

Appendix 2-A

Original APS Longitudinal Cohort (Cohort 1) Sampling Plan

Introduction

The goal of the Longitudinal Cohort is to identify and characterize the pathways for making the *choice* of becoming an engineer. Incoming freshman will be studied through ethnographic, interview and survey techniques up until the end of their junior year. There will be 160 participants total, 40 participants each from TPub, UPri, SPri, and LPub. In each institution, 8 of the 40 will be studied in depth through ethnographies as well as interviews and surveys. Since ethnographic studies are much more resource intensive, the other 32 will be studied through interviews and surveys only. In addition, there will be a control group at each institution consisting of 40 participants, who will not be subjected to any form of direct observation. Key statistics such as SAT scores, transcripts, major status, and other material institutional statistics their institutions track and keep on file in the registrar's office will be monitored for both groups.

Institutional Background Information

Technical Public Institution (TPub)

Approximately 600 – 650 engineering freshmen enroll at TPub each year. The students are essentially identified as engineering students since TPub is an engineering institution, however students do not necessarily have to declare their major during their freshman year. Some students declare when they arrive, others declare later during their matriculation. All freshmen must enroll in “freshmen success” and their instructor for the course is also their advisor. Each instructor/advisor has 10-15 advisees. Engineering majors offered at TPub included in this study are Chemical Engineering, (General) Engineering, Geology and Geological Engineering, Geophysics, Metallurgical and Materials Engineering, Mining Engineering, Petroleum Engineering, Engineering Physics. For the purposes of this study the following majors will be excluded from the study: Economics, Mathematical and Computer Science, and Chemistry. In 2002, over 500 students graduated from the undergraduate engineering programs at TPub with over 400 students receiving degrees in the majors not excluded from this study.

Urban Private University (UPri)

Approximately 180 freshmen enter the UPri engineering program each year. Freshmen are accepted into the engineering program upon enrolling at UPri, and all freshmen across the University are required to stay on campus. Engineering majors offered at UPri include Chemical, Civil, Systems and Computer Science, Mechanical, and Electrical Engineering. In 2002, over 100 students graduated from undergraduate engineering programs at UPri.

Suburban Private University (SPri)

Approximately 320-350 freshmen self-identify as interested in engineering at SPri each year. Freshmen designate a preliminary academic interest (PAI) in Engineering, including Computer Science, during the summer and are assigned Academic Advisors that will advise them until they declare a major. Their selection of PAI does not guarantee or bind students to declare engineering. Students at SPri do not usually declare their major until the end of their sophomore year or during their junior year. The University does not offer a traditional introduction to engineering course, but does offer a few engineering

related seminars for freshman with limited enrollment, approximately 15 students. Freshmen have to take a yearlong sequence in the humanities and a two-quarter course in writing and rhetoric. During the remainder of the freshman year, students interested in engineering usually opt to enroll in math courses (either single or multi-variable calculus), start the physics sequence, and take a freshman seminar. The School of Engineering offers the following undergraduate engineering majors: Chemical Engineering, Civil and Environmental Engineering, Electrical Engineering, Material Science & Engineering, Management Science and Engineering (Industrial Engineering), Mechanical Engineering, Computer Science, Engineering/General Engineering- Aeronautics/Astronautics, Computer Systems Engineering, Individually Designed Majors, Product Design, BioMedical Computation, and Bio Mechanical. For the purposes of this study, Computer Science will be excluded. In 2002, over 300 students graduated from undergraduate engineering programs at SPri, including 154 students in Computer Science.

Large Public University (LPub)

Approximately 650 freshmen are coded as pre-engineering prior to their arrival at LPub. Students can change this coding at any time and it does not bind the student to apply to the engineering program. Either the student or the University may assign students with the “pre-engineering” code. An additional small group of students, approximately 20, are admitted into an engineering major as incoming freshmen. Pre-engineering students may apply to multiple engineering majors granted they have completed the requisite pre-engineering coursework. Students usually begin applying at the end of their sophomore year and are admitted into the engineering major beginning with their junior year. Admission into the undergraduate engineering program is extremely competitive and not all applicants are admitted into the engineering program. LPub offers an Introduction to Engineering Design course (Engr 100) as a recommended course for pre-engineering students. The typical first quarter course load for a pre-engineering student is calculus, inorganic chemistry, and either English Composition or Engr 100. The College of Engineering offers the following undergraduate engineering majors: Aeronautics and Astronautics Engineering, Bioengineering, Chemical Engineering, Civil and Environmental Engineering, Computer Engineering, Electrical Engineering, Materials Science and Engineering, Mechanical Engineering, Technical Communication and Interdisciplinary Engineering Studies. In 2002, over 600 students graduated from undergraduate engineering programs at LPub.

