College for all Texans

Making Opportunity Affordable

Engineering Articulation Fact Book

Texas Public Institutions of Higher Education

June 2009

Texas Higher Education Coordinating Board

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Mission of the Coordinating Board

The Texas Higher Education Coordinating Board's mission is to work with the Legislature, Governor, governing boards, higher education institutions and other entities to help Texas meet the goals of the state's higher education plan, *Closing the Gaps by 2015*, and thereby provide the people of Texas the widest access to higher education of the highest quality in the most efficient manner.

Philosophy of the Coordinating Board

The Texas Higher Education Coordinating Board will promote access to quality higher education across the state with the conviction that access without quality is mediocrity and that quality without access is unacceptable. The Board will be open, ethical, responsive, and committed to public service. The Board will approach its work with a sense of purpose and responsibility to the people of Texas and is committed to the best use of public monies. The Coordinating Board will engage in actions that add value to Texas and to higher education. The agency will avoid efforts that do not add value or that are duplicated by other entities.

Support for this report comes from the Lumina Foundation for Education, which has generously supported the Texas Higher Education Coordinating Board for regional and statewide education and dissemination programs related to *Closing the Gaps by 2015.*

Executive Summary

Background

The goal of this study is to examine the education pathways of a single cohort of students who started at either a public two-year or public four-year institution and wanted to earn a degree in engineering, especially those students interested in a mechanical engineering degree. The data files were constructed by identifying all students who enrolled in a Texas public institution of higher education fall semester 2002, based on information submitted to the Texas Higher Education Coordinating Board on the CBM001 data file. From the 169,630 students in the fall 2002 statewide cohort of first-time-in-college students (both full- and part-time), we identified an engineering cohort of 7,637 students who either earned a bachelor's degree in engineering, or declared an engineering major at some point during the six-year time frame of this study, from fall semester 2002 through the summer semester of 2008.

Eight education outcome groups were identified and compared on enrollment patterns, degree completion rates, time-to-degree, semester credit load, financial support, and the total education cost of earning a bachelor's degree. The eight education outcome groups were based on where students first entered college (public two-year or four-year institutions) and whether or not they earned a bachelor's degree in mechanical engineering, a different engineering discipline, a non-engineering field, or did not earn a bachelor's degree within the six-year period of time. Students who did not earn an engineering degree, but who declared an engineering major at some point during the six years, were called pass-through engineering majors.

For more information about the methodology for identifying the base cohort for this study see Appendix A.

Key Findings

The Engineering Cohort

- Of the 169,630 students who first enrolled at a public college or university in the fall semester 2002, nearly two-thirds (65.7%) started at a two-year institution and one-third (34.3%) started at a four-year institution.

- Of the 169,630 public higher education students who first enrolled in fall 2002, a total of 7,637 students (4.5%) earned a bachelor's degree in engineering or declared an engineering major at some point during the following six years.

- A majority of this engineering cohort started at a four-year institution (N=5,671 or 74%), and one-fourth of this cohort started at a two-year institution (N=1,966 or 26%).

Cost Per Degree

- Public colleges and universities spent $424.2 million from Fiscal Year 2003 through Fiscal Year 2008 to educate the 7,637 students in the engineering cohort.

- For this $424.2 million investment, the following outcomes were obtained:
    - 2,566 bachelor's degrees in engineering
        - 649 bachelor's degrees in mechanical engineering
        - 1,917 bachelor's degrees in other engineering disciplines
    - 1,489 bachelor's degrees in non-engineering fields by students who attempted an engineering major, but who graduated in another field
    - 3,582 students who did not earn a bachelor's degree
- The average cost to the institution(s) per successful student degree completion in mechanical engineering was $77,700 for students who started at a two-year institution and $80,300 for students who started at a four-year institution.
- The average cost to the institution(s) per successful student degree completion in other engineering disciplines was $75,000 for students who started at a two-year institution and $81,300 for students who started at a four-year institution.
- The average cost to the institution(s) per successful student degree completion in non-engineering fields was $49,500 for students who started at a two-year institution and $60,700 for students who started at a four-year institution.
- Public colleges and universities spent about $129.8 million on the 3,582 students who pursued an engineering degree, but did not complete a bachelor's degree in any field, or about $36,200 per student.
- The average mechanical engineering program cost, based on the dollars spent educating students who earned an engineering degree or who were enrolled as an engineering major, regardless of whether they earned an engineering degree or not, was $145,000 for students who started at a two-year institution and $112,600 for students who started at a four-year institution.
- The average engineering program cost for other engineering majors was $186,500 for students who started at a two-year institution and $120,900 for students who started at a four-year institution.

For more information about calculating the cost of a degree for this study see Appendix B.

Degree Completion

- Of the 1,966 students in the engineering cohort who started at a two-year institution, 314 earned an engineering degree (85 in mechanical engineering and 229 in other engineering disciplines), for an engineering degree completion rate of 16 percent. An additional 202 of these students completed a bachelor's degree in a non-engineering field, for an overall bachelor's completion rate of 26 percent.

- Of the 5,671 students in the engineering cohort who started at a four-year institution, 2,252 completed an engineering degree (564 in mechanical engineering and 1,688 in other engineering disciplines), for an engineering degree completion rate of 40 percent. An additional 1,287 of these students completed a bachelor's degree in a non-engineering field, for an overall bachelor's completion rate of 62 percent.

- Overall, 74 percent of the engineering cohort students who started at a two-year institution did not earn a bachelor's degree in any field, compared with 38 percent of this cohort who started at a four-year institution.

Time-to-Degree and Semester Credit Hours Earned

- One-third of the engineering cohort students who started at a two-year institution and completed a bachelor's degree in mechanical engineering did so in five years or less, compared with 83 percent of this cohort who started at a four-year institution.

- About 40 percent of the engineering cohort students who started at a two-year institution and completed a bachelor's degree in another engineering discipline did so in five years or less, while 86 percent of this cohort who started at a four-year institution completed a bachelor's degree in another engineering discipline in five years or less.

- Students who earned a bachelor's degree in mechanical engineering attempted a weighted average of 154 semester credit hours (two-year and four-year total credits) if they started at a two-year institution and 141 semester credit hours if they started at a four-year institution.

- Students who earned a bachelor's degree in a different engineering discipline attempted a weighted average of 150 semester credit hours if they started at a two-year institution and 139 semester credit hours if they started at a four-year institution.

- Students who earned a bachelor's degree in a non-engineering field attempted a weighted average of 152 semester credit hours if they started at a two-year institution and 147 semester credit hours if they started at a four-year institution.

- A relatively small percentage of the engineering cohort students who started at a two-year institution (16%), and a higher percentage of students who started at a four-year institution (35%), earned dual credit hours while enrolled in high school during the two years prior to entering college. On average, students in both groups earned about 10 dual credits. These credit hours do not include any credit by advanced placement or credit by examination.

- Small percentages of the engineering cohort students attempted developmental education semester credit hours at either two-year (11%) or four-year (7%) institutions.

- Of the engineering cohort students who attempted developmental education semester credit hours at a two-year institution, 90 percent did not earn a bachelor's degree in any field, and 71 percent of the students who attempted developmental education semester credit hours at a four-year institution did not earn a bachelor's degree in any field.

Financial Support and Student Debt

- Of the 7,637 students in the engineering cohort, 5,654 students (74%) received a total of $138.4 million of financial support (tuition waivers and exemptions, categorical aid, grants and scholarships, work study, and loans) from Fiscal Year 2003 through Fiscal Year 2008. Of this total financial support, $48.7 million went to students who did not earn a bachelor's degree in any field.

- More than half (52%) of the engineering cohort students received a grant or scholarship, and nearly half (48%) had loans and incurred student debt.

- Students who started at a two-year institution and earned a bachelor's degree in mechanical engineering received, on average, a total of $30,700 in financial support, compared with an average total of $35,000 for students who started at a four-year institution.

- Students who earned another engineering degree and started at a two-year institution received about $34,700 in financial support, compared with an average of $37,500 for students who started at a four-year institution and earned the same degree.

- Students who earned a bachelor's degree in a non-engineering field and started at a two-year institution received about $32,800 in financial support, compared with an average of $39,200 for students who started at a four-year institution and earned a bachelor's degree in a non-engineering field.

- Students who did not earn a bachelor's degree in any field received, on average, approximately $20,000 in financial support.

- Students who started at a two-year institution and earned a bachelor's degree in mechanical engineering had a slightly higher level of loan debt ($22,800) than students who started at a four-year institution and earned the same degree ($21,400) or about $1,400 less.

- Students who started at two-year and four-year institutions and earned a degree in another engineering discipline had similar levels of student debt ($22,800 versus $22,600 respectively).

- Students who did not earn a degree had lower levels of student debt, but that debt averaged more than $14,000 over six years.

Note: Student debt reported in this study only includes loans processed by the institutions' financial aid offices and does not include private loans that the student or their parents received.

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Introduction

The *Engineering Articulation Fact Book* is designed to provide an analysis of data that will inform the dialogue among stakeholders and policymakers seeking the most efficient and effective pathways for earning a four-year bachelor's degree in engineering from a Texas public institution of higher education. At issue is to what extent students who begin their college careers as either full- or part-time students at a public two-year institution differ from students who begin at a public four-year institution with respect to their enrollment history, the number of semester credit hours attempted, the number of dual credit courses taken in high school, the number of developmental education semester credit hours attempted in college, the number of semesters enrolled, the amount of financial support received, and the amount of student debt incurred. Given the enrollment history, does the successful completion rate differ for those who start at two-year versus four-year institutions? Perhaps the most important question is whether starting at a public two-year institution lowers the total cost of earning a bachelor's degree in engineering. In addition, the cost of running an engineering program includes the costs of educating students who may not have earned an engineering degree, so it is legitimate to ask what it costs to educate all students who pursue an engineering degree, not just those who successfully complete the degree, and to allocate those costs across the number of degrees earned.

The purpose of this report is to follow a single cohort of students who first entered a Texas public college or university in fall semester 2002 and track their education progress for six years (i.e., through summer 2008). By comparing students who started at a public two-year institution with those who started at a public four-year institution, we hope to provide answers to the following questions.

Key Questions

1. Who pursues an engineering degree?
2. What is the completion rate of students who pursue an engineering degree?
3. Does the completion rate differ for students who first enroll at a two-year versus a four-year institution?
4. How many semester credit hours do students attempt at two-year and four-year institutions? How does it differ by where they first started college?
5. How many semesters does it take to complete a bachelor's degree in engineering, and does it differ for students who start at two-year and four-year institutions?
6. How do students who start at a two-year institution and earn a baccalaureate degree differ from students who start at a four-year institution and earn the same degree?
7. Does the total cost of an individual student degree differ for students who start at two-year and four-year institutions? Do the engineering program costs differ by where the students started college?
8. Does student financial support and student debt level differ by where students started college?

Methodology

To accurately monitor the various pathways from the time students entered a Texas higher education institution to the point they either graduated with a bachelor's degree or left without obtaining the degree, a longitudinal study design was employed. Every student who first enrolled in a public college or university in the state of Texas fall semester 2002 was identified. This cohort was followed for six years to determine whether or not they earned a bachelor's degree by the end of the summer semester 2008. Data were compiled from existing Texas Higher Education Coordinating Board files to monitor (1) enrollment and semester credit hour load; (2) financial support in the form of tuition waivers, grants and/or scholarships, work study, and loans; and (3) awards (degrees and certificates) earned. In addition, degree completion rates and time-to-degree information were summarized. Specific details about the methodology may be found in Appendix A.

Acknowledgements

The Texas Higher Education Coordinating Board would like to thank higher education consultant Gary R. Hanson, Ph.D., retired Senior Research and Policy Analyst for the Institutional Studies and Policy Analysis Office of The University of Texas System, for his careful data analyses, critical insights, and clear writing of this report. A special thanks also to Mary E. Smith, Ph.D., Assistant Deputy Commissioner for Academic Planning and Policy at the Coordinating Board, and Georgia D. Hodde, Administrative Assistant for Academic Planning and Policy at the Coordinating Board, for their formatting skills, careful editing, and meticulous attention to detail. Finally, we would like to thank the following staff of the Coordinating Board who contributed their time, knowledge, and expertise for this report: Susan E. Brown, L. Diane Eargle, David W. Gardner, Ph.D., Gary W. Johnstone, Kevin P. Lemoine, Ph.D., Jim K. Pinkard, and MacGregor M. Stephenson, J.D., Ph.D.

The Texas Education Pipeline

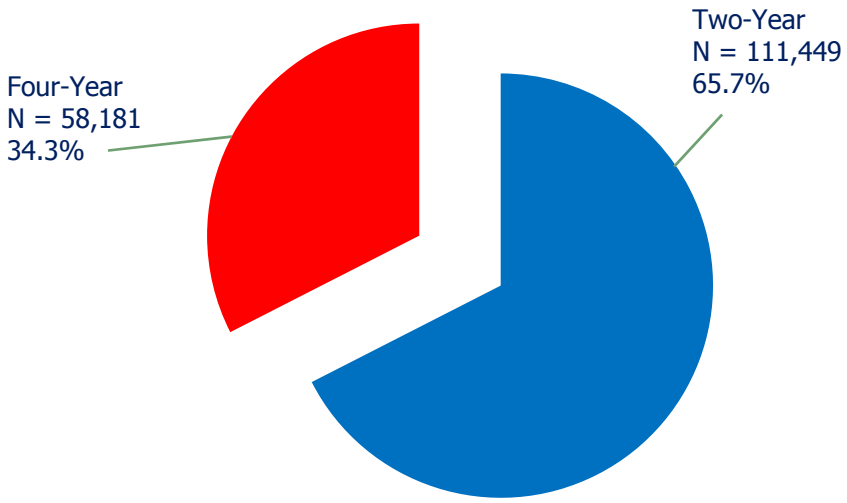
The Texas Education Pipeline – Point of Entry, Fall 2002

The data for the *Engineering Articulation Fact Book* are based on 169,630 students who first enrolled in a Texas public college or university for the 2002 fall semester. To better understand how these students progressed through the Texas public higher education pipeline, it is important to know who they were at the time they first entered college. The broader Texas education pipeline data will provide an important perspective when reviewing similar data for engineering students within this cohort.

As shown in the graph below, two-thirds of this cohort first entered a public two-year institution, and one-third entered a public four-year institution.

Because students who first enter Texas public two-year and four-year institutions have different goals, interests, and skills, it is important to review their demographic characteristics separately.

First-Time-in-College Enrollment
in Texas Public Institutions, Fall 2002 (N=169,630)

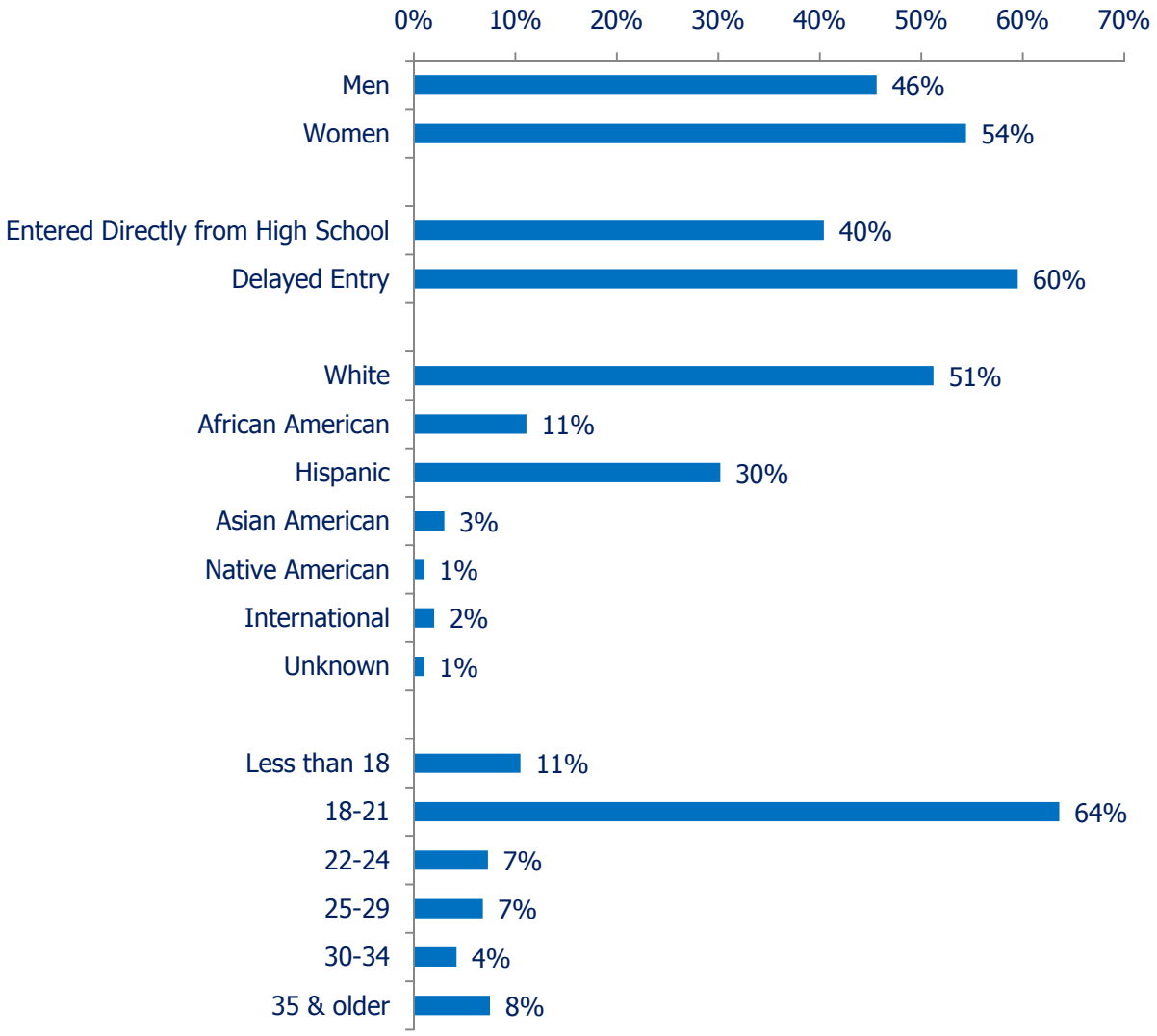


The Texas Education Pipeline – Two-Year Students (N=111,449)

The following chart summarizes the demographic profile of students who first entered a public two-year institution in Texas in fall 2002. Some points of interest include the following:

- More than half (54%) of the first-time-in-college students who entered a two-year institution were women.
- Of the students who entered a two-year institution in fall 2002, 60 percent delayed entry for one or more years after they graduated from high school.
- Slightly more than half of the two-year students were White, 30 percent were Hispanic, and 11 percent were African American.
- More than one-fourth of the two-year students were 22 years or older when they first entered a two-year institution.

