More data are needed for engineering technology students and workers to better understand the field and labor market.

Analyzing the Engineering Technician and Technologist Workforce
Data Coverage and Gaps

Daniel Kuehn

Labor market data inform employment and training policies on Capitol Hill and in statehouses. As budget pressures mount in higher education, the data are also of tremendous value for program planning in colleges and universities.

One of the most conspicuous features of the labor market data on engineering technicians and technologists is the lack of clear information on these workers. The problem is particularly acute for technicians—those who work in the field of engineering technology but do not have a 4-year degree in the subject.\(^1\) The paucity of information on this workforce is largely the result of a federal data infrastructure that values bachelor’s and graduate degrees over other credentials—such as an associate’s degree or a certificate—in the skills hierarchy.

This article provides an introduction to what is known about engineering technicians and technologists, and an overview of the types of data available on them. It also exposes large data gaps that affect not only technicians but

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\(^1\) Those who work in engineering technology and have a 4-year degree are referred to as “technologists.” Technologists typically have more specialized skills in a piece of equipment, or are involved in design or systems development. They frequently do work that is associated with engineers, although at the more applied end of the engineering spectrum. Technicians, in contrast, are typically involved with equipment installation, maintenance, and adjustment.
all sub-baccalaureate science, technology, engineering, and mathematics (STEM) workers.

Background
Before discussing what is not known, it’s worth identifying what is known about the engineering technician and technologist workforce. After all, there are sufficient data to produce a new NAE report, *Engineering Technology Education in the United States* (Frase et al. 2017), filled with useful details on the workforce and recommendations for the future.

In particular, there is thorough data coverage in two major areas of interest:

1. the annual production of credentials at all levels (e.g., certificates, associate’s and bachelor’s degrees) in engineering technology, and
2. the experiences of individuals with bachelor’s degrees in engineering technology.

What do these data reveal? Among other trends, the degree production data show an engineering technician and technologist workforce dominated by sub-baccalaureate degree holders (“technicians”), with particularly strong recent growth in nondegree certificate awards.

The federal government’s substantial data collection efforts for bachelor’s degree holders reveal a major disconnect between an individual’s training in engineering technology and likelihood of working as a technologist. Across the major federal datasets, individuals with a bachelor’s degree in engineering technology have a low probability of working as an engineering technologist, and are indeed more likely to work in other related technical fields than in their own field of study. These and other data trends are discussed below.

After covering what is known and the strength of the data on engineering technologists, the article moves into a discussion of data gaps, particularly those related to the technician workforce. Although certain pieces of the puzzle in isolation are readily available, the federal government does not provide the detailed, coherent data on the sub-baccalaureate degree workforce that it does on bachelor’s degree holders. The article concludes with some suggestions for filling data gaps and strengthening engineering technology education in the United States.

Engineering Technology Degree Awards
The most up-to-date and comprehensive data on the annual production of engineering technology (ET) degrees come from the Department of Education’s Integrated Postsecondary Education Data System (IPEDS), which reports degrees awarded to gender and race/ethnicity groups for every accredited college in the United States by detailed degree fields. It allows users to, for example, identify how many African American males earned an associate’s degree in mechanical engineering technology from Tidewater Community College in 2014. Some of this level of detail is available in the recent NAE report.
Broader trends in engineering technician and technology certificate and degree awards, based on IPEDS data, are presented in figure 1 (reproduced from the NAE report). The figure presents data for 1989–2014 by type of award: certificate, associate’s degree, and bachelor’s degree. For most of the period, more associate’s degrees were earned than any other type of award. After a decline in the early 1990s from a peak of almost 50,000, associate’s degrees awarded ranged between 30,000 and 40,000 per year. Bachelor’s degrees were earned at about half the rate of associate’s degrees—15,000–20,000 annually—and remained stable throughout the period.

