August 2015

NATIONAL ACADEMY OF ENGINEERING

# Workshop on Effective Practices in Supporting Transfer Students

The National Academy of Engineering (NAE) and American Society for Engineering Education (ASEE) cosponsored a workshop to explore and catalyze efforts to document and disseminate proven approaches to support transfer students from two-year to four-year undergraduate institutions. The event, held on June 14, 2014, in Indianapolis, Indiana, built on the NAE-ASEE project, Engaging the Leadership of Engineering Education in the Two-Year to Four-Year Engineering and Engineering Technology Student Transfer Pilot Project (NSF ENG-1042875).[1]

## BACKGROUND

In 2011 the NAE and ASEE undertook a pilot project to explore the transfer experience of engineering and engineering technology (E/ET) students from two- to four-year schools as a follow-up to the 2005 NAE report on Enhancing the Community College Pathway to Engineering Careers, which concluded that (1) community colleges are essential to the education of engineers in the United States but (2) have not achieved their full potential as contributors to engineering bachelor's degree graduates because of miscommunication about the roles of community colleges and challenges in articulation; and (3) more data are needed on community college students and their transfer to engineering programs.[2]

The twofold goal of the pilot project was to determine how many students had substantially completed a two-year E/ET program and then transferred to an engineering program at a four-year institution and to identify barriers and challenges for these students. At the time there was a lack of data on E/ET transfer students and the pilot project aimed to enhance understanding of the difficulty of collecting data and determine whether there was value in the data collection to the two- and four-year schools as well as other engineering education stakeholder communities.

The project data indicated that two-year transfer engineering student populations are typically more diverse than four-year "resident" students in the two- and four-year schools surveyed[3]—there's a higher representation of African-American, Latino, and first-generation students—and the overall BS degree graduation rates of two-year transfer students are comparable to those of students that began their engineering studies at four-year schools (figure 1and figure 2).

The NAE-ASEE project collected data on graduation rates of transfer students using a six-year time frame (the norm used in BS/BA graduation data collection) and found an average graduation rate of 57 percent in engineering and engineering technology for two-year transfer students three years after their junior year at four-year schools—very close to the average graduation rate of 60.8 percent for engineering students beginning at a four-year institution using the same six-year time frame (NSB 2012).

Two-year institutions are measured by graduation rates, but there is little incentive for their students to get an associate's degree if they plan to transfer to a four-year institution. Of the four-year schools surveyed in the NAE-ASEE pilot project, only three asked transfer students during the admission process if they had an associate's degree; in most cases, they looked only at the student's GPA and coursework.

1. For more information on the project, please see www.nae.edu/Projects/CASEE/CASEEProjects/25978.aspx and Gibbons et al. (2011).

2. Most community colleges are two-year institutions that offer engineering and/or engineering technology programs. This workshop dealt with students transferring from these two-year programs to fully accredited four-year engineering and engineering technology degree programs.

3. The project surveyed 17 representative engineering baccalaureate degree–granting engineering colleges and 35 geographically distributed community colleges. The engineering colleges varied by status (public or private), highest engineering degree granted (i.e., doctorate, master's, bachelor's), and institutional focus (i.e., international research, national research, regional comprehensive, etc.).