Profile of Students Who First Entered a Public Two-Year Institution in Texas in Fall 2002



First-Year Enrollment Profile for Students First Entering a Public Two-Year Institution in Texas in Fall 2002

The following table summarizes dual credit earned, first-year college credits, and first-year major for students first entering a public two-year institution in Texas in fall 2002. Some points of interest include the following:

- Less than two percent of students who first entered a two-year institution earned dual credits while attending high school during the two years prior to entering college.
- Of those students earning dual credits, nearly 12 percent earned 12 or more dual credits, on average they earned 7.5 credits.
- During the first year of enrollment at a two-year institution, students attempted an average of 18.3 semester credit hours. Approximately 30 percent attempted fewer than 12 semester credit hours during their first year.
- Nearly one-third (31.2%) of the students majored in Liberal Arts and Sciences, General Studies, or Humanities during their first year.
- Nearly one-fourth (22.8%) of the students did not declare a major their first year.

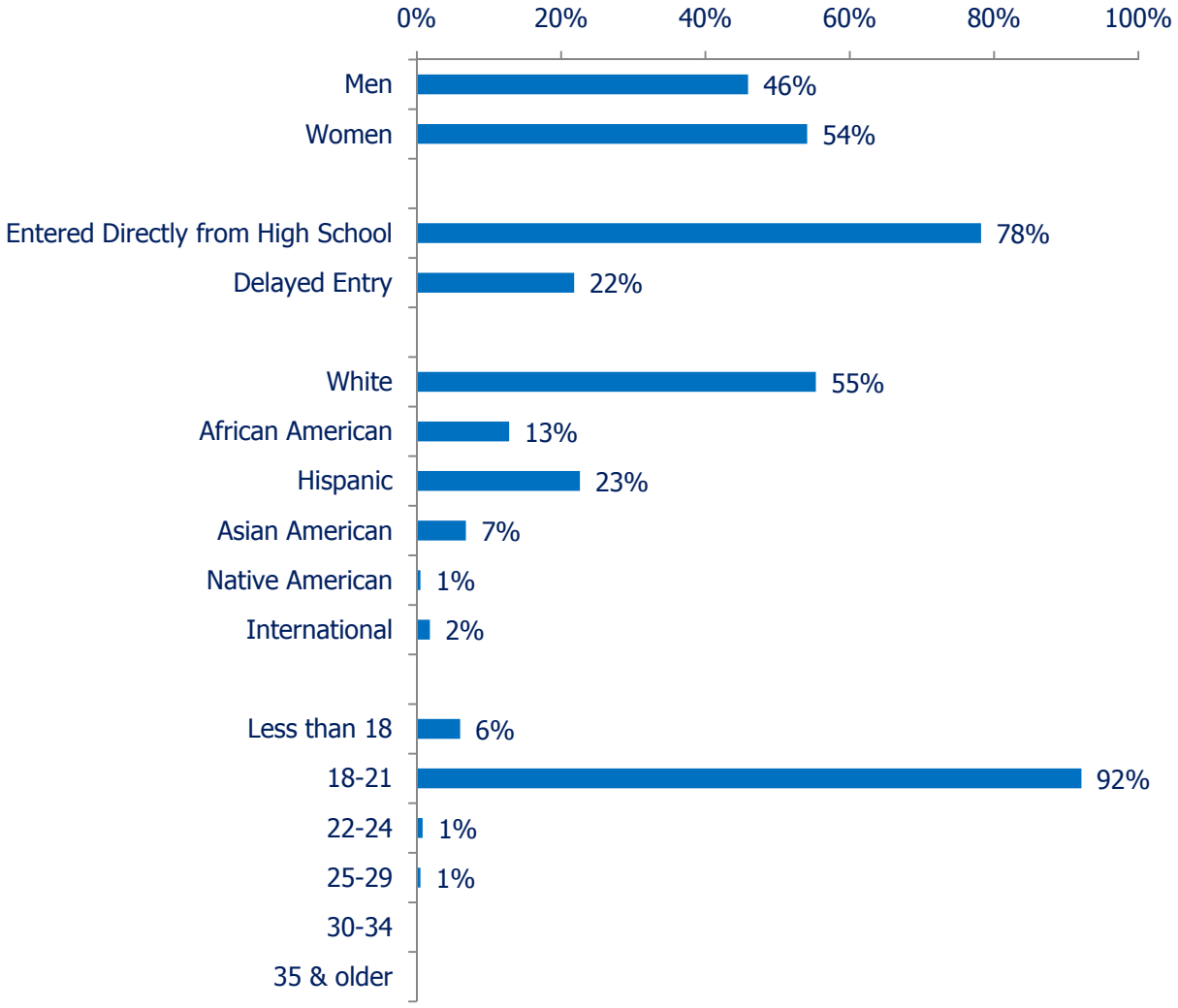
Profile of Students First Entering a Public Two-Year Institution in Texas in Fall 2002		
Dual Credits Earned in High School		
Number earning dual credit	1,629	
Percent of all two-year students with dual credit	1.5%	
If dual credit, average dual credits earned	7.5	
If dual credit, percent earning more than 12 credits	11.6%	
First-Year College Credits		
Less than 12 credits	29.6%	
12-23 credits	31.8%	
24 or more credits	38.6%	
Average First-Year Credit Load	18.3	
10 Most Popular First-Year Majors	N	%
Liberal Arts and Sciences, General Studies, and Humanities	34,735	31.2
Undeclared/Unknown	25,444	22.8
Health Professions and Related Clinical Sciences	11,487	10.3
Business, Management, Marketing, and Related Support Services	9,561	8.6
Education	4,145	3.7
Computer and Information Sciences and Support Services	3,257	2.9
Security and Protective Services	2,916	2.6
Mechanic and Repair Technologies/Technicians	2,584	2.3
Visual and Performing Arts	2,099	1.9
Engineering Technologies/Technicians	1,880	1.7

The Texas Education Pipeline – Four-Year Students (N=58,181)

The following chart summarizes the demographic profile of students who first entered a public four-year institution in Texas in fall 2002. Some points of interest include the following:

- More women (54%) than men (46%) first entered a four-year institution in fall 2002.
- More than 75 percent of the students who entered a four-year institution did so immediately following high school graduation.
- More than half (55%) of the students who entered a four-year institution were White, 23 percent were Hispanic, and 13 percent were African American.
- Nearly all (98%) of the students were under 21 years old when they first entered a four-year institution.

Profile of Students Who First Entered a Public Four-Year Institution in Texas in Fall 2002



First-Year Enrollment Profile for Students First Entering a Public Four-Year Institution in Texas in Fall 2002

The following table summarizes dual credit earned, first-year college credits, and first-year major for students first entering a public four-year institution in Texas in fall 2002. Some points of interest include the following:

- More than 9,500 students earned dual credits in the two years prior to first entering a four-year institution, about 16.5 percent.
- Of those who earned dual credits, more than 35 percent earned 12 or more dual credits or about one semester's worth of credit. The average number of dual credits earned was 9.5.
- Three-fourths of the four-year students attempted 25 or more semester credit hours their first year, for an average of 26.5 semester credit hours. Only 3.2 percent attempted less than 12 semester credit hours their first year.
- Of those who declared a major their first year, Liberal Arts and Sciences/General Studies/Humanities, Business/Management/Marketing and Related Support Services, and Engineering were the most popular.

Profile of Students First Entering a Public Four-Year Institution in Texas in Fall 2002		
Dual Credits Earned in High School		
Number earning dual credit	9,578	
Percent of all four-year students with dual credit	16.5%	
If dual credit, average dual credits earned	9.5	
If dual credit, percent earning more than 12 credits	35.9%	
First-Year College Credits		
Less than 12 credits	3.2%	
12-23 credits	13.7%	
24 or more credits	83.0%	
Average First-Year Credit Load	26.5	
10 Most Popular First-Year Majors	N	%
Undeclared/Unknown	7,535	13.0
Liberal Arts and Sciences, General Studies, and Humanities	7,073	12.2
Business, Management, Marketing, and Related Support Services	7,024	12.1
Engineering	5,227	9.0
Health Professions and Related Clinical Sciences	4,174	7.2
Biological and Biomedical Sciences	3,954	6.8
Multi/Interdisciplinary Studies	3,618	6.2
Visual and Performing Arts	2,638	4.5
Communication, Journalism, and Related Programs	2,221	3.8
Psychology	2,121	3.6

Summary: The Texas Education Pipeline

For purposes of this study, students who pursued an engineering degree were part of a larger cohort of students who first entered a Texas public college or university in fall semester 2002. Understanding the characteristics of this larger cohort (N=169,630) with whom the engineering students first started college provides a background perspective for how engineering students might be similar to and how they might be different from other college students. Because a major goal of this report is to compare engineering students who started at a public two-year institution with engineering students who started at a public four-year institution, this section compares the statewide cohort of students in the same way.

The statewide cohort of students who first entered a public two-year institution in fall 2002 were quite similar to the students who started at a public four-year institution in terms of gender and ethnicity, although a slightly higher percentage of students starting at the public two-year institutions were Hispanic (30%) than were found at four-year institutions (23%). Students who started at a two-year institution were somewhat older – more than one-fourth were older than 21 years old, compared with almost none of the four-year students, and they were less likely to start college immediately following high school (40%) than their four-year counterparts (78%).

Students who started at a public two-year institution were less likely to have taken any dual credits in high school during the two years prior to starting college (less than 2%) than students who started at a public four-year institution (nearly 17%). During the first year of college, students who started at a two-year institution were more likely to start as part-time students, more than 6 out of 10, compared with fewer than one-fourth of the students who started part-time at a four-year institution. The average semester credit load for the first year was about 18 semester credit hours for two-year students and 27 semester credit hours for four-year students. More than twice as many two-year students declared Liberal Arts, General Studies, or Humanities majors, or were undecided (54%), compared with 25 percent of the four-year students.

The Texas Engineering Cohort

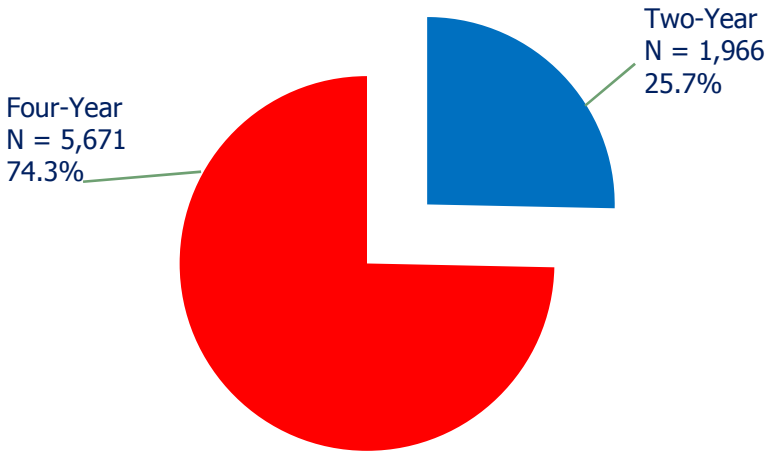
The Engineering Pipeline-Point of Entry, Fall 2002

To understand the students who pursue engineering degrees, we must examine where they start their college studies. The cohort of engineering students for this *Engineering Articulation Fact Book* was defined by (1) students who earned an engineering degree; and (2) students who majored in engineering at any time between fall 2002 and summer 2008. The engineering cohort for this study consisted of 7,637 students who met these criteria.

The graphs and tables below summarize information regarding where these students started their college studies and provide an overview of students' demographic characteristics the first year they enrolled in a Texas public higher education institution.

As shown in the graph below, one-fourth of the students in the engineering cohort started their college studies at a two-year institution.

Type of Public Institution First Entered by Engineering Cohort (N=7,637)

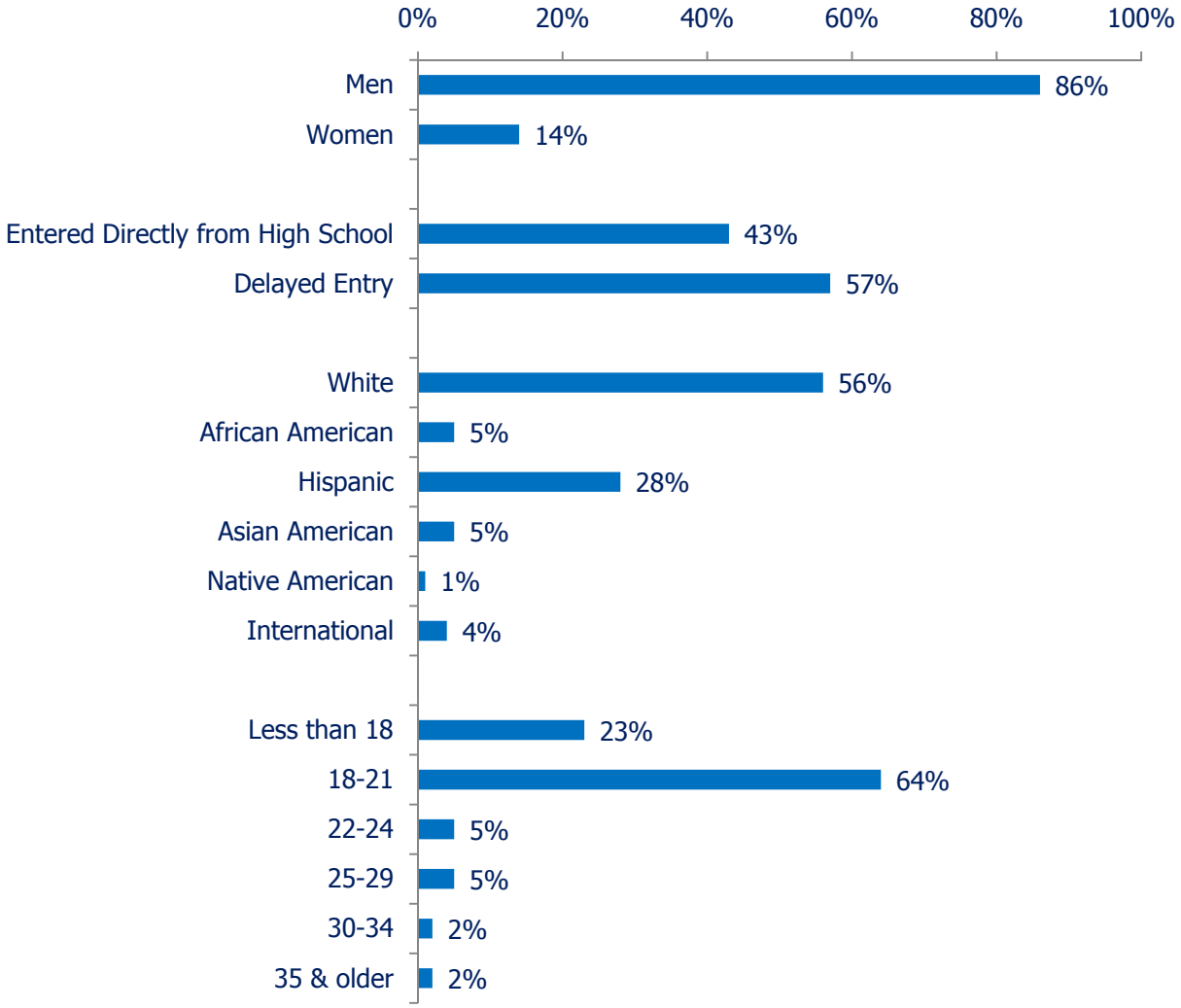


Engineering Students Who First Entered a Public Two-Year Institution in Texas in Fall 2002 (N=1,966)

The following graph summarizes the demographic profile of engineering students who first entered a public two-year institution in Texas in fall 2002. Some points of interest include the following:

- A majority of the students starting their engineering studies at a two-year institution were men (86%).
- More than half of the students (57%) delayed starting college immediately after high school graduation.
- More than half (56%) of the students were White, and more than a fourth (28%) were Hispanic.
- Nearly 87 percent of these students were under 22 years of age when they first entered a two-year institution.

Profile of Engineering Students Who First Entered a Public Two-Year Institution in Texas in Fall 2002



First-Year Enrollment Profile for Engineering Students First Entering a Public Two-Year Institution in Texas in Fall 2002 (N= 1,966)

The following table summarizes dual credits earned, first-year college credits, and first-year major for engineering students first entering a public two-year institution in Texas in fall 2002. Some points of interest include the following:

- Less than 5 percent of the engineering students who started at a two-year institution earned dual credits in the two years prior to high school graduation.
- Of those students who earned dual credits, on average they earned nearly nine semester credit hours while in high school.
- Nearly 60 percent of these engineering students attempted 24 or more semester credit hours their first year.
- The most popular first-year majors for students who eventually pursued engineering studies were Engineering (31.0%); Liberal Arts and Sciences, General Studies, and Humanities (29.8%); and an undeclared major (18.8%).