Identifying Students for the Study

There will be 160 observed participants total in the Longitudinal Cohort: 40 participants each from TPub, UPri, SPri, and LPub. An additional 160 participants, 40 at each institution, will be identified to comprise a control group at each school. The observed and control students will simultaneously be identified based on the criterion at each school and will randomly be assigned to either the observed or control group. Each institution will also oversample from its respective underrepresented populations of engineering students. The percent ratio of participants identified below will be representative of both the observed and control group.

Technical Public Institution

Students will be selected to participate in the study based on the following criteria:

- Gender: only 23% of TPub undergraduates are women so this population will be oversampled to obtain a 50/50 percent ratio of women to men in the study.

- Underrepresented Ethnic Populations: only 11% of TPub undergraduates are minority students, including African-American, Asian American, Hispanic American, and Native-American populations. For the purposes of this study, African-American, Hispanic American, and Native American populations will be oversampled. Another sub-group of underrepresented populations will include participants in the *TPub MEP summer program*. The *TPub MEP summer program* is a remedial program some students must attend and pass in order to gain admission into TPub. (Targeted percent ratio to be around 25/75 underrepresented populations to majority populations.)
- Keen Interest in Engineering – interviews will be conducted with students to assess their interest in engineering (targeted percent ratio to be determined).
- Social Integration with Campus – based on focus groups of upper-class students, social support groups are important to a successful matriculation through TPub. The study will include students from a range of residences (on and off-campus), varsity athletes, and students involved in other TPub activities (targeted percent ratio to be determined).

Urban Private University

Students will be identified to participate in the study during the summer as soon as their acceptance into the engineering program has been confirmed by the payment of their enrollment fee. The freshman engineering class is relatively small, averaging 149 US and 35 Non-US students. Thus, the main criteria for participating in the study are:

- Gender – the School of Engineering has a small representation of men, so this population will be oversampled to obtain a 50/50 percent ratio of men to women in the study.
- Origin – the school of engineering has a large representation of international students and this population will be oversampled to obtain a 50/50 percent ratio of US to Non-US students.
- Participation in *freshman summer bridge program* – a select group of students is invited to participate in the Summer Bridge program based on their SAT scores. At the end of the program, it is expected that students will increase awareness of the requirements and rewards of the engineering professions; proficiency to earn above average grades during the freshmen year; and knowledge of campus resources. This population will be sampled to obtain a 50/50 percent ratio of participants in the Summer Bridge program to non-participants.

Suburban Private University

Students will be identified to participate in the study during mid-June – July. Freshmen are required to submit several information forms and questionnaires by mid-June. These forms include personal information, information about their academic interests, as well as housing preferences. Students will be selected to participate in the study based on the following criteria:

- Preliminary Academic Interest (PAI) in Engineering (target 100 percent of participants)
- Gender – the freshmen engineering class has a small representation of women (approximately 25%), so this population will be oversampled to obtain a 50/50 percent ratio of women to men in the study
- Underrepresented Ethnic Populations: African Americans, Native Americans, Mexican Americans, Puerto Ricans, and other Latino groups comprise approximately 25% of the freshmen engineering class. We will oversample from these populations to ensure at least a 25/75 percent ratio of underrepresented ethnic populations to majority populations.
- Participation in *SPri summer bridge program* – a selected group of around 40 students from underrepresented ethnic populations as well as women. SSEA enables students to explore various

engineering disciplines and science and engage with engineering faculty early in their academic career. We would like to have approximately 25/75 percent ratio of SSEA participants to non-participants expressed as an equal 25/75 percent ratio of women and men SSEA participants to women and men non-participants.

- Housing assignments (4 class dorms, all freshman dorms, Freshman Sophomore College, ethnic theme houses) and participation in varsity athletics are two additional factors we would like account for in both the observed and control group (targeted percent ratios to be determined).

Large Public University

LPub will seek to identify students who during their freshman year are participating in activities that (in retrospective studies) indicate an interest in being admitted to the engineering majors. Since our goal is to understand both the pathways into engineering and those that fail to flow into the field, our primary goal is to identify students whose activities display organized intent. In other words, we will *not* be selecting our sample from only those students that indicators suggest are very likely to succeed and be retained in engineering, on the basis of either academic or cultural factors.

