interviews with representatives from a UC Engineering program revealed that despite receiving an average of over 1,000 applications each year, the department is not able to fill the 150 slots it annually reserves for community college transfers because applicants do not complete the right coursework.

Discussion Questions:

- What can postsecondary educators do to encourage students to complete more lower-division major coursework while enrolled at a community college?
- How can community colleges increase students' access to the courses necessary for transfer?
- How can educators and industry partners collaborate to mitigate students' financial concerns? What can industry do to offer paid opportunities that relate to students' studies and help them move along the transfer path?
- What can four-year educators do to ensure community college transfer students and counselors are aware of their transfer requirements?

Preliminary Findings from an Analysis of Factors Predicting Students' Transfer Success

The RP Group's multivariate regression analysis which tested the impact of a series of variables on students' time-to-transfer and time-to-degree found that:

- Taking math in the first semester of enrollment at the community college shortens time-to-degree
- Earning an AS results in fewer total community college units while earning a certificate results in longer time-to-degree
- More units earned in the summer at the community college shortens time to transfer
- Taking more full-time terms at the university and having fewer withdrawals results in shorter time-to-degree
- Achieving more total units at the community college results in longer time to degree, but shorter time at the university

What Effective Practices Could Enhance Engineering Transfer?

Initial research into promising practices that could support Engineering students' transfer success indicates a range of strategies including institutional, intra-segmental and inter-segmental approaches.

Because students identified the lack of access to required coursework as an obstacle to transfer, the RP Group investigated how other programs have used technology to address this issue. For example, many high-demand health occupations programs offer online courses that facilitate transfer, particularly for students balancing school and work. To reduce travel and the time required to meet in person, these online programs concentrate lab work one day a week or offer it during weekends or interim sessions.

Another strategy for increasing transfer used by other disciplines includes implementation of University Centers where four-year institutions establish satellites at community colleges to offer upper-division courses leading to degree completion. In today's climate of reduced access due to budget cuts and impacted programs, these initiatives provide students with opportunities to earn bachelor's degrees from four-year universities without ever leaving the community college campus.

The RP Group also found examples of course alignment in both the community college and four year segments. For example, community college Early Childhood (EC)/Child Development (CD) programs developed a 24-unit EC/CD Major Transfer Degree. As a result, students striving for a bachelor's degree in EC/CD can embark upon a clear path to transfer that is consistent among community colleges statewide. Similarly, in 2006 the CSU Nursing programs standardized their lower-division major requirements and agreed on a general education pattern through the statewide Inter-segmental Major Preparation Articulated Curriculum (IMPAC) initiative. This agreement makes transfer requirements consistent across the state for students wishing to transfer into CSU Nursing programs.

Discussion Questions:

- How can technology be used to increase the availability and accessibility of critical major preparation coursework?
- What can educators from California's community colleges, the CSUs and UCs do to standardize requirements for Engineering transfer students?
- How can community colleges and universities partner to offer students the opportunity to complete as much coursework as possible prior to transfer and/or for the purposes of degree completion?

For more information on the CTE Transfer Research Project, visit www.rpgroup.org, or contact Eva Schiorring, Project Director, eschiorring@rpgroup.org.