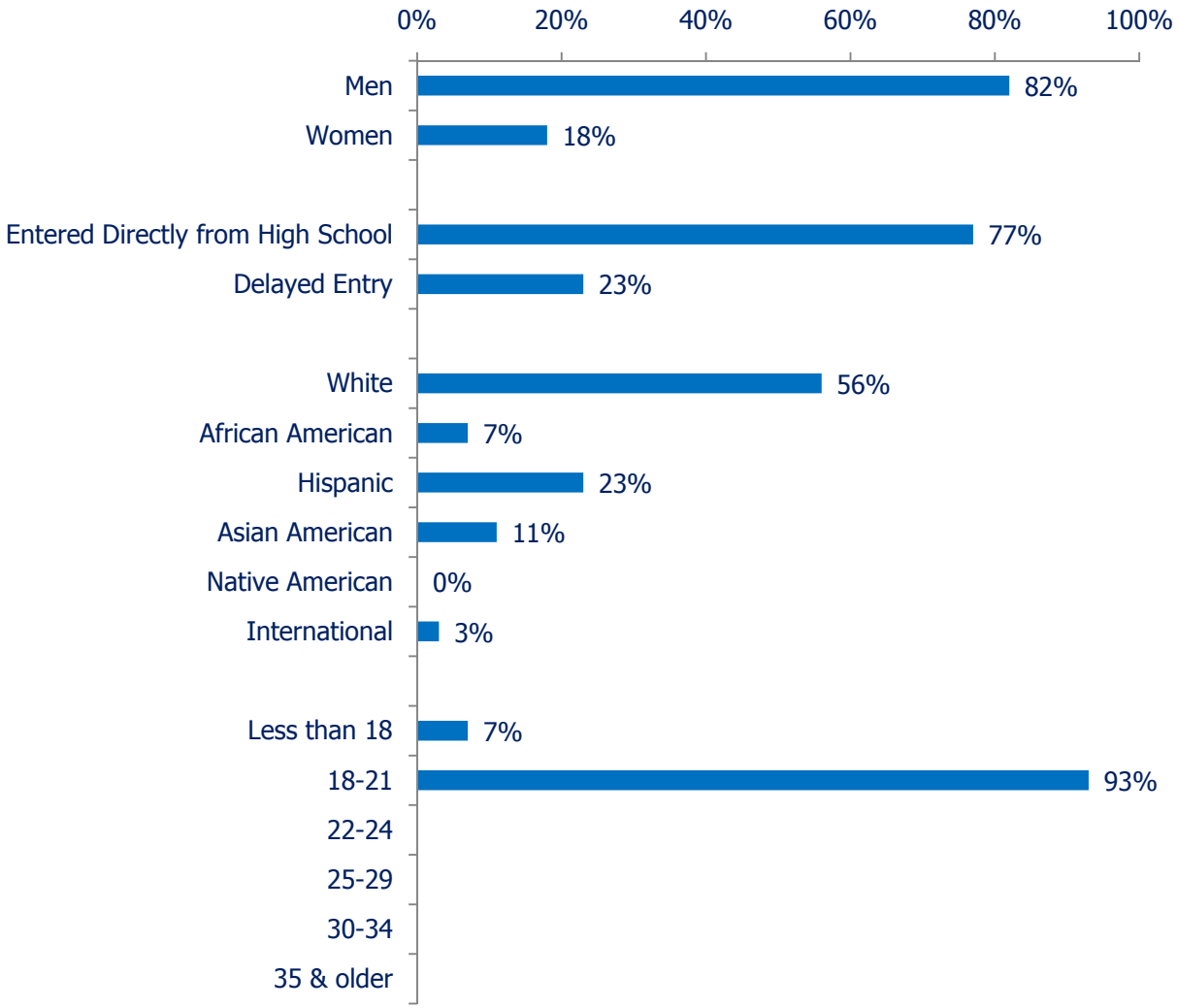
Profile of Engineering Students First Entering a Public Two-Year Institution in Texas in Fall 2002		
Dual Credits Earned in High School		
Number earning dual credit	89	
Percent of all students with dual credit	4.5%	
If dual credit, average dual credits earned	8.8	
If dual credit, percent earning more than 12 credits	18.0%	
First-Year College Credits		
Less than 12 credits	17.6%	
12-23 credits	24.0%	
24 or more credits	58.4%	
Average First-Year Credit Load	23.4	
Five Most Popular First-Year Majors	N	%
Engineering	609	31.0
Liberal Arts and Sciences, General Studies, and Humanities	585	29.8
Undeclared	369	18.8
Computer and Information Sciences and Support Services	74	3.8
Engineering Technologies/Technicians	56	2.8

Engineering Students Who First Entered a Public Four-Year Institution in Texas in Fall 2002 (N=5,671)

The following graph summarizes the demographic profile of engineering students who first entered a public four-year institution in Texas in fall 2002. Some points of interest include the following:

- More than 80 percent of the engineering students who first entered a four-year institution were men.
- More than three-fourths of these students started college immediately following their high school graduation.
- More than half (56%) of these students were White, nearly one-fourth (23%) were Hispanic, and 11 percent were Asian American.
- All of the students entering a four-year institution were 21 years old or younger.

Profile of Engineering Students Who First Entered a Public Four-Year Institution in Texas in Fall 2002



First-Year Enrollment Profile for Engineering Students First Entering a Public Four-Year Institution in Texas in Fall 2002 (N=5,671)

The following table summarizes dual credits earned, first-year college credits, and first-year major for engineering students first entering a public four-year institution in Texas in fall 2002. Some points of interest include the following:

- Nearly one engineering student in five (19.7%) who first entered a four-year institution earned dual credits in the two years prior to high school graduation.
- On average, these students earned about 10 semester credit hours while in high school.
- During the first year at a four-year institution, on average, students attempted nearly 33 semester credit hours.
- The most popular first-year majors were Engineering (82.4%); an undeclared major (5.0%); and Liberal Arts and Sciences, General Studies, and Humanities (4.1%).

Profile of Engineering Students First Entering a Public Four-Year Institution in Texas in Fall 2002		
Dual Credits Earned in High School		
Number earning dual credit	1,116	
Percent of all students with dual credit	19.7%	
If dual credit, average dual credits earned	10.3	
If dual credit, percent earning more than 12 credits	27.4%	
First-Year College Credits		
Less than 12 credits	0.4%	
12-23 credits	5.2%	
24 or more credits	94.4%	
Average First-Year Credit Load	32.7	
Five Most Popular First-Year Majors	N	%
Engineering	4,674	82.4
Undeclared	281	5.0
Liberal Arts and Sciences, General Studies, and Humanities	234	4.1
Business, Management, Marketing and Related Support Services	58	1.0
Engineering Technologies/Technicians	51	0.9

Summary: The Texas Engineering Cohort

Of the 169,630 students who first entered Texas public two-year and four-year institutions in fall 2002, only 7,637 or 4.5 percent declared an engineering major at any time in the six years that followed. About one-fourth of the students declaring an engineering major started at a two-year institution. The students who pursued an engineering degree were predominately male (more than 80%) at both the two-year and four-year institutions. More of the students (about 12%) who started at a two-year institution were more than 21 years old, compared with less than one percent of the engineering students who started at a four-year institution. The ethnic distribution of two-year and four-year engineering students was similar, although a slightly higher percentage of Hispanic students started at two-year institutions, and a slightly higher percentage of Asian American students started at four-year institutions.

While relatively small percentages of either two- or four-year engineering students earned dual credits in high school, more of the engineering students who started at a public four-year institution had dual credits, nearly one student in five, compared with only 5 percent of those who first entered a public two-year institution. During the first year of college, engineering students at the two-year institutions were more likely to be part-time, more than 40 percent, compared with only 5 percent of the engineering students at the four-year institutions. While four-year engineering students completed about 33 semester credit hours their first year, students at two-year institutions completed 23 semester credit hours on average. Since many engineering students who started at two-year institutions did not declare a major in engineering because a program did not exist on their campus, it is not surprising that more of them did not declare any major or started in Liberal Arts, General Studies, and Humanities than their four-year counterparts who overwhelmingly chose engineering as a major their first year, more than 80 percent.

Degree Completion: Texas Engineering Cohort

Engineering Cohort Enrollment History

A primary goal of this study is to compare the education pathways of engineering students who started at public two-year institutions with those who started at public four-year institutions. Because students do not necessarily attend a single institution or graduate from the institution where they first enrolled, it is important to define how students progress from their point of entry to their endpoint, either earning a degree within six years or leaving higher education before earning a degree.

To define these pathways, all students who were enrolled as an engineering major at any time during the six-year period between fall semester 2002 and summer semester 2008 were identified. Next, the type of institution where the student started (two-year or four-year) was noted, and finally, the degree attainment of each engineering student in this cohort was identified as (1) a mechanical engineering degree; (2) a degree in another engineering discipline; (3) a degree in a field other than engineering; and (4) no bachelor's degree earned.

Students who were enrolled as an engineering major for one or more semesters and did not earn a degree in engineering were labeled as pass-through engineering. These students may or may not have started in engineering, and they may or may not have enrolled as an engineering major at the time they left the institution, with or without a degree. However, at some point during the six-year time period of this study these students enrolled as an engineering major and were included in the engineering cohort.

Engineering Cohort Degree Completion

A total of 7,637 students pursued an engineering degree between fall semester 2002 through summer semester 2008. This section summarizes how many students earned a bachelor's degree in engineering or another discipline, an associate's degree, or a certificate. Included in the table on the following page are a definition of each education outcome group, the number of students who were in each group, and the number of degrees and certificates earned.

Overall, the engineering cohort earned a total of 4,055 bachelor's degrees, 422 associate's degrees, and 69 certificates. Some students earned more than one type of degree, and not all degrees earned were in the field of engineering.

The following trends are noted:

- The majority of bachelor's degrees (3,539 of 4,055, or 87%) were earned by engineering cohort students who started at a four-year institution.
- More than 500 bachelor's degrees were earned by engineering cohort students who transferred from a two-year institution. Of these, 314 (61%) were engineering degrees.
- Relatively small numbers of the engineering cohort earned associate's degrees, although a majority (75%) of these degrees were earned by students who first entered a two-year institution.

Number of Degrees Earned by Students in each Education Outcome Group within the Engineering Cohort							
Initial Inst	**Degree Major**	**Degree Status**	**Definition**	**Group Size**	**Bach**	**Assoc**	**Cert**
Two-Year	Mech Eng	Bach Degree	Students who started at a public two-year institution and earned a bachelor's degree in mechanical engineering	85	85	13	0
Two-Year	Other Eng	Bach Degree	Students who started at a public two-year institution and earned a bachelor's degree in another engineering discipline	229	229	31	1
Four-Year	Mech Eng	Bach Degree	Students who started at a public four-year institution and earned a bachelor's degree in mechanical engineering	564	564	0	0
Four-Year	Other Eng	Bach Degree	Students who started at a public four-year institution and earned a bachelor's degree in another engineering discipline	1,688	1,688	2	0
Two-Year	Pass-Thru Eng	Bach Degree	Students who started at a public two-year institution and were enrolled one or more semesters as an engineering major, but earned a bachelor's degree in a non-engineering field	202	202	31	4
Four-Year	Pass-Thru Eng	Bach Degree	Students who started at a public four-year institution and were enrolled one or more semesters as an engineering major, but earned a bachelor's degree in a non-engineering field	1,287	1,287	12	0
Two-Year	Pass-Thru Eng	No Bach Degree	Students who started at a public two-year institution and were enrolled one or more semesters as an engineering major, but did not earn a bachelor's degree	1,450	0	239	35
Four-Year	Pass-Thru Eng	No Bach Degree	Students who started at a public four-year institution and were enrolled one or more semesters as an engineering major, but did not earn a bachelor's degree	2,132	0	94	29
Total				7,637	4,055	422	69

The table below shows the number and percent of the engineering cohort who completed a bachelor's or associate's degree between fall 2002 through summer 2008. The following trends are noted:

- Of the 1,966 students who started at a two-year institution and pursued an engineering degree at some point in their education studies, 85 students (4.3%) earned a bachelor's degree in mechanical engineering, 229 students (11.6%) earned a bachelor's degree in another engineering discipline, and 202 students (10.3%) earned a degree in a non-engineering field.

- Nearly three-fourths (73.8%) of the engineering cohort students who started at a two-year institution did not earn a bachelor's degree in any field.

- Of the 5,671 engineering cohort students who started at a four-year institution, 564 (9.9%) earned a bachelor's degree in mechanical engineering, 1,688 students (29.8%) earned a bachelor's degree in another engineering discipline, and 1,287 students (22.7%) earned a bachelor's degree in a non-engineering field.

- Nearly 40 percent of the engineering cohort who started at a four-year institution did not earn a bachelor's degree in any field.

- Of the engineering cohort students who started at a two-year institution, more than 300 (15.5%) earned an associate's degree, while less than 100 students (1.7%) who started at a four-year institution earned an associate's degree.

Number and Percent of Students in each Education Outcome Group within the Engineering Cohort Who Completed a Bachelor's or Associate's Degree

	Group Size	Completed Mech Eng Degree		Completed Other Eng Degree		Completed Non-Eng Degree		No Bach Degree		Completed Assoc Degree	
	N	N	%	N	%	N	%	N	%	N	%
Two-Year	1,966	85	4.3%	229	11.6%	202	10.3%	1,450	73.8%	304	15.5%
Four-Year	5,671	564	9.9%	1,688	29.8%	1,287	22.7%	2,132	37.6%	98	1.7%
All	7,637	649	8.5%	1,917	25.1%	1,489	19.5%	3,582	46.9%	402	5.3%

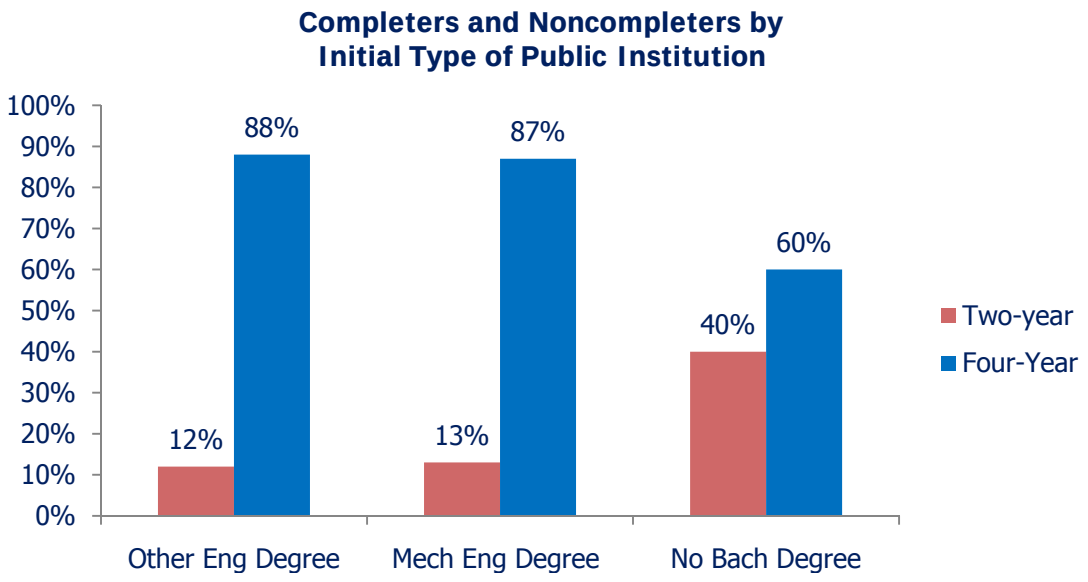
Some students in the engineering cohort earned more than one type of degree – some combination of a bachelor's degree, an associate's degree, and/or a program certificate. The following trends are noted:

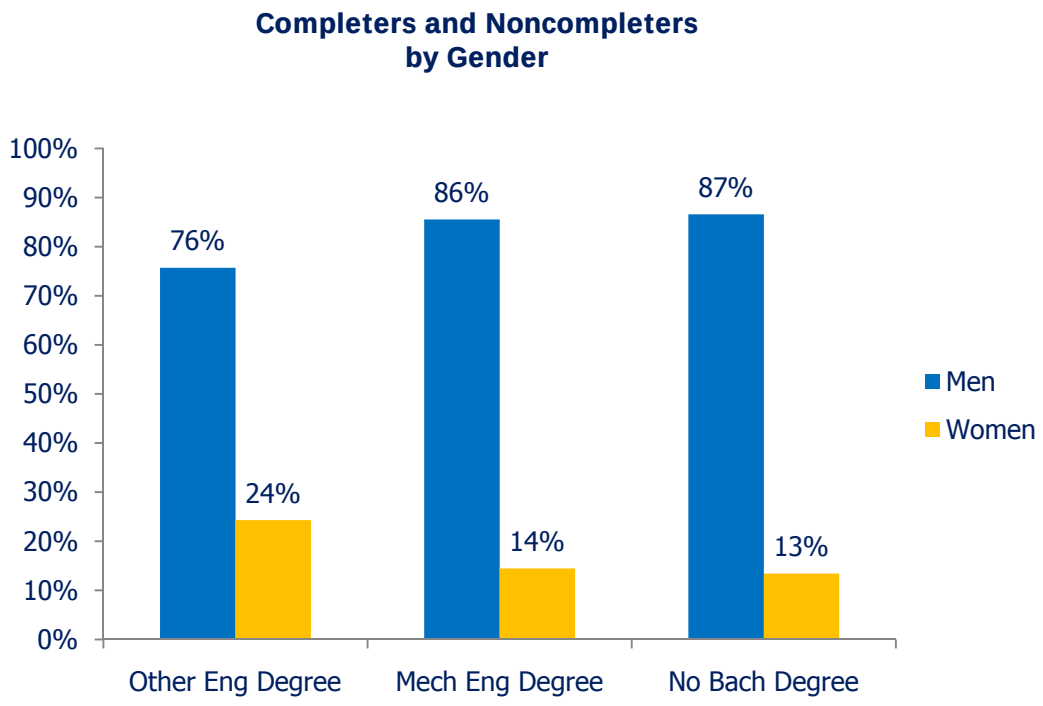
- More than half of the students (52.0%) earned a bachelor's degree and no other degree or certificate.
- More than 300 students (4.0%) earned an associate's degree and no other degree or certificate.
- Eighty-five (1.1%) students earned a bachelor's degree and an associate's degree.
- Sixty-nine (0.9%) students earned multiple awards in various combinations of the bachelor's degree, the associate's degree, and a program certificate.

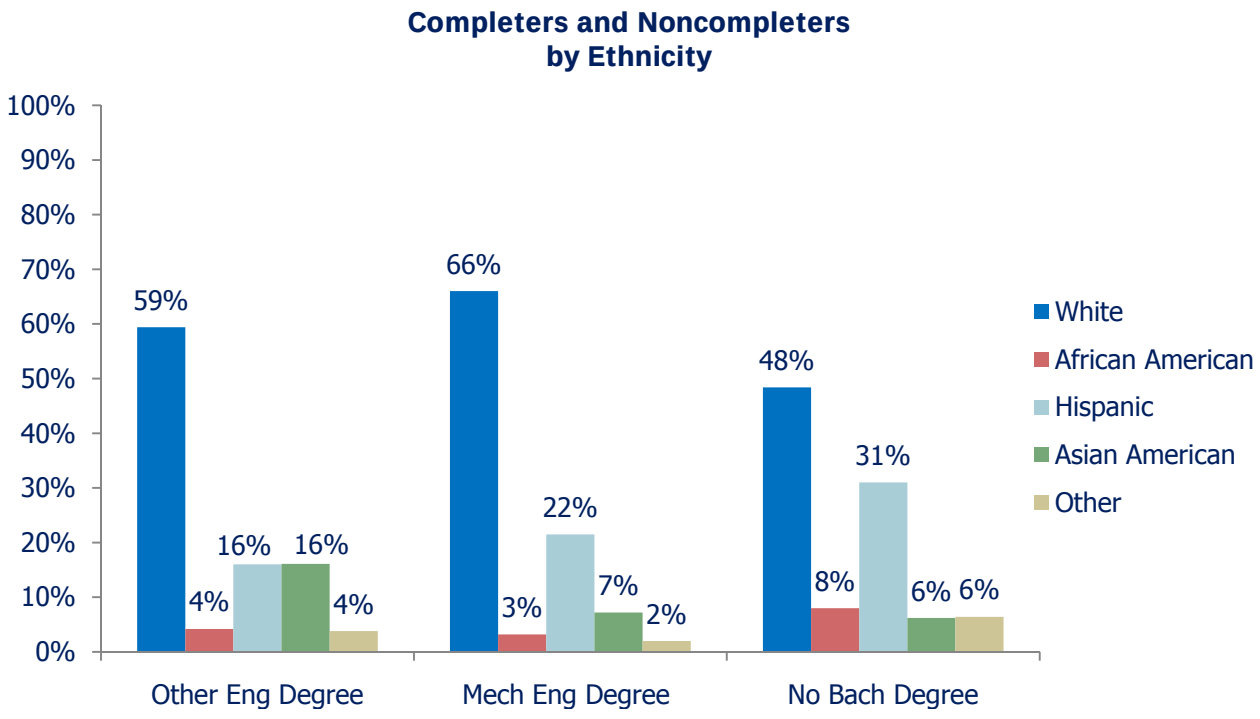
Who Completed an Engineering Degree?