The criteria therefore for identifying between 75%-100% of the Longitudinal Cohort will be the following:

- Students Coded as “Pre-Engineering”
- From those coded as pre-engineering, we will then select from among students enrolled during the first quarter in one or more prerequisite courses required for all engineering majors. Students enrolled in one of the prerequisite math courses (1 in a sequence of 3 calculus courses) and the chemistry course (inorganic chemistry) will be included in the possible sample. Students also enrolled in Engineering 100 will be preferred in the sample.
- Upon invitation to the study, students express an evident willingness to participate in the study for three years.

The criterion for identifying up to 25% of the Longitudinal Cohort will be students who are among a small number admitted to an engineering major at LPub as incoming freshman. Approximately 2% of the overall engineering undergraduate population (20 students) enters the engineering majors through this route. Demographically, most of these students are male and are either of Caucasian or Asian-American descent. We will select up to 25% of the cohort (10 students) from this group, with the determining factor being the number of female students from this group that we can enlist into the study. For example, if there are three women who enter the major this way and are willing to participate, we will recruit three men from this group. The purposes of studying this more “elite” sub-population are two-fold. First, we want to see if their pathways differ significantly from those in the more typical track. Second, we want to be able to understand how women and men in this more elite track navigate their education in comparison to those in the typical track.

Since only about 20% of the freshmen meet the above criteria 1 and 2, we will be oversampling from this population.

Additional factors considered in the design of the observed and sample groups include:

- Gender – in 2002, around 26% of graduates of the engineering program were women so this population will be oversampled to obtain a 50/50 percent ratio of women to men in the study.
- Underrepresented Ethnic Populations – in 2002, around 6% of graduates of the engineering program were minority students, including African-American, Hispanic American, and Native-American populations. These populations will be oversampled to obtain a 25/75 percent ratio of

underrepresented to majority populations. Some of these students may be identified from participation in MESA activities during their high school years and who meet the above described criteria (MESA stands for Math, Engineering, and Science Academy, a program designed to recruit underrepresented populations).

Inviting Students to Participate in the Study

Technical Public Institution

The details for inviting students to participate in the study at TPub are being finalized. Some strategies for recruiting students to participate in the study include reviewing information garnered from a survey or questionnaire, conducting interviews with students, and contacts in their Freshmen Success course.

Urban Private University

A personalized letter will be sent to identified students in July to their permanent address. The letter will attempt to persuade students to participate in the study, and give descriptive information about the nature of the study. The letter will also include a consent form for the students to complete with a stamped-returned envelope. A follow-up phone call will be placed to further explain the study and answer any questions the students might have about the study.

Suburban Private University

A personalized letter sent to identified students in July - August to their permanent address. The letter will include enough information to garner interest in the study but not persuade students to study engineering, and a consent agreement with a stamped-returned envelope. Subsequent communications before interested students arrive on campus will establish a short meeting with a member of the longitudinal team once on campus to secure their participation in the study. Other venues for advertising the study include introductory mathematics courses, engineering programming during the New Student Orientation, their academic advisors, the Engineering Diversity Programs office, residential staff, and engineering societies.

Large Public University

A personalized letter sent in October to their university address inviting them to participate in the study. Members of the longitudinal research team will also make short presentations in the calculus sequence courses. The in-class solicitation and letter will include enough information to garner interest in the study but not to persuade students to study engineering. Subsequent communications with students will include a short individual meeting with a member of the research team to secure their participation and explain the commitment. Other venues for advertising the study include introductory mathematics courses, the chemistry course, the engineering presentations during the New Student Orientation, their academic advisors, Engineering 100 course, and a list-serv accessible to students coded as pre-engineering majors.

Replacement Strategy

We will choose a cohort of 40 freshmen to follow through their first three years at their respective institutions. At TPub and UPri, this represents following students through 2 – 3 years in their engineering major, while at SPri and LPub, students will be followed into the end of their first year in an engineering major. There are multiple pathways into engineering other than clear and linear progress from first quarter freshman year. If however all 160 observed students remain in engineering through the junior year, we will likely have chosen our initial sample in a way that is somewhat unrepresentative of the overall populations of engineering students. Also there are attrition rates at each school, for instance at LPub, on average only about 75% of applicants are admitted into the engineering program each year. Because we are seeking relative representation of pathways, we will therefore employ an ethnographically informed strategy for bringing students into the sample as others drop out. As students drop out and as we learn more about the other pathways into the disciplines (e.g., community college transfers, switching from a more basic science major or mathematics), we will solicit participation from students who have these basic profiles. At the end of the 3 years, we should therefore have a solid and closely observed image of what the first three years are like for a large number of students, but we will also have some solid understandings of other pathways based on replacement participants.