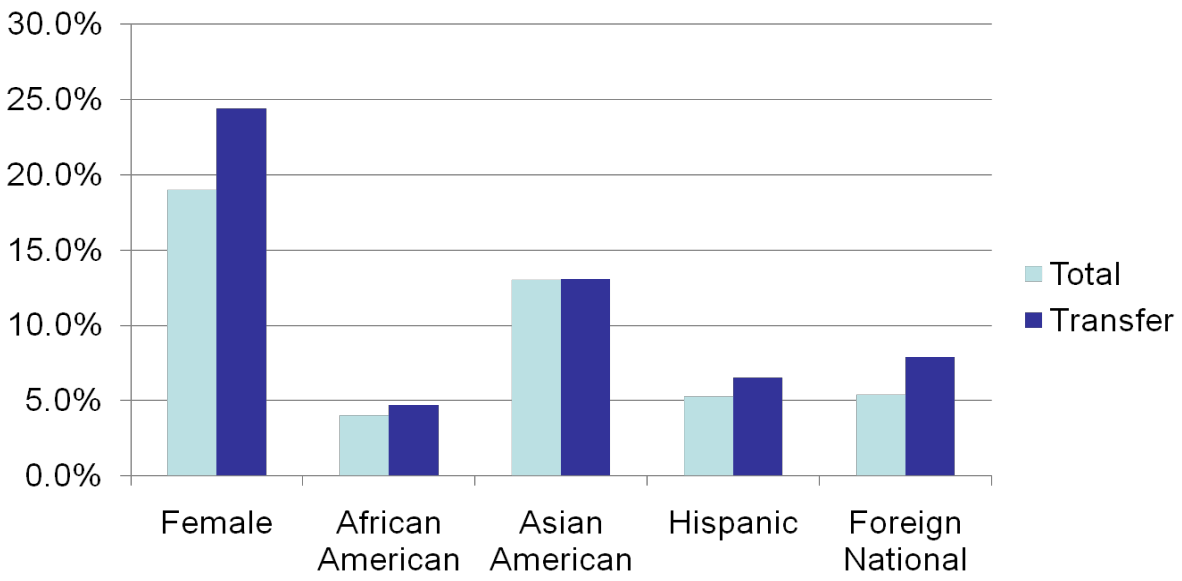


**Figure 1. Demographic Comparison, 2009: Overall Enrollment in Engineering/Engineering Technology (E/ET) at 4-Year Institutions vs. 2-Year Transfers in E/ET into the 4-YR Institutions. Source: NAE-ASEE Pilot Survey 2011.**

Reverse transfer initiatives at some four-year institutions enable students to earn an associate's degree in addition to their four-year degree, and thus may reflect somewhat more accurately the impact of two-year institutions on their student populations.

Some deans of engineering at four-year public institutions[4] have criticized the use of six-year graduation rates as many of their engineering transfer students are older, working and attending school part-time, and are penalized by a standard based on full-time student status. Indeed, the NAE-ASEE pilot study reported a national median age of 23 and an average age of 28 for students at two-year institutions. At community colleges, 42 percent of those enrolled were first-generation students and 60 percent were part-time. The latter may need financial aid, but most financial aid packages available to two- and four-year students have time and status limitations that assume full-time status.

The project reaffirmed the lack of consistency in data collection (e.g., methods used, frequency of collection, types of data collected) on two-year student populations. The challenges are due in part to discrepancies in enrollment status. For example, significant numbers of students are enrolled in two-year institutions for both credit and noncredit courses. In addition, the NAE-ASEE data show that a number of four-year students and even BS/BA graduates enroll in two-year colleges and acquire a two-year degree that is tied to employment opportunities or course requirements. It is difficult to capture the number of students going back and forth (sometimes referred to as "student churn") between two- and four-year institutions because the students' institutional affiliation is not clear.

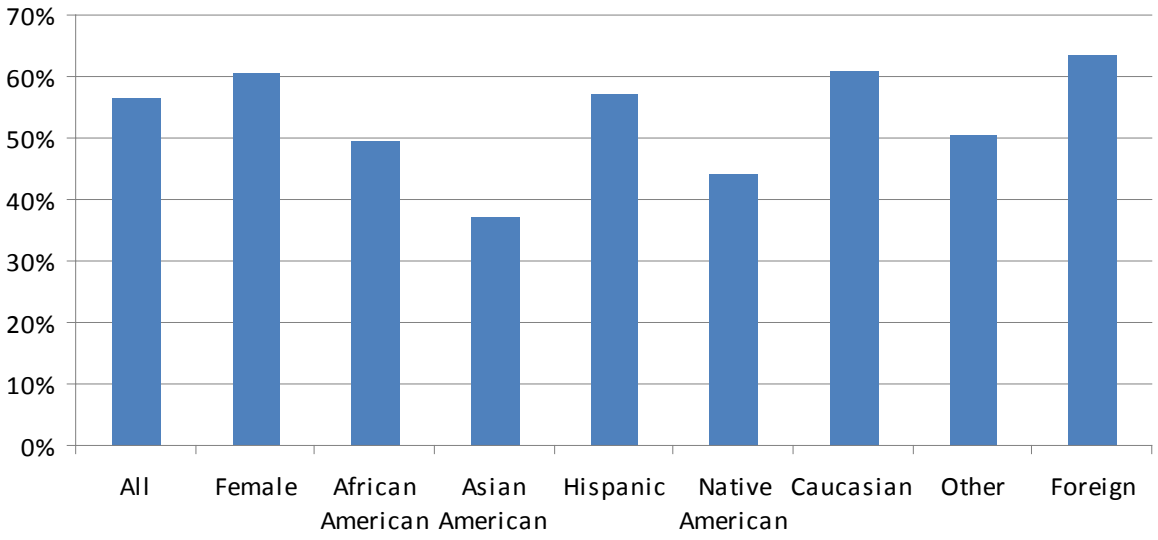


**Figure 2. Graduation Rate for 2-Year Transfers: 3 Years After Reaching Junior Year.**
**Source: NAE-ASEE Pilot Survey 2011.**