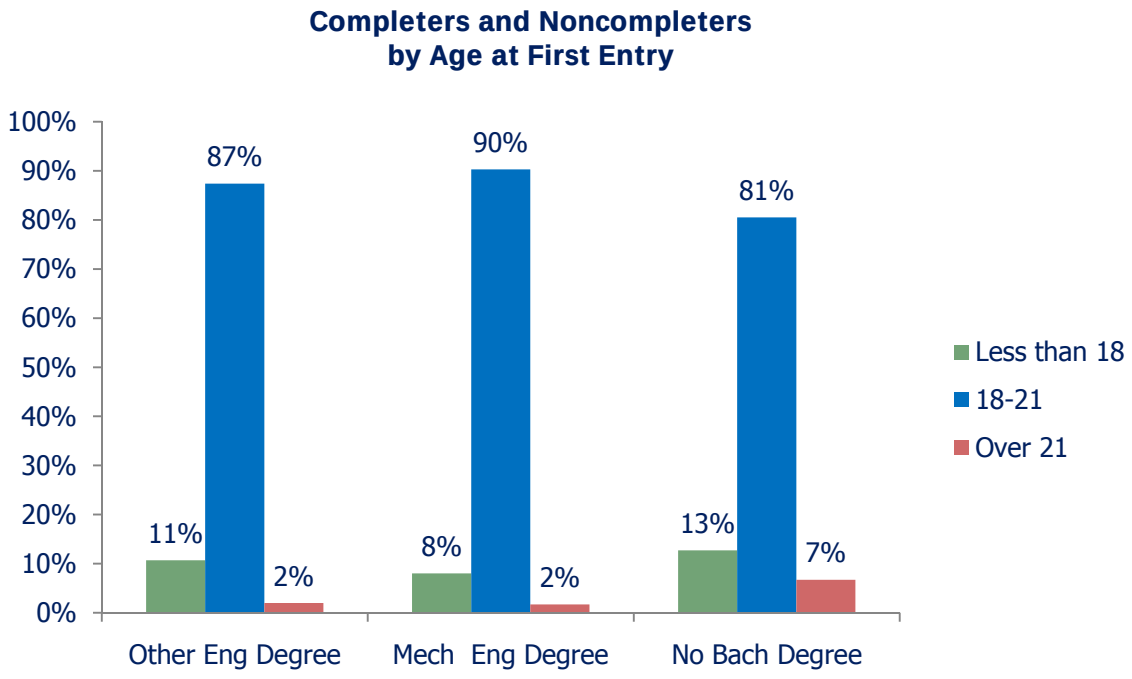
Not all students who pursue an engineering degree complete the program. To better understand the characteristics of successful completers, a comparison of completers and non-completers is shown in the graphs below. Students from the engineering cohort who completed either a bachelor's degree in mechanical engineering or a bachelor's degree in another engineering discipline differed from students who did not complete a bachelor's degree in any field in the following ways:

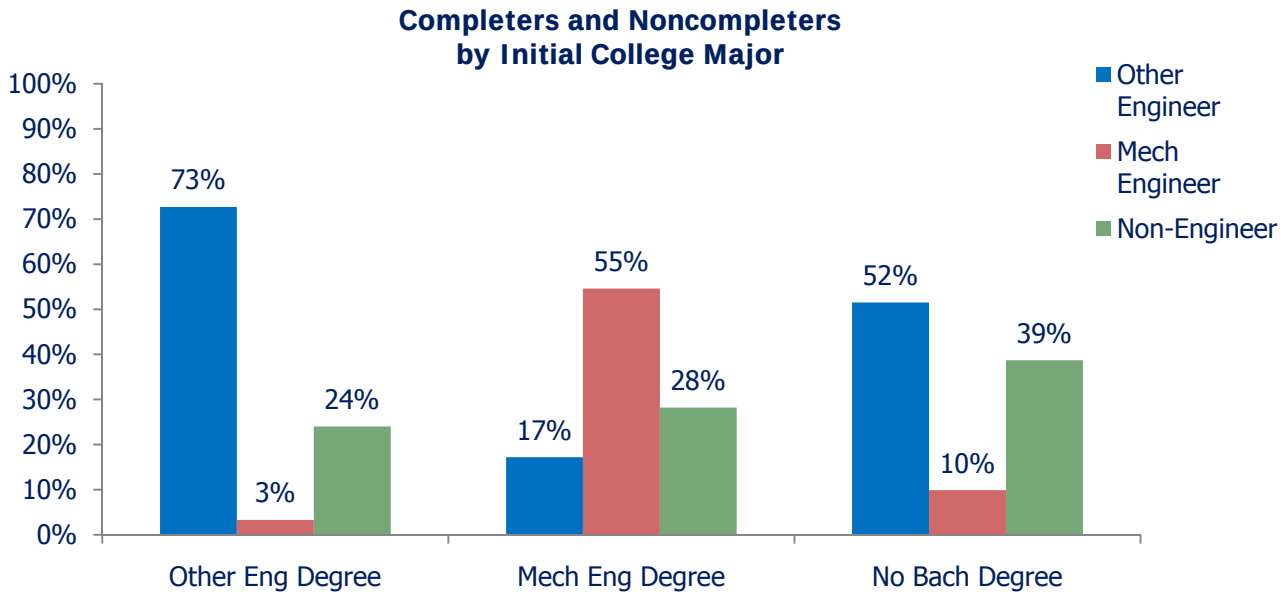
- A larger proportion of the students who did not complete a bachelor's degree (40%) started at a two-year institution than students who earned a mechanical engineering degree (13%) or other engineering degree (12%).
- Women earned a larger proportion of other engineering degrees (24%) than women earning mechanical engineering degrees (14%).
- A larger proportion of Hispanic (31%) and African American (8%) students were found in the non-completers group than in either the other engineering group (16% and 4% respectively) or the mechanical engineering group (22% and 3% respectively).
- There were more Asian American students in the other engineering group (16%) than either the mechanical engineering (7%) or non-completer groups (6%).
- More of the non-completers were over 21 years old when they started college (7%) than either of the engineering groups (2%).
- Approximately one-fourth of mechanical engineering (28%) and other engineering (24%) students started in a non-engineering major their first year of college.


Completers and Noncompleters by
Initial Type of Public Institution
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
88%
87%
60%
40%
12%
13%
Other Eng Degree
Mech Eng Degree
No Bach Degree
Two-year
Four-Year


Completers and Noncompleters
by Gender
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
76%
86%
87%
24%
14%
13%
Other Eng Degree
Mech Eng Degree
No Bach Degree
Men
Women


Completers and Noncompleters
by Ethnicity
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
59%
4%
16%
16%
4%
66%
3%
22%
7%
2%
48%
8%
31%
6%
6%
Other Eng Degree
Mech Eng Degree
No Bach Degree
White
African American
Hispanic
Asian American
Other


Completers and Noncompleters
by Age at First Entry
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
11%
87%
2%
8%
90%
2%
13%
81%
7%
Other Eng Degree
Mech Eng Degree
No Bach Degree
Less than 18
18-21
Over 21



Summary: Degree Completion

While the engineering cohort was defined as those students who declared an engineering major at some point during the six years from fall semester 2002 through summer semester 2008, not all of the students completed a bachelor's degree. Among those who did earn a bachelor's degree, not all of them earned a degree in either mechanical engineering or other engineering discipline. The primary interest was in how this cohort of prospective engineers progressed toward the bachelor's degree, and to what extent the pathway was different for students who started at public two-year and public four-year institutions.

Overall, more of the students who declared an engineering major did not earn an engineering degree (5,071) than those who did (2,566), by nearly a two-to-one ratio.

Of the students who started at a public two-year institution, only one student in six, or about 16 percent, earned a bachelor's degree in either mechanical engineering or some other engineering discipline. Another 10 percent earned a bachelor's degree in a non-engineering field, but nearly three-fourths of the students did not earn a bachelor's degree in any field. In addition, only one student in six who started at a two-year institution earned an associate's degree.

In contrast, nearly 40 percent of the students who started at a public four-year institution completed a bachelor's degree in either mechanical engineering or other engineering discipline, and another 23 percent earned a bachelor's degree in a non-engineering field. Approximately 38 percent of the students who started at a four-year institution did not earn a degree in any field.

The majority of bachelor's degrees in engineering were earned by students who started at a public four-year institution. While 75 percent of the students in the engineering cohort started at a four-year institution, they earned 88 percent of the engineering degrees. The 25 percent of the engineering cohort students who started at a public two-year institution earned 12 percent of the engineering degrees.

Time-to-Degree: Texas Engineering Cohort

How Much Time and Effort are Invested Earning a Bachelor's Degree in Engineering?

Engineering students invest time and effort earning their bachelor's degrees. The amount of time can be measured in terms of the number of fall, spring, and summer semesters enrolled, and the effort invested can be summarized by the number of semester credit hours they attempted over the six years. In addition, the amount of time can be measured in terms of the number of students who earn their degrees in four, five, or six years from the date of their initial enrollment.

In this study, semester credit hours were categorized into three types based on the number of semester credit hours attempted as (1) a mechanical engineering major; (2) another engineering major; and (3) a non-engineering major. In addition, the semester credit hours attempted also were categorized according to where the semester credit hours were attempted, at a public two-year or public four-year institution.

Degrees Earned in Four, Five, and Six Years

Students vary in the amount of time it takes to earn a bachelor's degree. The table below summarizes the rate, defined as the number of years from start to finish, at which students in the engineering cohort completed their bachelor's degree. The following trends are evident.

Of the students who first started at a public two-year institution:

- Less than 4 percent (3.5%) earned a bachelor's degree in mechanical engineering in four years or less; 10 percent earned a degree in another engineering discipline in the same amount of time.

- About one-third (31%) of the mechanical and other engineering students earned a bachelor's degree during the fifth year after initial enrollment in fall 2002.

- Two-thirds (65.9%) of the mechanical engineering students and 59 percent of the other engineering students earned a bachelor's degree in their sixth year of enrollment.

- Students who earned a non-engineering degree generally took less time to earn their degree – nearly 45 percent completed their degree by the fifth year, compared with 34 percent of the mechanical engineering students and 41 percent of the other engineering students.

Of the students who first started at a public four-year institution:

- Nearly 30 percent of the mechanical engineering degrees and 40 percent of the other engineering degrees were earned in four years or less.

- More than half (53.7%) of the mechanical engineering degrees and nearly half (47.0%) of the other engineering degrees were earned in the fifth year of enrollment.

- Less than one-fifth of the mechanical engineering degrees (17.2%) and the other engineering degrees (13.8%) were earned in the sixth year of enrollment.

- Students who earned a non-engineering degree took slightly longer – one-fourth (24.6%) completed their degree in the sixth year, compared with 17.2 percent of the mechanical engineering students and 13.8 percent of the other engineering students.

Number and Percent of Students in each Education Outcome Group within the Engineering Cohort Who Completed a Bachelor's Degree in Four, Five, or Six Years								
			4 Years or Less		5 Years		6 Years	
Initial Inst	Degree Major	Degree Status	N	%	N	%	N	%
Two-Year	Mech Eng	Bach Degree	3	3.5%	26	30.6%	56	65.9%
Two-Year	Other Eng	Bach Degree	23	10.0%	71	31.0%	135	59.0%
Four-Year	Mech Eng	Bach Degree	164	29.1%	303	53.7%	97	17.2%
Four-Year	Other Eng	Bach Degree	661	39.2%	794	47.0%	233	13.8%
Two-Year	Pass-Thru Eng	Bach Degree	13	6.4%	77	38.1%	112	55.4%
Four-Year	Pass-Thru Eng	Bach Degree	337	26.2%	634	49.3%	316	24.6%
All			1,201	29.6%	1,905	47.0%	949	23.4%

Semesters Spent at Public Two-Year Institutions

A majority of the engineering cohort students who started at a public two-year or a public four-year institution enrolled in more than one institution during their pursuit of an engineering degree (76.2% and 67.7% respectively). To accurately summarize the amount of time they spent at each type of institution, the number of fall, spring, and summer semesters are summarized separately within two-year and four-year institutions.

The table and graph on the following pages show the average number of semesters students in the engineering cohort spent enrolled in public two-year institutions according to their education outcome status group. The following trends are noted:

For students who started at a public two-year institution:

- Mechanical engineering and other engineering students spent, on average, about 5 total semesters enrolled in two-year institutions, counting all fall, spring, and summer semesters.

- Students who pursued an engineering degree, but did not earn one, spent on average 6.5 semesters enrolled in two-year institutions.

For students who started at a public four-year institution:

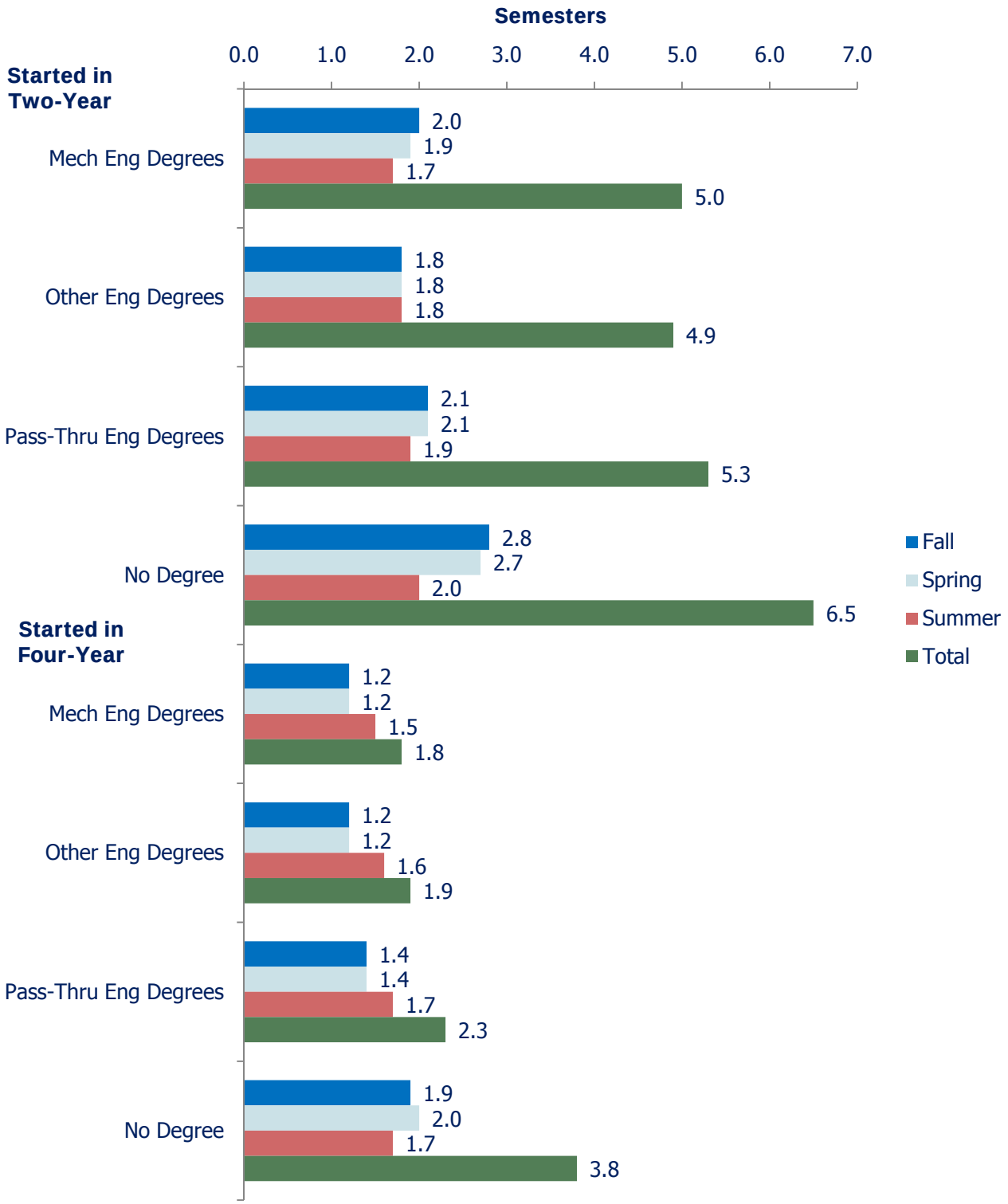
- Students who earned a bachelor's degree in mechanical engineering or another engineering discipline spent, on average, less than 2 semesters (1.8 semesters for mechanical engineering and 1.9 semesters for other engineering) enrolled in two-year institutions.

- Students who pursued an engineering degree but did not complete either an engineering degree or any other bachelor's degree spent nearly twice as much time enrolled in two-year institutions (3.8 semesters).

- Students who pursued an engineering degree but who earned a bachelor's degree in a non-engineering field spent 2.3 semesters, on average, enrolled in two-year institutions.

Average Semesters Spent at Public Two-Year Institutions by Students in each Education Outcome Group within the Engineering Cohort										
			Fall Semesters		Spring Semesters		Summer Semesters		Total Semesters	
Initial Inst	Degree Major	Degree Status	# Stu	Mean Sem	# Stu	Mean Sem	# Stu	Mean Sem	# Stu	Mean Sem
Two-Year	Mech Eng	Bach Degree	84	2.0	80	1.9	63	1.7	85	5.0
Two-Year	Other Eng	Bach Degree	228	1.8	210	1.8	180	1.8	229	4.9
Four-Year	Mech Eng	Bach Degree	69	1.2	79	1.2	288	1.5	337	1.8
Four-Year	Other Eng	Bach Degree	192	1.2	257	1.2	971	1.6	1,079	1.9
Two-Year	Pass-Thru Eng	Bach Degree	200	2.1	189	2.1	140	1.9	202	5.3
Four-Year	Pass-Thru Eng	Bach Degree	216	1.4	293	1.4	767	1.7	849	2.3
Two-Year	Pass-Thru Eng	No Bach Degree	1,442	2.8	1,344	2.7	870	2.0	1,450	6.5
Four-Year	Pass-Thru Eng	No Bach Degree	853	1.9	866	2.0	884	1.7	1,258	3.8
All			3,284	2.2	3,318	2.1	4,163	1.7	5,489	3.9

Average Semesters Spent at Public Two-Year Institutions by Students in each Education Outcome Group within the Engineering Cohort



Semesters Spent at Public Four-Year Institutions

The table and graph on the following pages show the average number of semesters students in the engineering cohort spent enrolled in public four-year institutions according to their education outcome status group. The following trends are noted:

For students who started at a public two-year institution:

- Students who earned a bachelor's degree in mechanical or other engineering discipline spent, on average, about 9 semesters enrolled in four-year institutions (9.3 semesters for mechanical engineering and 9.0 semesters for other engineering).

- Students who pursued an engineering degree but who earned a bachelor's degree in a non-engineering field spent less time enrolled in a four-year institution, about 8.8 total semesters.

- Students who pursued an engineering degree but did not earn a bachelor's degree in any field spent, on average, about 5.5 semesters enrolled in a four-year institution.

For students who started at a public four-year institution:

- On average, mechanical engineering students spent 10.9 total semesters, and other engineering students spent about 10.4 semesters, enrolled in a four-year institution.

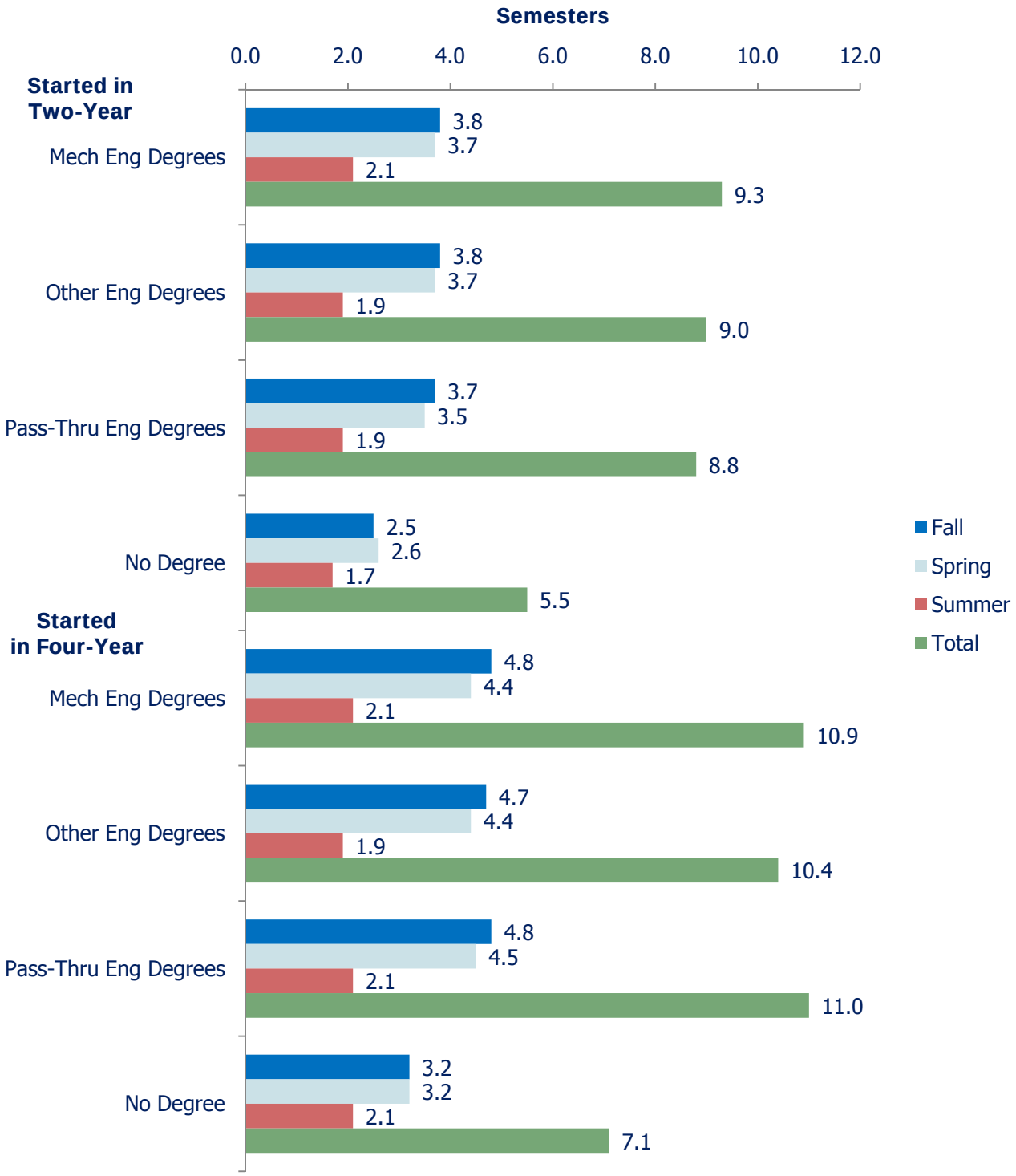
- Students who earned a non-engineering bachelor's degree spent, on average, about 11.0 semesters enrolled in a four-year institution.

- Students who did not earn a bachelor's degree in any field spent, on average, about 7.1 semesters enrolled in a four-year institution.

Average Semesters Spent at Public Four-Year Institutions by Students in each Education Outcome Group within the Engineering Cohort										
			Fall Semesters		Spring Semesters		Summer Semesters		Total Semesters	
Initial Inst	Degree Major	Degree Status	# Stu	Mean Sem	# Stu	Mean Sem	# Stu	Mean Sem	# Stu	Mean Sem
Two-Year	Mech Eng	Bach Degree	85	3.8	85	3.7	73	2.1	85	9.3
Two-Year	Other Eng	Bach Degree	229	3.8	229	3.7	181	1.9	229	9.0
Four-Year	Mech Eng	Bach Degree	564	4.8	564	4.4	465	2.1	564	10.9
Four-Year	Other Eng	Bach Degree	1,688	4.7	1,688	4.4	1,268	1.9	1,688	10.4
Two-Year	Pass-Thu Eng	Bach Degree	202	3.7	202	3.5	169	1.9	202	8.8
Four-Year	Pass-Thru Eng	Bach Degree	1,287	4.8	1,287	4.5	1,083	2.1	1,287	11.0
Two-Year	Pass-Thru Eng	No Bach Degree	821	2.5	776	2.6	458	1.7	866	5.5
Four-Year	Pass-Thru Eng	No Bach Degree	2,129	3.2	1,946	3.2	1,025	2.1	2,132	7.1
All			7,005	3.9	6,777	3.8	4,722	2.0	7,053	8.9

Note: The total student count for the time spent at four-year institutions does not add up to the total cohort size (7,637) because only some of the 1,450 pass-through engineering students who started at a two-year institution actually took any credits at four-year institutions. Thus, there were 584 students who started at a two-year institution and pursued an engineering degree but never spent any time at four-year institutions. All other students spent at least some time at four-year institutions.

Average Semesters Spent in Public Four-Year Institutions by Students in each Education Outcome Group within the Engineering Cohort



How Many Semester Credit Hours Do Students Attempt?

Because many students in the engineering cohort enrolled in both public two-year and public four-year institutions, and may have been enrolled in more than one major, the number of semester credit hours were categorized into three groups by (1) semester credit hours attempted as a mechanical engineering major; (2) semester credit hours attempted as another engineering major; and (3) semester credit hours attempted as a non-engineering major. To summarize the total semester credit hours attempted, a weighted average was calculated based on these three types of semester credit hours. In addition, students who started at a two-year institution typically enrolled as a General Studies or Liberal Arts major before transferring to a four-year institution and enrolling as an engineering major.

The table below summarizes the average number of semester credit hours attempted at public two-year and public four-year institutions. The following trends are noted.

For students who started at a public two-year institution:

- Students who earned a bachelor's degree in mechanical engineering attempted about 46 semester credit hours at two-year institutions and 108 semester credit hours at four-year institutions, for a total weighted average of 154 semester credit hours.

- Students who earned a bachelor's degree in another engineering discipline attempted slightly fewer semester credit hours, 44 semester credit hours at two-year institutions and 107 at four-year institutions, for a total weighted average of 150 semester credit hours.

- Students who earned a bachelor's degree in a non-engineering field attempted about the same weighted average semester credit hours (152), but they took more of those semester credit hours at two-year institutions (51) and fewer at four-year institutions (103).

- Students who did not earn a bachelor's degree in any field attempted fewer weighted average semester credit hours (97), but they took more semester credit hours at two-year institutions (62). While enrolled at four-year institutions, these students attempted fewer semester credit hours (60) before leaving without the degree.

For students who started at a public four-year institution:

- Students who earned a bachelor's degree in mechanical engineering attempted a total weighted average of 141 semester credit hours, attempting 135 semester credit hours at four-year institutions and 9 semester credit hours at two-year institutions. About 60 percent of these students attempted semester credit hours at two-year institutions (337 of 564).

- Students who earned a bachelor's degree in another engineering discipline attempted slightly fewer semester credit hours than students who earned a bachelor's degree in mechanical engineering – a total weighted average of 139, with 10 semester credit hours at two-year institutions and 132 semester credit hours at four-year institutions. About 64 percent of these students attempted semester credit hours at two-year institutions (1,079 of 1,688).

- Students who earned a bachelor's degree in a non-engineering field attempted a slightly higher total weighted average of 147 semester credit hours, attempting 14 semester credit hours at two-year institutions and 138 semester credit hours at four-year institutions. About 66 percent of these students attempted semester credit hours at two-year institutions (849 of 1,287).

- Students who did not earn a bachelor's degree in any field attempted a total weighted average of 103 semester credit hours, attempting 32 of those semester credit hours at two-year institutions and 84 semester credit hours at four-year institutions. Approximately 60 percent of these students attempted semester credit hours at two-year institutions (1,258 of 2,132).

- Overall, students who started at a four-year institution and earned a bachelor's degree in engineering attempted about 10 fewer semester credit hours than students who started at a two-year institution and earned the same degrees.

Average Number of Semester Credit Hours Attempted at Public Two- and Four-Year Institutions, and the Total Weighted Average Semester Credit Hours Attempted by Students in each Education Outcome Group within the Engineering Cohort

			Attempted at 2-Year Inst SCH		Attempted at 4-Year Inst SCH		Total Weighted Average SCH Attempted	
Initial Inst	Degree Major	Degree Status	# Stu	Mean SCH	# Stu	Mean SCH	# Stu	Mean SCH
Two-Year	Mech Eng	Bach Degree	85	45.9	85	108.0	85	153.9
Two-Year	Other Eng	Bach Degree	229	43.7	229	106.6	229	150.3
Four-Year	Mech Eng	Bach Degree	337	8.7	564	135.4	564	140.6
Four-Year	Other Eng	Bach Degree	1,079	9.9	1,688	132.2	1,688	138.5
Two-Year	Pass-Thru Eng	Bach Degree*	202	50.7	199	102.5	202	151.7
Four-Year	Pass-Thru Eng	Bach Degree	849	13.7	1,287	137.8	1,287	146.8
Two-Year	Pass-Thru Eng	No Bach Degree	1,450	61.6	853	59.9	1,450	96.9
Four-Year	Pass-Thru Eng	No Bach Degree	1,258	32.3	2,132	84.2	2,132	103.2
All			5,489	32.7	7,037	108.2	7,637	123.2

*Three students earned bachelor's degrees from community colleges.

Dual Credits Earned

Students may enroll in college-level courses while in high school and apply these credits toward a college degree. Institutions report dual credits earned to the Texas Higher Education Coordinating Board in the year in which they were taken. These credits become part of the student's enrollment history. For purposes of this study, dual credits were compiled for two years prior (Fiscal Year 2001 and Fiscal Year 2002) to fall 2002 and are included in each student's record. These credit hours do not include any credit by advanced placement or credit by examination.

The table below summarizes the average number of dual credits earned by each of the eight education outcome groups within the engineering cohort.

- A relatively small percentage (15.8%) of the engineering cohort students earned dual credits in the two years prior to entering college. On average, they earned about 10 semester credit hours.
- A very small number of students, less than 20, who started at a two-year institution and completed a bachelor's degree in engineering earned dual credits in high school.
- Students who started at a four-year institution and completed a bachelor's degree in engineering earned a slightly higher number of dual credits (on average, about 11 semester credit hours), and more of these students, more than 500, earned dual credits.
- About one-third of the students (30.4%) who earned dual credits in high school did not complete a bachelor's degree in any field.
- Nearly 70 percent of the students who earned dual credits in high school completed a bachelor's degree.

Average Dual Credits Earned in High School by Students in each Education Outcome Group within the Engineering Cohort				
			Dual Credits Earned	
Initial Inst	Degree Major	Degree Status	# Stu	Mean Dual Credits
Two-Year	Mech Eng	Bach Degree	5	10.0
Two-Year	Other Eng	Bach Degree	11	8.9
Four-Year	Mech Eng	Bach Degree	148	10.5
Four-Year	Other Eng	Bach Degree	368	11.3
Two-Year	Pass-Thru Eng	Bach Degree	14	9.8
Four-Year	Pass-Thru Eng	Bach Degree	291	10.0
Two-Year	Pass-Thru Eng	No Bach Degree	59	8.4
Four-Year	Pass-Thru Eng	No Bach Degree	309	9.3
All			1,205	10.2

Developmental Education Semester Credit Hours Attempted

Not all students enter college prepared for college-level coursework and must take developmental education courses to improve their skills. The table below summarizes the average number of developmental education semester credit hours attempted at public two-year and public four-year institutions by each of the eight education outcome groups within the engineering cohort. The following trends are noted:

- A relatively small number of the engineering cohort students attempted developmental education semester credit hours at either two-year institutions (12.5%) or four-year institutions (7.9%).
- For those students taking developmental education courses at two-year institutions, they attempted, on average, about 8.2 developmental education semester credits hours.
- For those students taking developmental education courses at four-year institutions they attempted, on average, about 5.3 developmental education semester credit hours.
- Of the 951 students who attempted developmental education semester credit hours at two-year institutions, nearly 90 percent did not earn a bachelor's degree in any field.
- Of the 605 students who attempted developmental education semester credit hours at four-year institutions, 71 percent did not earn a bachelor's degree in any field.

Average Number of Developmental Education Semester Credit Hours Attempted at Public Two- and Four-Year Institutions by Students in each Education Outcome Group within the Engineering Cohort

			Attempted at 2-Year Inst		Attempted at 4-Year Inst	
Initial Inst	Degree Major	Degree Status	# Stu	Mean SCH	# Stu	Mean SCH
Two-Year	Mech Eng	Bach Degree	15	4.0	0	0
Two-Year	Other Eng	Bach Degree	29	6.6	2	3.5
Four-Year	Mech Eng	Bach Degree	1	15.0	18	3.2
Four-Year	Other Eng	Bach Degree	5	3.8	48	4.1
Two-Year	Pass-Thru Eng	Bach Degree	44	5.8	3	3.7
Four-Year	Pass-Thru Eng	Bach Degree	10	3.6	58	4.4
Two-Year	Pass-Thru Eng	No Bach Degree	718	9.1	50	4.5
Four-Year	Pass-Thru Eng	No Bach Degree	129	5.4	426	5.7
All			951	8.2	605	5.3

Summary: Time-To-Degree

The engineering curriculum is rigorous and demanding, and the amount of time and effort students expend in pursuing a bachelor's degree is considerable. One of the primary differences in time and effort between engineering cohort students who started at a public two-year institution versus those who started at a public four-year institution is that nearly two-thirds of the students who started at a public two-year institution and earned a bachelor's degree in mechanical engineering did not graduate until the sixth year after their initial enrollment. This compares with 17 percent of the students who started at a public four-year institution and earned a bachelor's degree in mechanical engineering in their sixth year. A similar pattern is noted for engineering cohort students who earned a bachelor's degree in other engineering disciplines, although slightly smaller percentages of two- and four-year students in other engineering majors graduated in the sixth year (59% for two-year and 14% for four-year students).

While all of the students who started at a public two-year institution attempted semester credit hours at public four-year institutions, a surprisingly high percentage of students who started at a public four-year institution attempted semester credit hours at public two-year institutions – about 60 percent of the students in mechanical engineering and 64 percent of the students in other engineering programs. On average, these four-year students attempted about 10 semester credit hours at public two-year institutions. Two-year students completed, on average, about 45 semester credit hours at two-year institutions and about 108 semester credit hours at four-year institutions.

Students who started at a public four-year institution attempted about 10 fewer semester credit hours than students who started at a public two-year institution. On average, students who started at a two-year institution and completed a bachelor's degree in mechanical engineering attempted 154 semester credit hours, those who earned a bachelor's degree in another engineering discipline attempted about 150 semester credit hours, and students who earned a non-engineering degree attempted 152 semester credit hours. On average, students who started at a four-year institution and completed a mechanical engineering degree attempted 141 semester credit hours, those who completed a degree in another discipline attempted 139 semester credit hours, and students who completed a degree in a non-engineering field attempted 147 semester credit hours.

The time and effort expended is considerable for students who did not earn bachelor's degrees in any field. Students who started at a public two-year institution and did not earn a bachelor's degree attempted 97 semester credit hours on average, taking more of them at two-year institutions (62) than at four-year institutions (60). Students who started at a public four-year institution and did not complete a bachelor's degree in any field attempted 103 semester credit hours, attempting 84 of the semester credit hours at a four-year institution.