**Note: This table displays the B.S. graduation rate for transfers from 2-year institutions, three years after they reached their junior year.**

## GOALS OF THE WORKSHOP

The workshop focused on educational institutions' policies and programs that support students' successful transfer from two- to four-year engineering programs. The topic is timely, given a 2014 Department of Education report (Kena et al. 2014) on the high attrition rate of students in two-year institutions and the small numbers who obtain associate's degrees. What are the strategies and bridging mechanisms to help students transition from two-year to four-year institutions efficiently and effectively and ultimately obtain a degree?

**4. The vast majority of four-year institutions that accept two-year transfer students in engineering are public; very few four-year private institutions admit significant numbers of transfer students in engineering.**

## TEXAS A&M ENGINEERING ACADEMIES: PARTNERITNG WITH COMMUNITY COLLEGES

**Teri Reed, Texas A&M University**

Teri Reed, assistant vice chancellor of academic affairs and assistant agency director of workforce development for Texas A&M Engineering Experiment Station at Texas A&M University, has worked on transfer student pathways at several four-year institutions.

When she arrived at Texas A&M in 2012 there were more than 70 different articulation agreements with transfer institutions, some of which were not even aware of the agreement. Reed acknowledged that Texas A&M is a large institution and that not every four-year institution has so many transfer agreements; but whatever the size of the institution or number of agreements, she said "the bottom line is that we have to make these things work for our students."

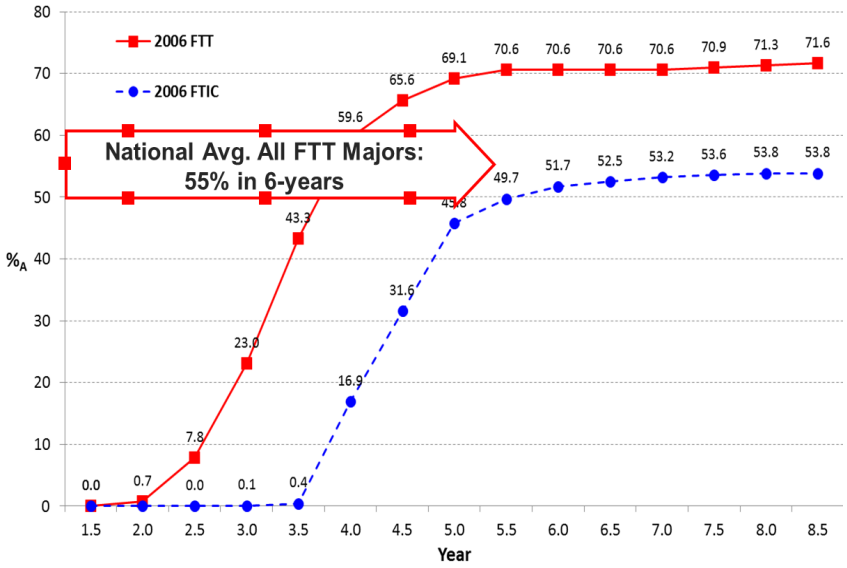


**Table 1. Graduation Rate Comparison of Texas A&M First Time Transfer Students and First Time in College**
**Source: Presentation by Teri Reed, Texas A&M University on Texas A&M Engineering Academies: Partnerting with Community Colleges. National data from National Center for Education Statistics.**

When the Texas Higher Education Coordinating Board passed regulations regarding reverse transfers[5], she said it "immensely helped the conversation." Texas A&M now has reverse transfer policies for crediting and transferring students' coursework to the original two-year institutions so that associate's degrees can be conferred. Assessments of two-year institutions based solely on graduation rates do not account for the instruction and support provided to the numerous students who transfer to a four-year institution before acquiring an associate's degree. The implementation of the reverse transfer policy in Texas helps to ensure that two-year institutions are not penalized (in terms of completion and graduation rates) if their students transfer to a four-year institution before attainment of an associate's degree.

As the practice of reverse transfer spreads, the challenge is to implement it effectively, and this requires the engagement of a committed administrator at the four-year institution. Texas A&M works closely with administrators at two-year institutions to ensure the reverse transfer of credits. Relationships between institutions are key; as administrators change positions, new relationships must be developed.

Another challenge is how the associate's degree is portrayed to potential students. Some community colleges create associate's degrees in engineering for students who want to transfer to a four-year institution for a BS in engineering and tell them it is a "2 plus 2" program, meaning the student can acquire the BS degree in four years. This is not usually the case.

Reed reported a conversation with the president of a very large community college in Texas who described the institution's associate's degree in engineering as a 2 plus 2 degree.

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**5. "The Reverse Transfer process was established by the Texas Legislature in 2011 to help students who transfer from a public community college to a public university receive an associate's degree as they successfully complete coursework. Texas public universities are required to identify, track, and follow up with each student who has (1) earned at least 30 SCH [semester credit hours] at a community college and (2) completed a total of 66 SCH." From the Texas Higher Education Coordinating Board Improving Transfer to Increase Student Success, July 3, 2014, page 3.**

But when Reed and her colleagues reviewed the curriculum she had to inform the president that what the school was offering would in most cases require 2 plus 5 years to earn a BS degree in engineering at Texas A&M. The program's mathematics courses, for example, went no further than college algebra—even though the algebra class was offered in the very first semester of the two-year program. There was thus plenty of time to continue mathematics coursework but it was not included in the program, which was already state approved and had students enrolled. For transfer students who "complete their math sequence prior to matriculation we [anticipate] a shift in percent of students graduating, an increase in student success and retention, and a decreased time-to-graduation." This example clearly illustrates why partnerships are critical and four-year institutions need to work closely with two-year institutions.

Recognizing that 2 plus 5 engineering BS degree programs are not in the interest of transfer students, Reed created a pathways project for students in engineering: the Texas A&M Engineering Academies[6]. The average time to graduation for transfer students in engineering at Texas A&M is 3½ to 4 years in addition to the 1 or 2 years completed at the other institution. Interestingly, Reed noted, the completion rate is higher for female students than for male students.

Students are admitted to the Engineering Academies through Texas A&M, where they take their engineering classes while their math and science courses are at the two-year institution (often in cohorts of students admitted to both institutions). This requires block scheduling and joint activities across the two institutions, and it fosters a broad learning community, which, research has demonstrated, leads to greater student success. For a major community college in the same neighborhood as the university there are buses that run between the two campuses. This arrangement enables students at the community college not only to take first-year engineering courses at Texas A&M but also to familiarize themselves with the campus and get other kinds of support such as online access and resources.

One of the challenges, Reed said, is faculty buy-in regarding the caliber of the transfer students. She is working to show faculty that the transfer students usually graduate at a higher rate than the native population of students. Of the 2006 cohort of first-time transfer students to Texas A&M, 71 percent graduated within six years (table 1).

That's not to say that transfer students don't struggle. There is on average an initial half-point drop in GPA for transfer students, but most recover. And many Texas A&M resident first-year engineering students experience a similar GPA drop. So Reed pointed out that it is critical to manage not only the student transitions but also the faculty expectations of the transfer students.

Texas A&M now shares its data on student success with two-year institutions, and this practice has been very useful as it provides information on how the former two-year students progressed and it can be used by the two-year institutions to evaluate their curriculum and adjust their program to ensure greater success for their students who transfer.

The biggest stumbling block for students in the Engineering Academies is the first-year program for transfer students to Texas A&M, so the university has an optional summer bridge program[7] to help them continue their successful studies.

One of the benefits of dual enrollment is a sense of belonging and community, including highly coveted perks, depending on the institution. Reed cited "this little thing in Texas called football" and said that dually enrolled students at Texas A&M "have full athletic privileges," with athletic passes and access to all the facilities. She added that some of them, even those that do not live nearby, come to the campus on a Saturday to watch a football game. Getting these students to campus is an explicit goal to help them feel part of the school.