Student Financial Support and Loan Debt: Texas Engineering Cohort

Student Financial Support and Loan Debt

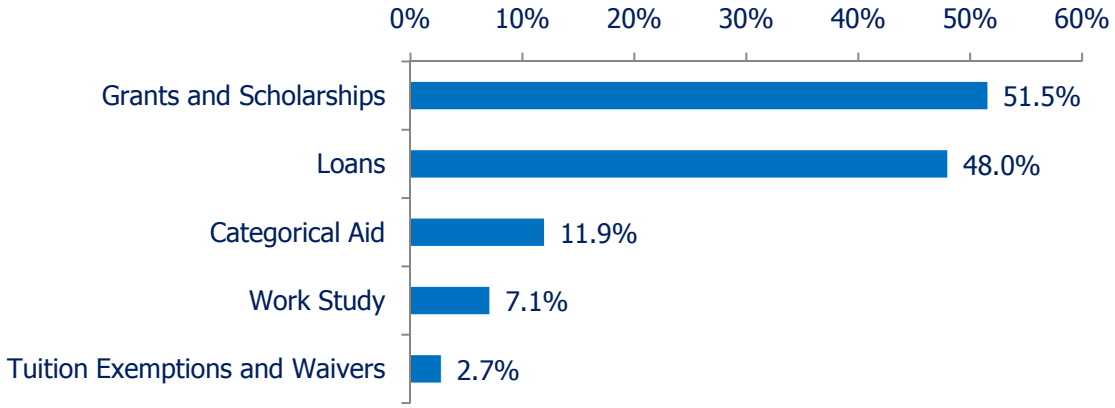
As the cost of attending college continues to increase, student financial support in the form of tuition waivers, grants and scholarships, college work-study programs, and loans plays an important role. While not all students apply for or receive financial assistance, more than 7 of every 10 students (5,654 of 7,637, or 74.0%) in the engineering cohort received some form of financial support.

In this section, the amount of student financial support provided and the average loan debt incurred by the engineering cohort over the six years from fall semester 2002 through summer semester 2008 are summarized in the tables and graphs that follow. Student debt reported in this study only includes loans processed by the institutions' financial aid offices and does not include private loans that the student or their parents received. The total dollars were summed across all years and across all institutions each student attended during the six-year period.

The first graph shows the percent of the engineering cohort students who received each type of financial support. Students may or may not have received support every year. The following are noted:

- More than half (51.5%) of the engineering cohort students received a grant or scholarship, and nearly half (48.0%) had loans.
- Small percentages of students in the engineering cohort received financial support in the form of categorical aid (11.9%), college work study support (7.1%), or tuition exemptions or waivers (2.7%).
- Approximately 26 percent of the engineering cohort students did not receive any form of financial support.

Percent of the Engineering Cohort
With Various Types of Financial Support Over Six Years



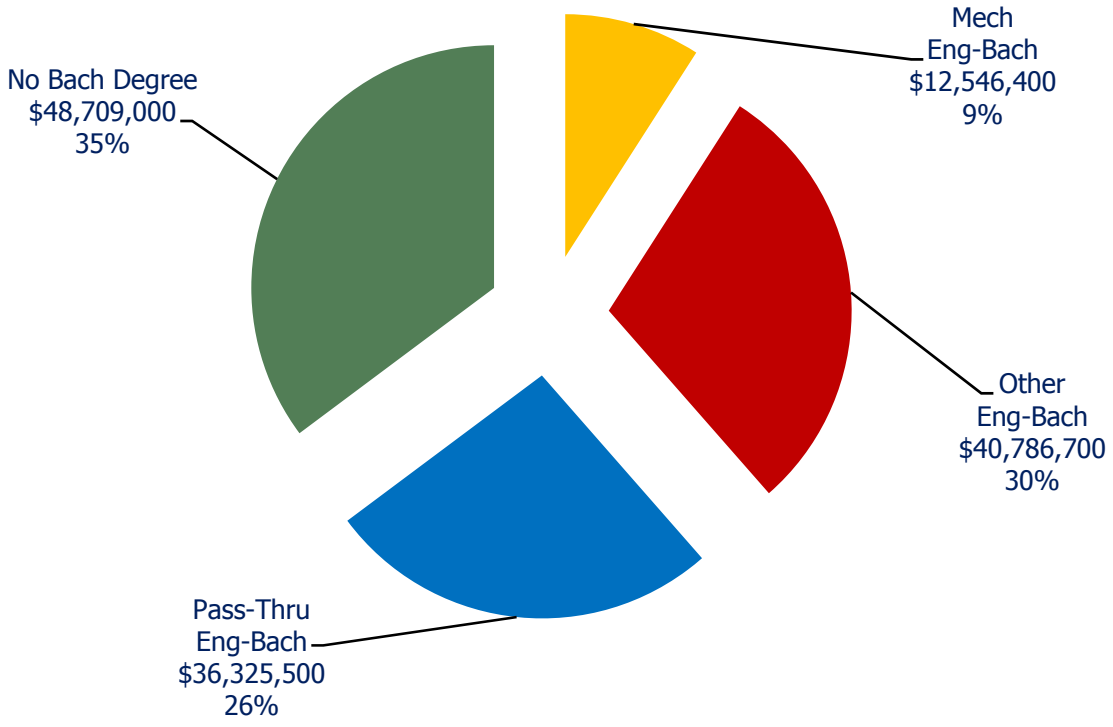
Note: Some students received more than one form of financial support.

Total Financial Support

Of the 7,637 students in the engineering cohort, 5,654 (74%) received a total of $138.4 million of financial support between fall semester 2002 and summer semester 2008. The graph below shows the share of this financial support by type of degree earned. The following trends are noted:

- Students who earned a bachelor's degree in engineering (mechanical or other) received a total of $53.3 million in financial support, or 39 percent of the total financial support received by the engineering cohort over six years.
- Students who earned a bachelor's degree in a non-engineering field received a total of $36.3 million in financial support, or 26 percent of the total financial support received by the engineering cohort over six years.
- Students who did not earn a bachelor's degree in any field received a total of $48.7 million in financial support, or 35 percent of the total financial support received by the engineering cohort over six years.

Total Financial Support by Type of Bachelor's Degree Earned by Engineering Cohort Students Who Received Financial Support (N=5,654)



Average Total Financial Support

The graph below shows the average financial support students in each education outcome group within the engineering cohort received over the six-year time period. The following trends are noted:

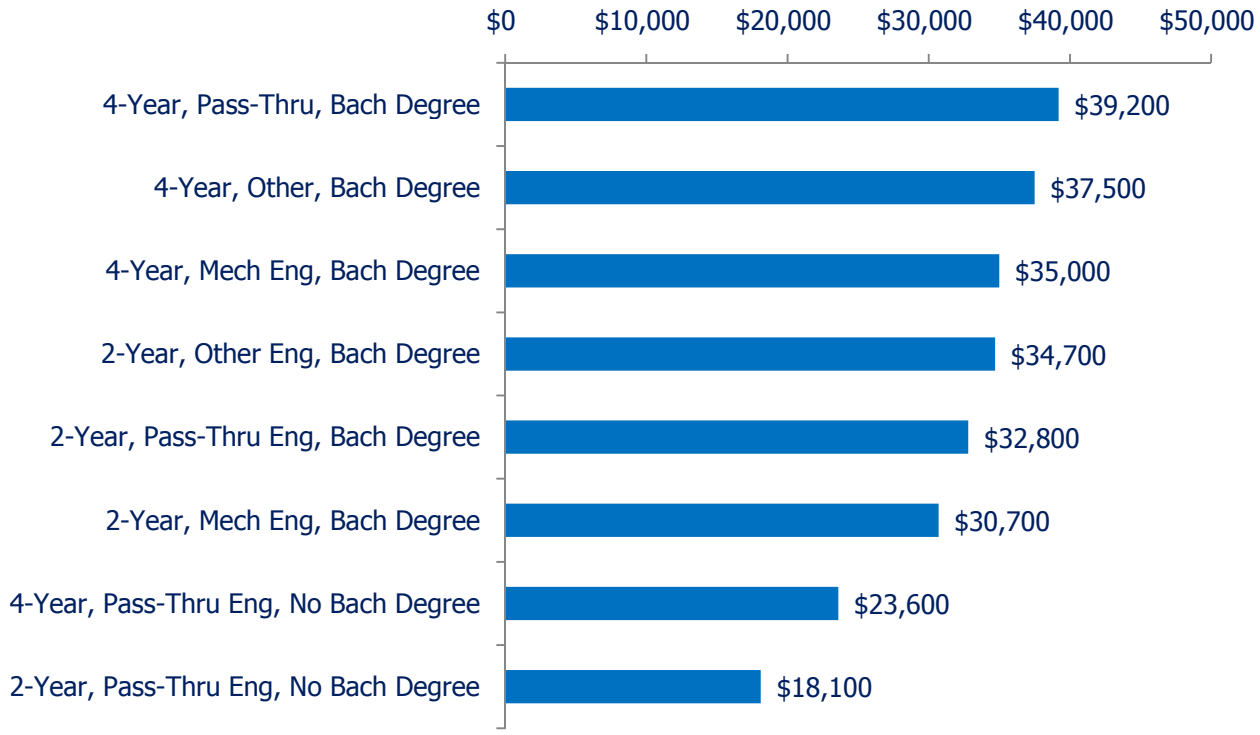
For students who earned a bachelor's degree:

- Students who started at a four-year institution received more financial support, on average, for each type of bachelor's degree (mechanical engineering, other engineering, or non-engineering) than students who started at a two-year institution and earned similar degrees.
    - Mechanical engineering degrees – $35,000 versus $30,700, or $4,300 more in financial support.
    - Other engineering degrees – $37,500 versus $34,700, or nearly $3,000 more in financial support.
    - Non-engineering degrees – $39,200 versus $32,800, or $6,400 more in financial support.

For students who did not earn a bachelor's degree:

- The financial support for students who did not earn a bachelor's degree, though lower than for students who earned a bachelor's degree, was considerable, nearly $20,000 on average.

Average Total Financial Support Received by Students in each Education Outcome Group within the Engineering Cohort



Note: Includes only the engineering cohort students who received financial support.

Type of Financial Support

While nearly three quarters of the engineering cohort students received grants, scholarships, and/or loans, the financial support varied by education outcome group. The table on the following page provides the number and percent of students, and the average total dollars of grants, scholarships, and loans students in each education outcome group received over the six-year time period. The graphs that follow provide a visual summary of the same information, ranked from highest to lowest average total dollars of support. The following points are noted:

- A larger percentage of students who started at a two-year institution and earned a bachelor's degree received scholarships and grants than students in other groups.

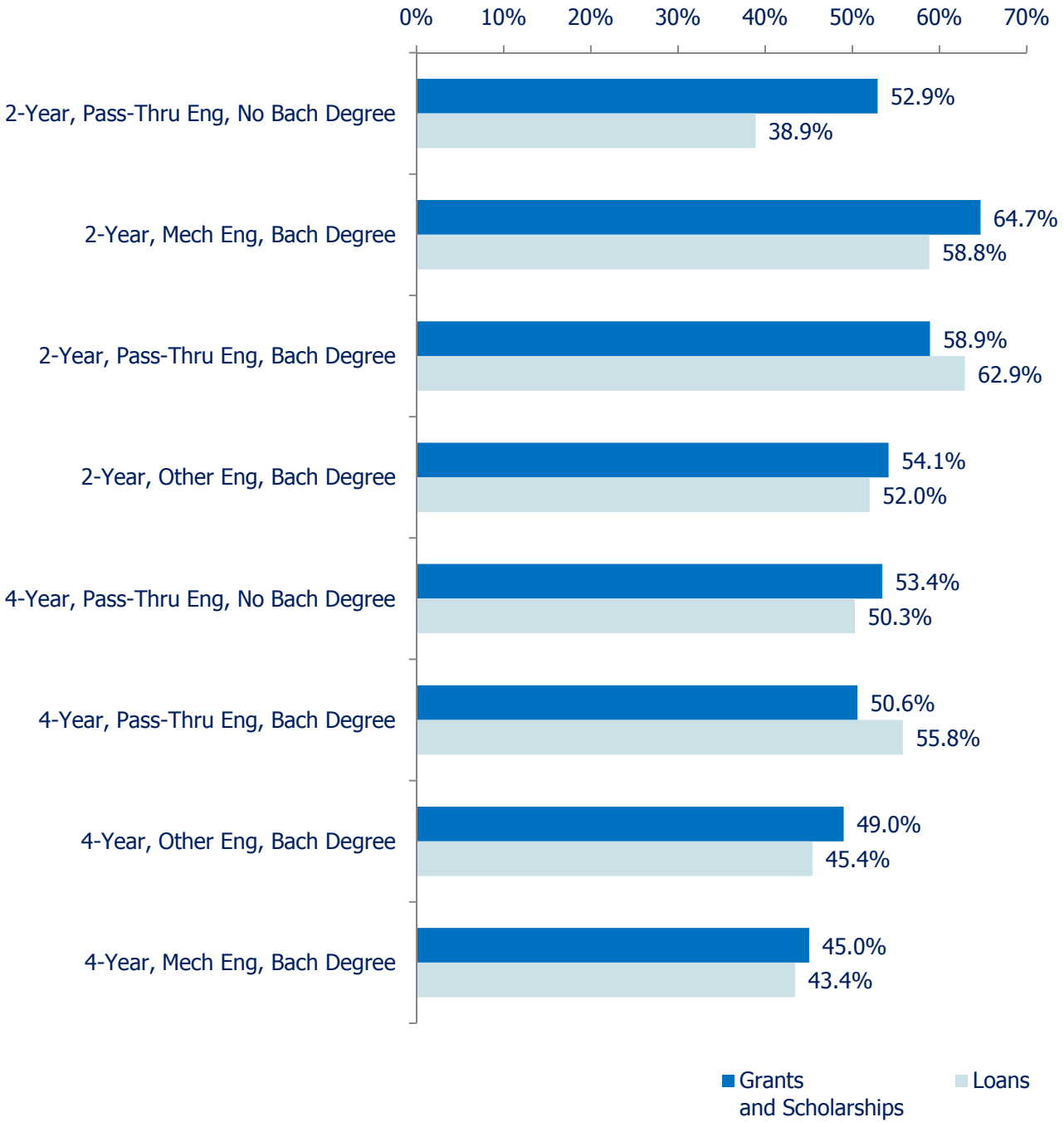
- In general, higher percentages of students who started at a two-year institution received scholarships and grants than students who started at a four-year institution. For example, nearly two-thirds of the students who started at a two-year institution and earned a bachelor's degree in mechanical engineering received a scholarship or grant, compared with only 45 percent of the students who started at a four-year institution and earned the same degree.

- A larger percentage of students who started at a two-year institution and earned a bachelor's degree in engineering incurred higher levels of student debt, on average, than students who started at a four-year institution and earned similar engineering degrees. For example, nearly 60 percent of the students who started at a two-year institution and earned a bachelor's degree in mechanical engineering received loans compared with 43 percent of the students who started at a four-year institution and earned the same degree.

- Students who started at a four-year institution and earned a degree in mechanical engineering had the smallest percentage of any group receiving grants and scholarships (45.0%). This group also had the smallest percentage of students who incurred loan debt (43.4%).

Average Total Dollars of Grants, Scholarships, and/or Loans Received by Students in each Education Outcome Group within the Engineering Cohort									
				Grants and Scholarships			Student Loan Debt		
Initial Inst	Degree Major	Degree Status	Cohort Size	# Stu	% Stu	Average Total Dollars	# Stu	% Stu	Average Total Dollars
Two-Year	Mech Eng	Bach Degree	85	55	64.7%	$14,500	50	58.8%	$22,800
Two-Year	Other Eng	Bach Degree	229	124	54.1%	$16,100	119	52.0%	$22,800
Four-Year	Mech Eng	Bach Degree	564	254	45.0%	$18,900	245	43.4%	$21,400
Four-Year	Other Eng	Bach Degree	1,688	827	49.0%	$19,500	767	45.4%	$22,600
Two-Year	Pass-Thru Eng	Bach Degree	202	119	58.9%	$13,500	127	62.9%	$20,700
Four-Year	Pass-Thru Eng	Bach Degree	1,287	651	50.6%	$19,200	718	55.8%	$24,100
Two-Year	Pass-Thru Eng	No Bach Degree	1,450	767	52.9%	$9,700	564	38.9%	$14,500
Four-Year	Pass-Thru Eng	No Bach Degree	2,132	1,139	53.4%	$12,900	1,072	50.3%	$15,100
Total			7,637	3,936	51.5%	$15,234	3,662	48.0%	$19,314

Percent of Students in each Education Outcome Group within the Engineering Cohort who Received Grants, Scholarships, and/or Loans



Amount of Grant and Scholarship Support

The graph on the following page summarizes the average total grant and scholarship funds students in the engineering cohort students received over the six years from fall semester 2002 through summer semester 2008. The following points are noted:

- Students who started at a four-year institution and earned a bachelor's degree received the highest total amount of grant and scholarship funds, ranging from an average of $18,900 for students earning a bachelor's degree in mechanical engineering to an average of $19,500 for students earning a bachelor's degree in another engineering discipline.

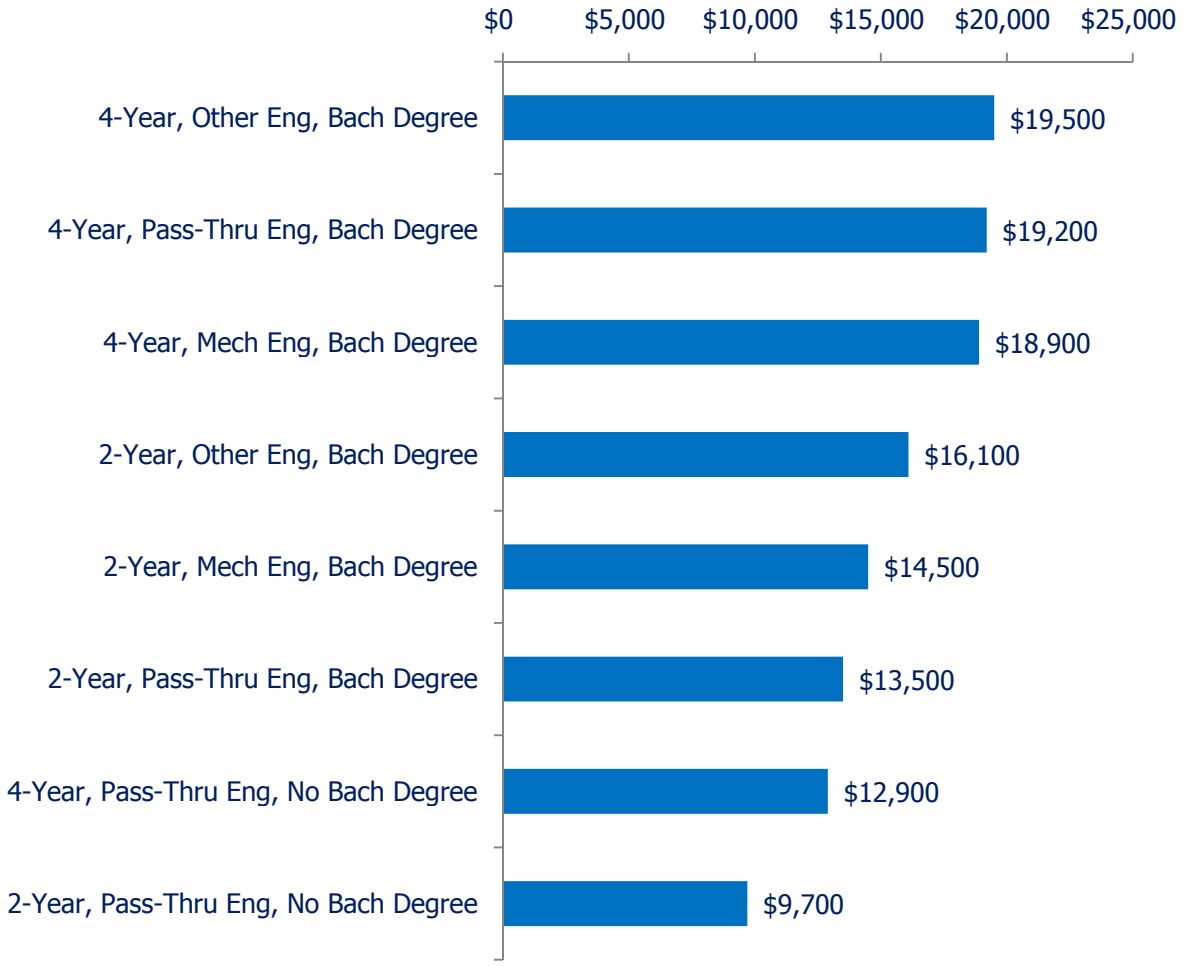
- Students who started at a two-year institution and earned a mechanical engineering degree received more than $4,000 less in grants and scholarships on average than students who started at a four-year institution and earned the same degree ($14,500 versus $18,900).