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**6. The academies are partnerships with regional two-year colleges that enable dual enrollment in Texas A&M to ensure the application of credits toward a Texas A&M degree.**

**7. Summer bridge programs, which are short intensive academic and social introductions to a university, are usually geared to first-year students and are now being developed for transfer students as well. According to Matthew McCurrie (2009, p. 28), "Retention experts have developed summer bridge programs as one tool to strengthen students academically and socially in preparation for the challenges of the first year of college."**

***"What's the right thing to do for the students? I always go back to that.... That's what I think we have to ask ourselves."***
***– Teri Reed, Texas A&M University***

The dually enrolled students pay tuition to Texas A&M, usually for two hours a semester, and the engineering differential fee. It is not a significant sum, but it helps fund the Engineering Academies and supports the sustainability of the program.

Reed has found that students want to transfer to Texas A&M after the first year of participation in the Engineering Academies. This is where the Texas legislature's reverse transfer policy is important as it helps to ensure that two-year institutions that partner with Texas A&M are not penalized for students' leaving their institution before they earn an associate's degree. If these students continue to study at Texas A&M the reverse transfer policy confers an associate's degree once they complete the required credits. The inclusion of these students in the data on completion rates can improve the status and ranking of the partnering two-year institutions, which is often a factor in receiving state and other sources of funding.

Texas A&M guarantees admission to a BS engineering program on the College Station campus through the Engineering Academies for students who achieve a 3.5 GPA (students with a GPA below 3.5 can apply but their admission is not guaranteed). About 60 percent of the students in the Engineering Academies achieve a 3.5 or higher.

The student population in the Engineering Academies is more diverse than the native 4-year student body, although there is room for improvement in the enrollment of women, who account for 20–25 percent of the entering class, about the same as at Texas A&M. The university is looking at other types of potential partnerships that would help attract women.

Finally, Reed noted the importance and value of a university system. There are nine universities in the Texas A&M University system that offer engineering degrees, from rural Texarkana to Doha, Qatar. Four are Hispanic-serving institutions and one is a historically black college. Texas A&M is creating synergy across the system by sharing its model for transfer students who begin in two-year institutions.
Reed reported that Texas is one of three states characterized by "expansive growth" in its high school graduation rate. Part of her job, therefore, is to propagate the model of the Texas A&M Engineering Academies to the state's other four-year universities to increase access for the growing numbers of college-aged students in Texas.

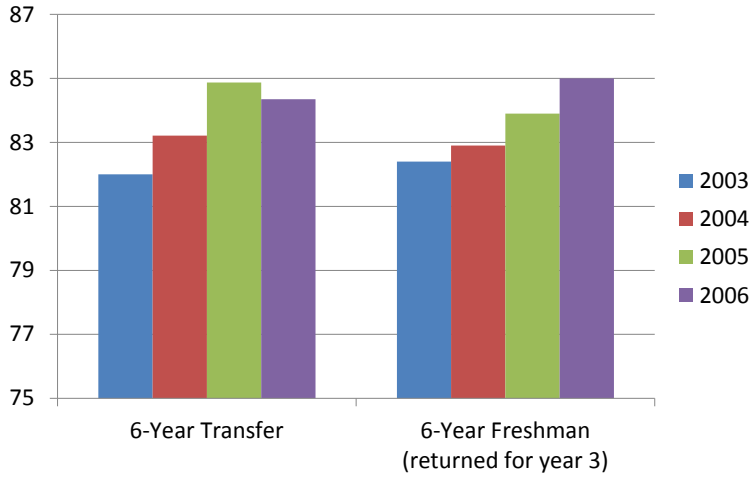


**Figure 3. Missouri S&T Graduation Rate Comparison 2006 Transfer Cohort and 2004 Freshman Cohort**
**Source: Presentation by Debra Anderson, Missouri University of Science and Technology on Missouri University of Science Technology: Lessons Learned from Successful Transfer Partnerships.**

## MISSOURI UNIVERSITY OF SCIENCE AND TECHNOLOGY: LESSONS LEARNED FROM SUCCESSFUL TRANSFER PARTNERSHIPS

### Debra Anderson, Missouri University of Science and Technology

Missouri University of Science and Technology (Missouri S&T), in Rolla, has about 8,000 students—6,300 undergraduates and a class of 1,200 entering first-year students. In 2013 the university admitted 568 transfer students—a record high. About 74 percent of the university's students are engineering majors, and over 90 percent are engineering, mathematics, or science majors.

The university has had transfer programs and partnerships with community colleges in Missouri since 1969. Its current transfer agreements ("partnerships") with 55 community colleges include every two-year institution in the state as well as many four-year colleges and universities that do not have engineering programs, some colleges and universities in other states, and a growing number of international institutions.

Students transfer to Missouri S&T with an average of 61 transfer credits and a GPA of 3.18, which dips very slightly (to 3.16) after a few semesters. It is important that the transfer students know about this potential decline in their GPA. Most of them know of the rigorous programs at Missouri S&T and are a bit nervous, but Anderson reported that year after year good students at the community college partner schools become good students at Missouri S&T, and she and her colleagues convey these success rates to their transfer students.

The 2013 class of transfer students came from 103 institutions (two- and four-year combined), and over 25 percent did not come from one of the partnership institutions. The university's transfer processes must therefore be transparent and accessible to all students.

Missouri S&T is located in the middle of the state, where the population is 64 percent Caucasian. About 8 percent of the university's transfer students are underrepresented minorities. The university's population of undergraduate transfers in engineering from international partnership institutions is growing.

Engineering transfer students enter either the freshman engineering program or a specific engineering department. Those from partnering institutions often have completed

much of their preengineering coursework at the two-year institution and so transfer directly into an engineering department. Students that did not have access at their previous institution to the required calculus and physics courses are admitted into the first-year engineering program. About 27 percent of newly admitted students enter freshman engineering courses as transfers.

Anderson explained that "the mechanism for moving students from freshman engineering into an engineering program for students currently on campus is consistent with the way we make decisions as we admit new transfer students. That is the spirit of our articulation agreements, that we're treating our transfer students in a manner that is consistent with our current native students."

Graduation rates were nearly identical for the 2006 cohort of transfer students majoring in engineering who entered Missouri S&T as juniors and the 2004 cohort admitted directly as first-year students (figure 3). The graduation rate for transfer students was 84 percent in 2006, and 85 percent for the native cohort. Anderson reiterated the importance of demonstrating such evidence of transfer student success to the academic departments.

Anderson noted that the institution has a "fairly transfer-friendly culture, but it's always still a challenge as new deans and new faculty members and new department heads come into place, and our faculty members at our sending institutions change and retire, to keep those relationships strong and working well." Faculty-to-faculty interactions between Missouri S&T and the transfer partner schools are "key to the strength of our partnerships." To that end, an annual transfer conference brings faculty members, administrators, and staff advisors from transfer partner schools to the Missouri S&T campus for sessions on curriculum and other issues and for informal conversations with the Missouri S&T leadership (usually the chancellor and provost) about their shared dedication to transfer student success.

A critical element of the success of the transfer programs is that all of the articulation agreements are at the university level, so it is not necessary to constantly manage department-level articulation agreements in which one engineering department might agree to transfer credit for a required course and another would not.

Moreover, the university's strategic plan includes goals for transfer students. The explicit connection of the value of transfer students to the overall goals of the university helps maintain strong support—including among faculty—for transfer students. There's a commitment to accommodate transfer students when determining class capacities and sections of courses. And in practical terms for the university, transfer students contribute to revenues as well as diversity on campus (broadly defined to include underrepresented minorities, women, first-time college attendees, even academic and geographic diversity), all of which supports the university's mission as a land-grant institution.

> ***"That is the spirit of our articulation agreements, that we're treating our transfer students in a manner that is consistent with our current native students."***
>
> ***– Debra Anderson, Missouri University of Science and Technology***

Anderson reviewed several transfer-friendly policies at Missouri S&T. For example, the requirement that students transfer not only credits but grades for all college-level courses confers recognition of the students' work at their two-year institution and its application toward their Missouri S&T degree. Many transfer students come in with high GPAs and should not be penalized if they have a difficult transition semester that might jeopardize their scholarship and other funding.

In addition, to keep the process as transparent as possible the transfer guides for each partnering institution are on the Missouri S&T website, which lists courses that will transfer and satisfy degree requirements. Students usually do not know what kind of engineering they're interested in, but they will need calculus, physics, and chemistry as well as English, history, and economics in addition to the courses associated

with their engineering major. These course requirements are laid out in the online guide.

Admission criteria for transfer students are very similar to those for native students. For example, if they've completed calculus II, or calculus I and college-level trigonometry, they are exempt from math placement testing. Transfer students "don't have to jump through any additional hoops."