- Students who started at a two-year institution and earned a degree in another engineering discipline received about $3,000 less, on average, in grants and scholarships than students who started at a four-year institution and earned a similar degree ($16,100 versus $19,500).

- Pass-through engineering students who started at a four-year institution who earned a non-engineering bachelor's degree received nearly $6,000 more, on average, than similar students who started at a two-year institution ($19,200 versus $13,500).

- Students in the engineering cohort who did not earn a bachelor's degree in any field received substantially lower total scholarship and grant support, on average, than students earning engineering degrees.

Average Total Scholarship and Grant Support Received by Students in each Education Outcome Group within the Engineering Cohort



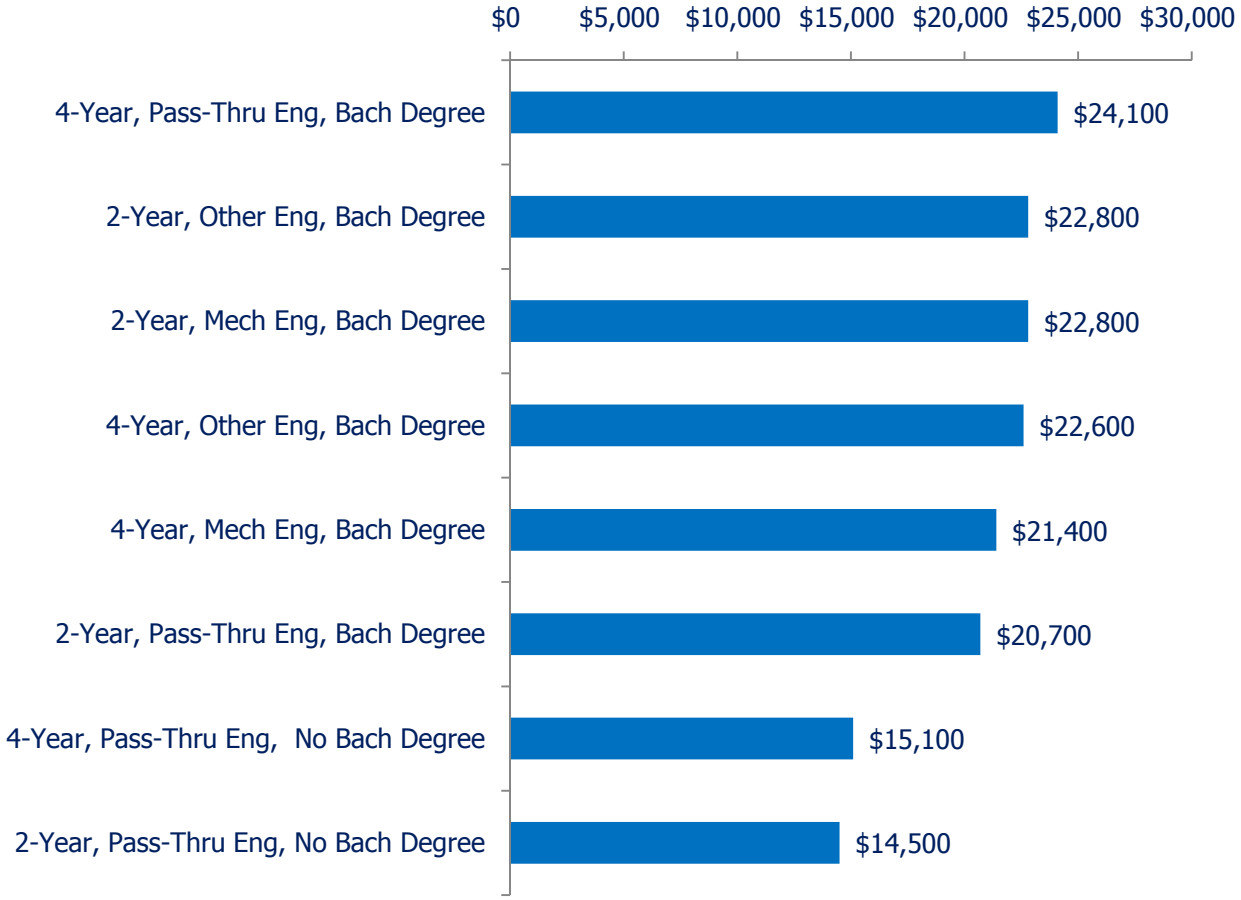
Note: Includes only the engineering cohort students who received scholarship and grant support.

Student Loan Debt

Nearly one-half of the students in the engineering cohort used loans to finance the pursuit of a bachelor's degree. The graph below shows the average total amount of loan debt students in the various education outcome groups accumulated from fall semester 2002 through summer semester 2008.

- Students who started at a two-year institution and earned a bachelor's degree in mechanical engineering had a slightly higher level of loan debt ($22,800) than students who started at a four-year institution and earned the same degree ($21,400) or about $1,400 less.
- Students who started at two-year and four-year institutions and earned a degree in another engineering discipline had similar levels of student debt ($22,800 and $22,600 respectively).
- Students who did not earn a bachelor's degree in any field had lower levels of student debt, but averaged more than $14,000 over six years.

Average Total Student Loan Debt Incurred by Students in each Education Outcome Group within the Engineering Cohort



Note: Includes only the engineering cohort students who incurred student debt.

Summary: Student Financial Support and Loan Debt

The engineering curriculum is demanding, and students often enroll in laboratory courses that demand large amounts of time, making it difficult to work outside of class. As a consequence, student financial support and the willingness to assume debt, play a significant role in a student's ability to finish a bachelor's degree in engineering. This section summarizes the types and total amount of financial support students received during the six-year time period of this study.

Nearly three-fourths of the engineering cohort, a total of 5,654 students, received a total of $138.4 million in financial support. These dollars included tuition waivers and exemptions, categorical aid, scholarships and grants, work study, and loans. Students who earned a bachelor's degree in engineering received more than $53 million of the total financial support provided, or about 39 percent. Students who earned a bachelor's degree in a non-engineering field received more than $36 million (26%) of the financial support, and students who did not earn a degree received nearly $49 million, or 35 percent of the total financial support. About one-half of the engineering cohort students received a grant or scholarship, and slightly less than half used loans to finance their education.

Engineering cohort students who started at a four-year institution received more financial support for each type of bachelor's degree than engineering cohort students who started at a two-year institution. For example, students who started at a four-year institution and earned a bachelor's degree in mechanical engineering received a total of nearly $35,000 over six years, compared with less than $31,000 for students who started at a two-year institution and earned the same degree. The relative support was similar for students earning other engineering degrees, about a $3,000 higher level of support for four-year students ($37,500) than students who started at a two-year institution ($34,700).

The type of financial support differed for two- and four-year engineering cohort students as well. A larger percentage of students, who started at a two-year institution and earned a bachelor's degree in engineering, received grants and scholarships. Likewise, a larger percentage of students who started at a two-year institution incurred student debt. While nearly 60 percent of the students who started at a two-year institution and earned a mechanical engineering degree incurred loan debt as part of their financial support, only 43 percent of the students who started at a four-year institution and earned a mechanical engineering degree incurred loan debt.

Finally, engineering cohort students who started at a two-year institution and earned a bachelor's degree in mechanical engineering incurred slightly higher debt, by about $1,400, than students who started at a four-year institution ($22,800 versus $21,400). The debt incurred by students earning degrees in other engineering disciplines did not differ for two-year and four-year students, both ending up more than $22,000 in debt ($22,800 for two-year, and $22,600 for four-year students). Students who did not earn a bachelor's degree in any field left with about $15,000 of debt.

Student debt reported in this study only includes loans processed by the institutions' financial aid offices and does not include private loans that the student or their parents received.

Cost Per Degree: Texas Engineering Cohort

What Does it Cost to Educate an Engineer?

Public colleges and universities spent $424.2 million from Fiscal Year 2003 through Fiscal Year 2008 to educate the 7,637 students in the engineering cohort.

For this investment, the following degrees were earned:

- 2,566 bachelor's degrees in engineering
  - 649 bachelor's degrees in mechanical engineering
  - 1,917 bachelor's degrees in other engineering disciplines
- 1,489 bachelor's degrees in non-engineering fields by students who attempted an engineering major, but graduated in another field
- 422 associate's degrees
- 3,582 students who did not earn a bachelor's degree

Of the students who attempted an engineering degree at some point during the six years of this study, only one-third (33.6%) earned a bachelor's degree in engineering, while 46.9 percent did not earn any kind of bachelor's degree.

Calculating the Cost of an Engineering Degree

The methodology used to calculate the costs for educating individual students is described in more detail in Appendix B. In summary, the cost of an engineering degree can be calculated in two ways. One way to calculate the cost is to determine how much it costs to educate each student by multiplying the number of semester credit hours attempted at each institution attended by the cost per semester credit hour for the discipline and level in which the student was enrolled at a particular institution for a given year. Then, the total costs can be added across all the institutions and years in which the student was enrolled. This cost per degree measure will summarize the cost per student degree. This cost measure includes all credits the students attempted whether they were enrolled as an engineering student for a given year or not. Hence, if a student enrolled in two institutions the same year, declaring an engineering major in one, but declaring a General Studies or Liberal Arts major in the second, both kinds of credits were included.

A second way to calculate the cost of an engineering degree is to calculate a program cost per degree by adding the total dollars institutions spent for all students who attempted an engineering major at any time during the six-year period of this study, and include all credits attempted for students who completed the degree, but include only those credits attempted for students who did not earn an engineering degree while the student declared an engineering major for a given institution(s) for a particular year(s).

Average Cost Per Student Degree

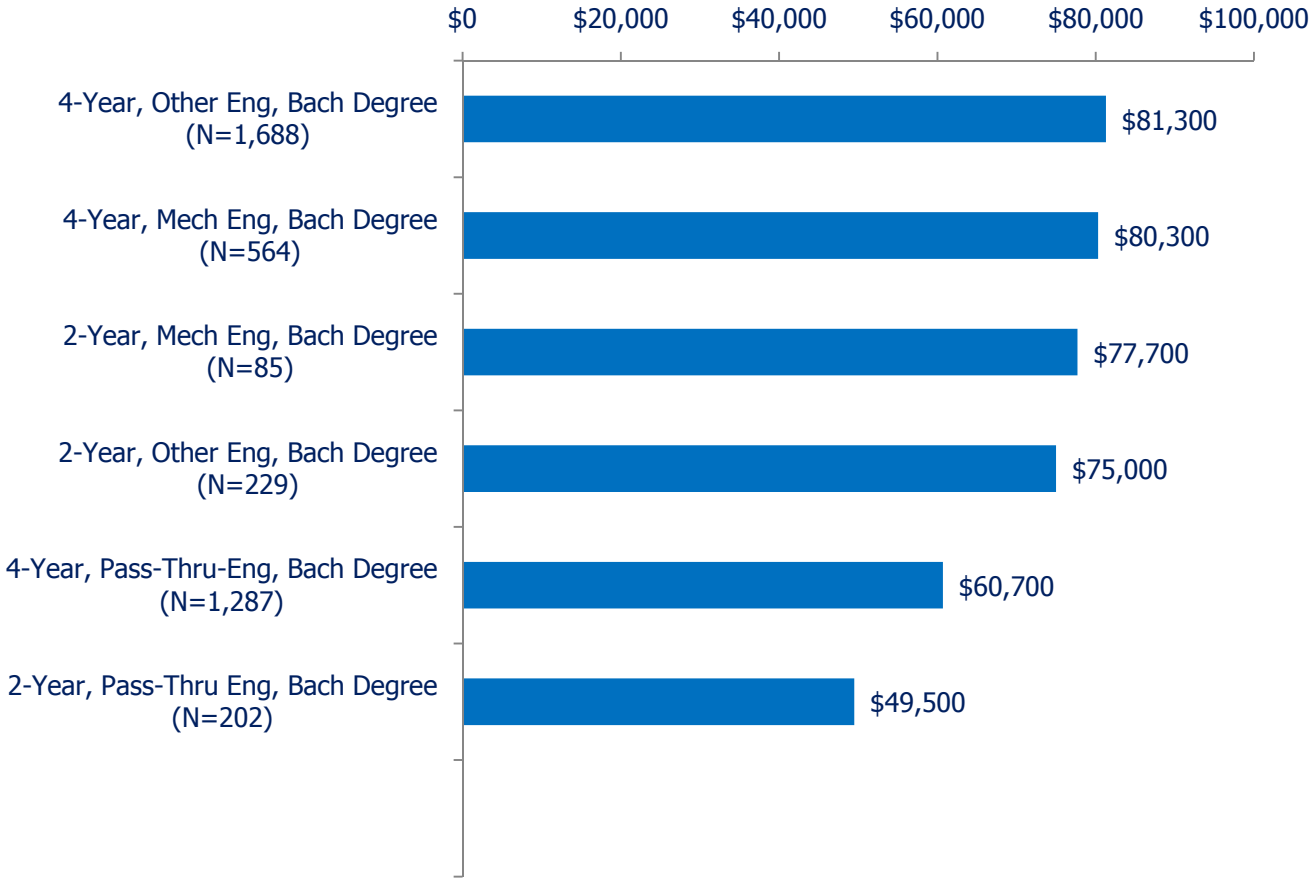
Using the method above for calculating the average cost of a degree, the graph below shows the total average cost per student degree for students in the engineering cohort. These costs are based on only those students who earned a bachelor's degree. The following trends are noted:

- The average cost per student degree was higher, by about $2,600, for mechanical engineering students who started at a four-year institution ($80,300), than for students who started at a two-year institution ($77,700) and earned the same degree.

- The average total cost per degree for students who started at a four-year institution and earned a bachelor's degree in a different engineering discipline also was higher, by $6,300, than the cost for students who started at a two-year institution and earned a bachelor's degree in another engineering discipline.

- The lowest cost per student was for the pass-through engineering student who earned a non-engineering degree. Again, the cost for students who started at a two-year institution ($49,500) was lower, by $11,200, than for students who started at a four-year institution and also earned a non-engineering degree ($60,700).

Average Total Cost Per Student Degree for Students in each Education Outcome Group within the Engineering Cohort



The graph above shows the average cost per student degree for only those students who successfully completed a bachelor's degree. However, there were 3,582 students in the engineering cohort who pursued an engineering bachelor's degree but did not complete it. The total cost of educating this group of students was $129.8 million over the six-year time period.

Because many of the students in the engineering cohort attempted semester credit hours at two-year and four-year institutions, the table below shows the relative percent of the total cost that was spent by each type of institution for students in each education outcome group. The following trends are noted:

- For students who earned a bachelor's degree in engineering, the majority of the dollars were spent by four-year institutions, more than 90 percent.
- Only about 8 percent of the costs were incurred by two-year institutions for educating students who started at a two-year institution and earned a degree in either mechanical engineering or a different engineering discipline.
- Nearly 15 percent of the costs of educating students who started at a two-year institution, but earned a non-engineering bachelor's degree, were incurred by the two-year institutions.
- Two-year institutions incurred about one-third (33.9%) of the costs of educating those students who started at a two-year institution but did not earn a bachelor's degree.