Students from partner schools are encouraged to apply early, send their transcripts as soon as their falls grades are posted, and come to the "transfer advising day" in late February or early March. This is the first day that upper-level students can register for classes and they get their first choice for scheduling. It's another transfer-friendly policy.

In addition to transfer orientation, the university's transfer assistance program includes a scholarship automatically awarded to transfer students who meet the admission criteria (e.g., the minimum GPA). The one-year scholarship is renewable for a second year and encourages students to stay at their community college and finish the first couple of years. (It takes transfer students five semesters, on average, to finish their degree; Missouri S&T scholarships for transfer students are allowed for up to four semesters.)

Annual surveys of Missouri S&T transfer students show that most feel prepared and are pleased with the education they received at their partnering institution. At Missouri S&T they are interested in participating in design teams, research, study groups, and professional organizations—they want to make the most of their experience at the university.

She concluded that "there is no one right pathway that will work for all students." It's important to support students who see the transfer process as their pathway to a BS degree. "It's our job to put the processes and the programs in place that make it possible for the students to graduate.... [A]ll the things that we do should be focused on what can we do that is best for the student that will make it most likely for that student to finish the degree. We're not competing with one another; we're really working together to do what's best for the students."

In conclusion Anderson recapped the importance of (1) a supportive campus culture for transfer students; (2) high-level administration support; (3) faculty-to-faculty interactions with partnering institutions; (4) collection of data that convey transfer students' progress to all of the constituents involved (e.g., faculty); (5) a transfer assistance program that ensures students have a good "on-boarding" experience; and (6) transfer credit policies that reward transfer students' hard work at both institutions.

## RELEVANT RESEARCH ON STEM TRANSFER STUDENTS WITH A FOCUS ON ENGINEERING AND ENGINEERING TECHNOLOGY

### Valerie Lundy-Wagner, Teachers College, Columbia University

Valerie Lundy-Wagner is a civil and environment engineer who is now working as a senior research associate at the Community College Research Center (CCRC) at Teachers College, Columbia University. CCRC provides research and technical assistance to state systems and institutions and identifies the types of state programs and policies that will be most beneficial to students. This is particularly important as half of all students in postsecondary institutions are at two-year institutions and many are first-generation and low-income students.

Discussions of two-year college students should also consider "what their understanding of the workforce is and their labor market outcomes and how that might be driving some of the decision making." Many states are using these methods of collecting data in order to determine allocation of funding and resources.

Lundy-Wagner reviewed administrative data on engineering and engineering technology students in the community college system of some 30 institutions in an unidentified state. The data—on demographics, academic preparation, enrollment patterns, and completion rates—were collected beginning in 2009 and students were tracked for at least four years. The CCRC study showed that only 20.7 percent of the students received a two-year degree or credential before transferring to a four-year institution.

| | Transferred (N=761) | Did Not Transfer (N=1,525) |
|---|---|---|
| % Female | 13.4% | 8.4% |
| % Asian | 11% | 9.2% |
| % Hispanic | 7.2% | 8.9% |
| Age (in years) | 20.11 | 20.62 |
| % Full-Time | 46.4% | 33.4% |
| % Mostly Part-Time | 20.2% | 24% |
| # Developmental Courses | 0.870 | 1.370 |
| # Math Developmental Courses | 0.495 | 0.786 |
| % Fail Developmental Math Courses | 14.6% | 27.2% |

**Table 2. Differences in Engineering Students that Do and Don't Transfer**
**Source: Presentation by Valerie Lundy-Wagner, Teachers College, Columbia University on Relevant Research on STEM Transfer Students with Focus on Engineering and Engineering Technology.**

Thus nearly 80 percent of students who transfer to a four-year institution could receive two-year degrees or credentials but do not. This has tremendous implications in states where funding allocations are based on performance and where measures of institutional success are often based on credentialing or number of degrees conferred.

Looking at the demographic data on students who transferred from the two-year schools in the state to four-year institutions, Lundy-Wagner noted differences that require additional research. For example, a significantly higher percentage of African-American students transferred to four-year institutions without credentialing. Overall, most of the students who did not acquire a credential were attending part-time and may not have been aware of the potential benefits of the two-year degree or credential. Yet "evidence [shows] that students from community colleges that earn a credential do better when they get into the four-year [institution]."

Although "most students in community college engineering and engineering technology programs aspire to transfer," certain groups are more likely to do so. Female, Asian, and full-time students are more likely transfer and Hispanic students less likely, as are students who took and/or failed a developmental math course (table 2).

Given the significance of credentialing and degree attainment for professional progress and the fact that more than half of students do not earn credentials from their two-year institutions, it is important to consider "the types of resources that are necessary for facilitating transfer and articulation."

Transfer success is also a function of students' "cultural capital" in the institution they are attending, and this in turn depends on whether students "feel like they're in a place that is supportive of them academically or psychologically or financially, or even logistically—if tutoring is only from 9:00 to 5:00 and [they] work, it's not really helping" the students. "When people don't feel like they can do things, they start expending other psychological energy on dispelling the stereotype that they could be [applying to] solving a math problem." Articulation addresses explicitly the issue of cultural capital, so consistent and straightforward processes and policies are needed on transfer articulation.

Lundy-Wagner cited Cañada College in California as an example of an institution that has developed a program for successful student engagement. The college offers a mathematics program every term where students enter at their own level in the subject and develop proficiency using a combination of face-to-face and online resources.

Community colleges should revisit their curriculum and consider the use of cohorts for potential transfer students as there is good evidence that working in consistent groups of students with similar ambitions works well. Community colleges also need to think about academic staff and their coordination. Lundy-Wagner also suggested that community

colleges implement a curricular audit for nonessential requirements on a regular basis; one institution's physical education requirement for obtaining an associate's degree has been a barrier for many students.

***"Evidence [shows] that students from community colleges that earn a credential do better when they get into the four-year [institution]."***

***- Valerie Lundy-Wagner, Teachers College, Columbia University***

In addition, four-year institutions need to "do a better job of emphasizing the credential receipt[8] with transfer" to their institution, focus on the transition curriculum, and emphasize the sense of belonging and acceptance academically and socially both in and outside of the classroom. That said, she acknowledged that there is inadequate research on the psychological support needed for transfer students from two-year institutions.

In an ideal world, Lundy-Wagner said, "a general engineering certificate program would contribute to an associate's degree program, which would eventually contribute to a bachelor's degree program." Such a system will require structural incentives for both students and institutions to ensure successful transfers for more students.

## CONCLUDING COMMENTS

The speakers concurred on a number of points. Coordination and communication between institutions are critical to clarify expectations and requirements for students, faculty, and administrators and to leverage resources for transfer students. Faculty and staff at four-year institutions lack confidence in the preparedness and abilities of two-year transfer students and therefore should be targeted in efforts to smooth the integration of these students. The dissemination of information about articulation agreements and transparency about transfer requirements and guidelines are essential. Efforts to incorporate students into the campus life of the four-year institution can help transfers adapt. A dip in GPA is typical after the transfer, and it can be helpful both for students to be aware of this and for administrators at the four-year institution as well so that transfer students are not penalized (e.g., in their scholarship eligibility).

The discussions at the workshop both revealed useful practices and raised questions that call for more research and better data collection to inform improved and more widespread efforts. The points conveyed here are a starting point for continued conversations and work not only by the workshop attendees but, ideally, by leading organizations such as the ASEE and NAE as well as the engineering education community.

8. A credential receipt is an earned credential or an associate's degree.

**References**

1. Gibbons MT, Cady ET, Didion C, Fortenberry N. 2011. Pilot Survey of Engineering and Engineering Technology Students in 2-Year and 4-Year Institutions. ASEE 2011 Conference Proceedings. Available at http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=6142767&tag=1.

2. Kena G, Aud S, Johnson F, Wang X, Zhang J, Rathbun A, Flicker-Wilkinson S, Kristapovich P, Notter L, Rosario V. 2014. The Condition of Education. Washington: National Center for Education Statistics, US Department of Education.

3. McCurrie MK. 2009. Measuring success in summer bridge programs: Retention efforts and basic writing. Journal of Basic Writing 28(2):28–49.

4. NAE [National Academy of Engineering]. 2005. Enhancing the Community College Pathway to Engineering Careers. Washington: National Academies Press.

5. NSB [National Science Board]. 2012. Science and Engineering Indicators. Washington.

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This workshop summary has been reviewed in draft form by **Bartlett Sheinberg**, West Houston Center for Science and Engineering, Houston Community College, and **John Slaughter (NAE),** University of Southern California. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published summary as sound as possible and to ensure that the summary meets institutional standards for clarity, objectivity and responsiveness to the charge. The review comments and draft manuscript remain confidential to protect the integrity of the process.

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