Relative Percent of the Total Cost Spent by Type of Institution for Students in each Education Outcome Group within the Engineering Cohort

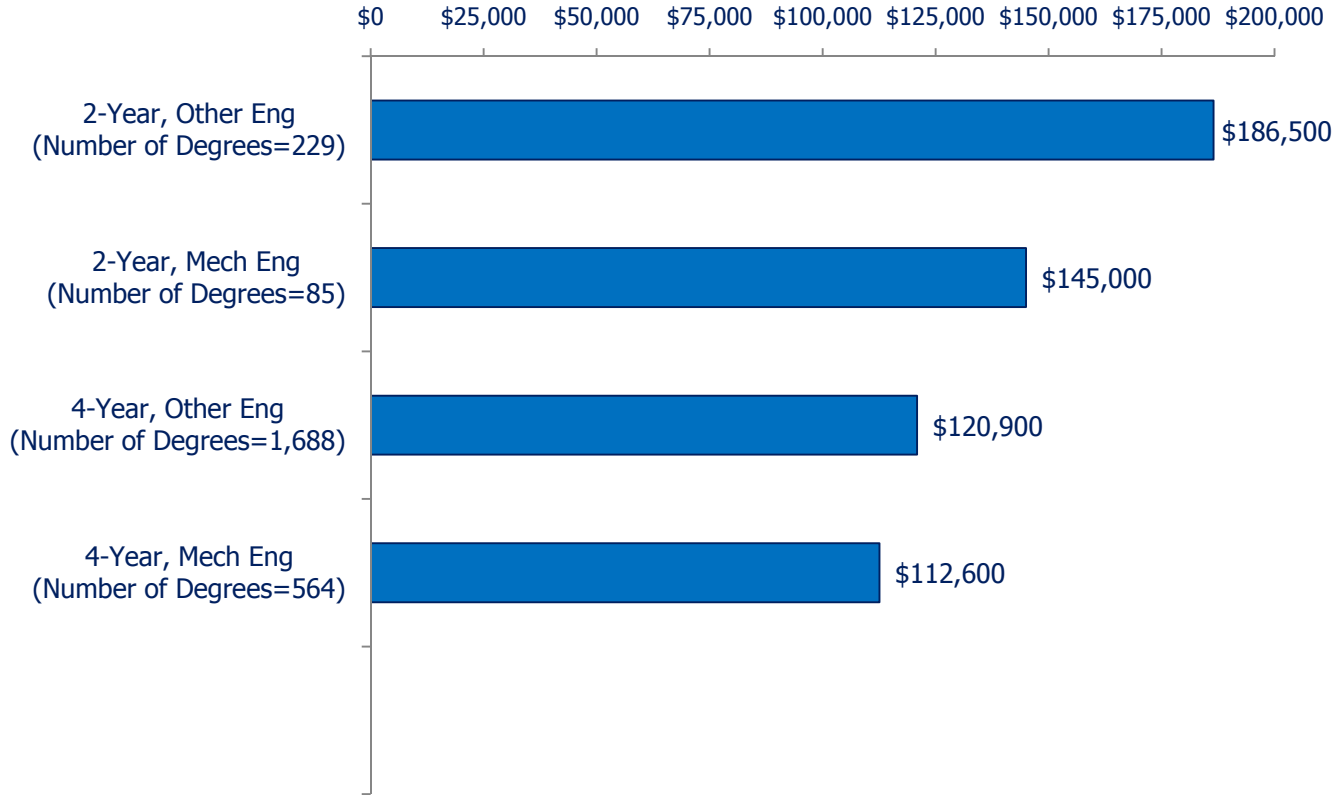
Initial Inst	Degree Major	Degree Status	# Stu	2-Year	4-Year	Total	% 2-Year	% 4-Year
Two-Year	Mech Eng	Bach Degree	85	$561,200	$6,039,900	$6,601,100	8.5%	91.5%
Two-Year	Other Eng	Bach Degree	229	$1,259,000	$15,927,000	$17,186,000	7.3%	92.7%
Four-Year	Mech Eng	Bach Degree	564	$436,200	$44,847,800	$45,284,000	1.0%	99.0%
Four-Year	Other Eng	Bach Degree	1,688	$1,556,100	$135,659,700	$137,215,800	1.1%	98.9%
Two-Year	Pass-Thru Eng	Bach Degree	202	$1,494,000	$8,503,000	$9,997,000	14.9%	85.1%
Four-Year	Pass-Thru Eng	Bach Degree	1,287	$1,592,100	$76,509,200	$78,101,300	2.0%	98.0%
Two-Year	Pass-Thru Eng	No Bach Degree	1,450	$14,432,600	$28,133,600	$42,566,200	33.9%	66.1%
Four-Year	Pass-Thru Eng	No Bach Degree	2,132	$6,215,000	$80,997,600	$87,212,600	7.1%	92.9%

Program Costs Per Degree

When the costs for engineering semester credit hours attempted by engineering cohort students who not only earned a degree but also by those students who started in engineering but did not complete an engineering degree are allocated across the engineering degrees earned, the total cost per degree awarded is very different than when the cost is based only on those students who completed a degree. The chart below summarizes the program cost by type of institution students first entered and the type of engineering degree they pursued. The following trends are noted:

- The highest program cost per degree is based on students who started at a two-year institution and pursued an engineering degree other than mechanical engineering, averaging more than $186,500.
- The next highest program cost per degree is based on students who started at a two-year institution and pursued a mechanical engineering degree, an average of $145,000.
- Program costs for students who started at a four-year institution and pursued either a mechanical engineering degree ($112,600) or a degree in another engineering discipline ($120,900), were considerably lower than the program costs based on students attending two-year institutions who pursued similar degrees.

Program Cost Per Engineering Bachelor's Degree by Type of Institution First Entered and Engineering Program Pursued by Students in each Education Outcome Group within the Engineering Cohort



Summary: Cost Per Degree

A primary goal of this report is to examine the amount of money public colleges and universities spend in educating students in mechanical and other engineering disciplines for the purpose of comparing the relative costs per degree for students who started at public two-year and public four-year institutions.

The average cost per degree was calculated in two ways. The first way answers the question, "What does it cost to educate one student from college entry to the degree earned?" The average cost per successful student degree was calculated by multiplying the total semester credit hours attempted by the cost per semester credit hour within the discipline and level in which the student had declared a major for a given academic year at a specific institution. The total cost was accumulated across six years and across all public institutions attended, divided by the number of engineering degrees. The second way answers the question, "How much do engineering programs spend per degree awarded to educate the students who pursue engineering?" The program cost per degree was calculated by adding the total costs for successful completers and the cost of educating students while they were enrolled as engineering students, but who did not complete an engineering degree, and dividing the total cost accumulated by the total number of degrees.

The average cost per successful student degree in mechanical engineering was slightly lower for students who started at a public two-year institution ($77,700) than for students who started at a public four-year institution ($80,300), a total difference of $2,600 or a difference of less than $450 per year over the six years. The cost difference between students who started at two-year and four-year institutions and earned a bachelor's degree in another engineering discipline was larger, by more than $6,000. Institutions spent, on average, about $81,300 per degree for students who started at a four-year institution compared with $75,000 for students who started at a two-year institution. Of the total dollars spent to educate a student who started at a two-year institution and earned a bachelor's degree in mechanical engineering, 92 percent of the dollars were spent by the four-year institutions. Less than 10 percent of the cost of the mechanical engineering degree for these students was spent by the two-year institutions the students attended.

The average program cost per degree is much higher because the costs of educating students who do not complete a bachelor's degree are added to the total costs of the successful completers. For students who started at a public two-year institution and pursued a degree in mechanical engineering, the average program cost per degree was $145,500, compared with an average program cost of $112,600 for students who started at a public four-year institution. The differences for students who pursue other engineering majors are even larger, averaging $186,500 for students who started at a two-year institution and $120,900 for students who started at a four-year institution. The average cost differences are primarily a reflection of the very different degree completion rates for students who start at a two-year institution (16%) and students who start at a four-year institution (39%).

Appendix A

Methodology

Base Cohort Data File

Data from numerous sources were used to compile the information for the *Engineering Articulation Fact Book*. The data files were constructed by identifying all students who enrolled in a Texas public institution of higher education fall semester 2002, based on information submitted to the Texas Higher Education Coordinating Board on the CBM001 data file. This base data file consisted of 169,630 students and included the following data elements for each student:

- Student identification number
- Institutional identification number, called the FICE code
- Fiscal year
- Type of institution (two-year or four-year)
- Gender
- Ethnicity
- Two-digit CIP code indicating student's declared major
- Four-digit CIP code
- Six-digit CIP code
- Age as of September 1, 2002
- High school flag indicating whether student entered directly from high school or delayed entry

In addition to the base cohort file, the following data files were constructed:

Dual Hours Attempted

This file contained the sum of the dual credit hours attempted for students in the base cohort enrolled in high school in Fiscal Year 2001 and Fiscal Year 2002. The data elements included:

- Institutional code (FICE) where dual credits were earned
- Student identification number
- Fiscal year
- Type of institution (two-year or four-year) where dual credit hours were attempted
- Total number of dual credit hours attempted

Semester Credit Hours

A record for each fiscal year was created for each student in the base cohort for each institution the student attended for any part of the fiscal year. The data elements included:

- Student identification number
- Institution identification number
- Fiscal year
- Type of institution (two-year or four-year)
- Fall semester enrollment (1=enrolled, 0=not enrolled)
- Spring semester enrollment
- Summer semester enrollment
- Two-digit CIP code indicating student's last declared major
- Four-digit CIP code
- Six-digit CIP code
- Engineering major flag (0=non-engineer, 1=other engineer, 2=mechanical engineer)
- State-funded semester credit hours attempted
- Non-state-funded semester credit hours attempted
- State-funded developmental education semester credit hours attempted
- Non-state-funded developmental education semester credit hours attempted
- Total semester credit hours attempted

Financial Support

A record for each fiscal year was created for each student in the base cohort using summary data from the Coordinating Board Financial Aid Data System (FADS) for each institution the student attended in a given fiscal year. The data elements included:

- Student identification number
- Institution identification number
- Fiscal year
- Total dollars of tuition waivers and exemptions
- Total dollars of categorical aid (institution-funded support)
- Total dollars of all types of grants and scholarships (federal, state, local) allocated through the institution's financial aid office
- Total dollars of work study funds
- Total dollars of loans administered by the institution

Degrees and Awards

A record containing information about the degrees and/or certificates for each fiscal year was created for each student in the base cohort using data reported via the Coordinating Board CBM009 annual reports. The data elements included:

- Student identification number
- Institution identification number
- Fiscal year of award
- Type of award (bachelor's degree, associate's degree, certificate, etc.)
- Two-digit CIP code indicating student's degree major
- Four-digit CIP code of degree major
- Six-digit CIP code of degree major
- Highest degree earned (1=bachelor's, 2=associate's, 3=certificate, 4=core-completer, 5=field of study completer)
- Type of institution (two-year or four-year)
- Engineering major flag at time of award (0=non-engineer, 1=other engineer, 2=mechanical engineer)

Cost Matrix and Fund Code Data Files

Because the cost data per student semester credit hour varied by discipline and level (lower-division and upper-division), a fund code and the cost data per student semester credit hour for the student's declared major was added to each student's annual enrollment record for each fiscal year and for each public institution attended. The fund code was reported separately by two-year and four-year institutions as were the cost data. For more information see Appendix B Calculating the Cost of a Degree.

The fund codes and cost data were reported for each public four-year institution for each fiscal year for the following disciplines:

Liberal Arts, Science, Fine Arts, Teacher Education, Agriculture, Engineering, Home Economics, Law, Social Services, Library Science, Vocational Training, Physical Training, Health Services, Pharmacy, Business Administration, Optometry, Teacher Education Practice, Technical, and Nursing.

The fund codes and cost data were reported for each public two-year institution for the following disciplines:

Agriculture, Architecture and Precision Production Trades, Biology, Physical Sciences and Science Technology, Business Management, Marketing and Administrative Services, Career Pilot, Communications, Computer and Information Sciences, Construction Trades, Consumer and Homemaking Education, Engineering, Engineering Related, English Language, Literature, Philosophy, Humanities and Interdisciplinary, Foreign Languages, Health Occupations-Dental Assistant, Medical Lab and Associate Degree Nursing, Health Occupations-Dental Hygiene,

Other Health Occupations, Health Occupations-Respiratory Therapy, Health Occupations-Vocational Nursing, Mathematics, Mechanics and Repairers-Automotive, Mechanics and Repairers-Diesel, Aviation Mechanics and Transportation Workers, Mechanics and Repairers-Electronics, Physical Education and Fitness, Protective Services and Public Administration, Psychology, Social Services and History, and Visual and Performing Arts.

The Engineering Cohort

The cohort of engineering students for this *Engineering Articulation Fact Book* was defined by searching the annual semester credit hour file and the award file for (1) students who earned an engineering degree; and (2) students who majored in engineering at any time between fall 2002 and summer 2008. Hence, students who declared an engineering major at any time during the six-year period of this study were included as members of the engineering cohort, regardless of where they started or what their initial or final declared major may have been. The engineering cohort for this study consisted of 7,637 students who met these criteria.

The Engineering Cohort Education Outcome Groups

To compare the demographics, completion rates, time-to-degree, annual semester credit hour load, financial support, and cost per degree, eight education outcome groups were identified. These groups were defined as follows:

All students who were enrolled in a Texas public institution of higher education as an engineering major at any time during the six-year period between fall semester 2002 and summer semester 2008 were identified. Next, the type of public institution where the student started (two-year or four-year) was noted. Finally, the degree attainment of each engineering student in this cohort was identified as (1) a mechanical engineering degree; (2) a degree in another engineering discipline; (3) a degree in a field other than engineering; and (4) no bachelor's degree earned.

Students who were enrolled as an engineering major for one or more semesters and did not earn a degree in engineering were labeled as pass-through engineering. These students may or may not have started in engineering, and they may or may not have enrolled as an engineering major at the time they left the institution, with or without a degree, but at some point during the six-year time period of this study, they enrolled as an engineering major and were included in the engineering cohort.

The table on the following page defines each engineering education outcome group and shows the number of students who were in each category.

Number and Category of Students in each Education Outcome Group within the Engineering Cohort				
Initial Institution	**Degree Major**	**Degree Status**	**Definition**	**Number**
Two-Year	Mech Eng	Bach Degree	Students who started at a public two-year institution and earned a bachelor's degree in mechanical engineering	85
Two-Year	Other Eng	Bach Degree	Students who started at a public two-year institution and earned a bachelor's degree in another engineering discipline	229
Four-Year	Mech Eng	Bach Degree	Students who started at a public four-year institution and earned a bachelor's degree in mechanical engineering	564
Four-Year	Other Eng	Bach Degree	Students who started at a public four-year institution and earned a bachelor's degree in another engineering discipline	1,688
Two-Year	Pass-Thru Eng	Bach Degree	Students who started at a public two-year institution and were enrolled one or more semesters as an engineering major, but earned a bachelor's degree in a non-engineering field	202
Four-Year	Pass-Thru Eng	Bach Degree	Students who started at a public four-year institution and were enrolled one or more semesters as an engineering major, but earned a bachelor's degree in a non-engineering field	1,287
Two-Year	Pass-Thru Eng	No Bach Degree	Students who started at a public two-year institution and were enrolled one or more semesters as an engineering major, but did not earn a bachelor's degree in any field	1,450
Four-Year	Pass-Thru Eng	No Bach Degree	Students who started at a public four-year institution and were enrolled one or more semesters as an engineering major, but did not earn a bachelor's degree in any field	2,132
Total				7,637

Appendix B

Calculating the Cost of a Degree

Data Sources

Each year, the Texas Higher Education Coordinating Board collects information from each of the public colleges and universities regarding their instructional and operations expenses.

For public two-year institutions, the data include expenses for instruction and administration from all sources of funds, including appropriated general revenue, tuition and fees, contract instruction, other education and general revenue, and local tax revenue. Each college reports the total instructional expenses and contact hours for each instructional discipline defined in the current Appropriations Act. Total expenses for the National Association of College and University Business Officers (NACUBO)-defined categories of administration, including institutional support, student services, library, instructional administration, organized activities, and instructional staff benefits (excluding physical plant employees) also are reported. A cost-per-semester-credit-hour is calculated for each discipline (Appendix A) within each institution by dividing the total instructional and operations (I&O) dollars spent by the total semester credit hours. The total contact hours reported by the institution are divided by 15 to obtain the number of semester credit hours. These data were not collected for the Fiscal Year 2006 fiscal year, so the Fiscal Year 2005 and Fiscal Year 2007 data were averaged and used for the cost matrix values for Fiscal Year 2006.

For the public four-year institutions, the instructional and operations costs are based on unrestricted funds for five cost elements – instruction, research, academic support, student services, and institutional support. The academic support, institutional support, and student services expenses are taken from the institution's Annual Financial Report. The instruction and research expenses are divided between faculty and teaching assistant salaries and departmental operating costs. These five cost elements, plus the associated capital outlay from current funds, comprise the funding sources for the instructional and operations expenses. Specific allocations within each of the five cost elements are described for the most recent fiscal year (2008) in greater detail in the report *Texas Public University Cost Study Fiscal Year 2006-Fiscal Year 2008*. The average cost per semester credit hour was obtained by dividing the total expenses by discipline and level (lower-division or upper-division) for each institution by the number of semester credit hours generated for that discipline and level.

Calculating Costs

Two methods were used to calculate the cost of a bachelor's degree. The first method added the costs for all semester credit hours attempted for each year and each institution in which the student was enrolled. The costs for only those students who successfully completed a degree were included. The second method added the costs of the successful completers and the costs of students who did not earn a degree in engineering, but who had declared an engineering major. For students who earned a non-engineering degree, or those who did not earn a bachelor's degree in any discipline, only those semester credit hours for the years and the institutions when the student declared an engineering major were included. See the definitions and formulas in the appropriate section on the following page:

The Cost Per Successful Student Degree

For each student record for each year and each institution attended, the institutional cost figure for a given discipline and level was multiplied by the number of semester credit hours attempted. For example, if a student attended a four-year institution as a junior (upper-division) for fall and spring semester during Fiscal Year 2006, declared a mechanical engineering major and attempted 30 semester credit hours, the average cost value for the upper-division credits at that institution for that year would be multiplied by 30 semester credit hours to get the total cost for that institution for that year. If the same student then attended a two-year institution for a summer semester, declared a general studies major rather than an engineering major, and attempted nine semester credit hours, the cost value for the two-year institution for that general studies discipline would be multiplied by the nine semester credit hours. The costs for the two institutions would be summed to determine the total student costs for Fiscal Year 2006. For students who successfully completed a degree, the total costs for all semester credit hours attempted at all institutions attended over the six-year period until the bachelor's degree was awarded were included. Then, the average cost per student degree was calculated by adding all of the expense dollars and dividing by the number of students who earned a given type of bachelor's degree (mechanical engineering, another engineering field of study, or a non-engineering field of study). Semester credit hours attempted by students after they earned a bachelor's degree were excluded from the cost per successful student degree. The cost of not earning a degree was also derived by multiplying the cost by discipline and level by the appropriate semester credit hours taken in that discipline and level and summed across all institutions and years the student was enrolled.

If students attended an institution that did not report a cost per semester credit hour for a particular discipline, level, or year attended, the statewide median for that discipline, level, and year was used.

The Program Cost Per Degree

Calculating the program cost per degree was based on a rationale that the cost of a degree should include the instructional and operating costs of educating all students who declared engineering majors, regardless of whether or not they earned a degree. Students who do not finish a degree take engineering courses, utilize laboratory facilities, and use other services while attending a given institution, and these costs are paid by the institution for students whether or not they finish the engineering degree. For purposes of this program cost per degree calculation, all of the semester credit hours of students who successfully completed a degree were multiplied by the appropriate cost per semester credit hour by discipline by level within each institution attended for each year a student was enrolled. For those students who did not complete a bachelor's degree, semester credit hours attempted while students declared an engineering major were multiplied by the appropriate cost per semester credit hour of the engineering discipline at a given institution for a given year. The total costs of the successful completers and the total costs of the semester credit hours attempted as an engineering major for students who did not complete a degree were added together and divided by the total degrees awarded. This cost per degree represents what it costs all of the institutions collectively to produce a given type of bachelor's degree in engineering. Also, this program cost is a more conservative estimate than including the cost of all semester credit hours for students who do not earn a degree, because many of the engineering students changed their major and attempted courses in other disciplines, and these costs should not be allocated to an engineering degree.

This document is available on the Texas Higher Education Coordinating Board Website:
http://www.thecb.state.tx.us

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