The most dynamic award level in engineering technology has been certificates: In 1989 about the same number of ET certificates were awarded as bachelor’s degrees. The number grew slowly until the mid-2000s, when there was a sharp uptick, and surpassed associate’s degrees in 2010. In 2014 nearly 50,000 ET certificates were awarded—more than double the number of bachelor’s degrees and about 40 percent more than the number of associate’s degrees.

In addition to these annual certificate and degree awards, federal surveys such as the National Science Foundation’s (NSF) National Survey of College Graduates (NSCG) and the Census Bureau’s American Communities Survey (ACS) provide estimates of the number of individuals in the workforce (the “stock”) with ET training. These estimates (for 2013) are presented in table 1, along with degree award data and information on engineering for comparison.

The ACS and the NSCG provide somewhat different estimates of the stock of 4-year degree holders, but approximately 450,000 Americans have bachelor’s degrees in engineering technology, compared to 4–5 million with bachelor’s degrees in engineering. Although the IPEDS data show that many more associate’s degrees than bachelor’s degrees in engineering technology were awarded in 2013, there is no reliable estimate of the stock of ET associate’s degree holders.

The reason for this data gap is that surveys in the United States are designed to report in much greater detail on individuals with bachelor’s degrees than individuals with sub-baccalaureate postsecondary credentials. As a result, there is strong data coverage of bachelor’s degree–bearing engineering technologists (who make up a small share of the combined technician and technologist workforce), but much less for the engineering technician workforce.2

### Engineering Technologists

Data on the engineering technologist workforce are available from a number of sources, reflecting the preoccupation of the federal statistical agencies with bachelor’s and graduate degrees. The NSF’s NSCG is typical of this emphasis, which is also apparent in the Department of Education’s nationally representative longitudinal survey, the Baccalaureate and Beyond (B&B), or the NSF’s Survey of Doctoral Recipients (SDR).

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**TABLE 1** Comparison of estimates of stock of and new awards in engineering technology and engineering in 2013, various sources

<table>
<thead>
<tr>
<th>Degree Holders</th>
<th>IPEDS</th>
<th>ACS</th>
<th>NSCG</th>
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<tbody>
<tr>
<td>Stock of bachelor’s degrees in engineering technology</td>
<td>—</td>
<td>480,925</td>
<td>435,716</td>
</tr>
<tr>
<td>Newly awarded bachelor’s degrees in engineering technology</td>
<td>18,322</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Newly awarded associate’s degrees in engineering technology</td>
<td>37,475</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Stock of bachelor’s degrees in engineering</td>
<td>—</td>
<td>5,098,403</td>
<td>3,879,754</td>
</tr>
<tr>
<td>Newly awarded bachelor’s degrees in engineering</td>
<td>87,812</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

ACS = American Communities Survey; IPEDS = Integrated Postsecondary Education Data System; NSCG = National Survey of College Graduates

a Although the most recent IPEDS data are from 2014, this table uses 2013 data for comparability with NSCG, which has data only through 2013.

b The federal government does not collect data that allow estimates to be made of the stock of 2-year engineering technology degrees.

Source: Calculations from noted datasets.

2 This differential degree of detail in labor market data is not restricted to engineering technicians; it’s true of all sub-baccalaureate STEM graduates.
Even the Census Bureau’s ACS, a meat-and-potatoes household survey, is valuable for forming a deep understanding of the ET workforce because it includes a question on the field of study in which respondents earned a bachelor’s degree. This minor addition to the survey instrument allows for analysis of what ET bachelor’s degree holders are doing with their lives: what industries they are working in, how much money they are earning, and the characteristics and activities of their family members.

The NAE report notes, for example, that ET bachelor’s degree holders frequently do not work as engineering technologists—a fact that is corroborated by both the NSCG and B&B data. Instead, they work in management or information technology occupations or, most commonly, simply as engineers.

The loose coupling between ET education and the labor market raises many questions. For example, are ET graduates actually working outside their field of study at such high rates, or are survey and occupational coding methods just not sophisticated enough to tease out the difference between engineering technology and other related degrees or occupations (Kuehn 2016)? If ET graduates are actually working in non-ET occupations, what is the reason for that?

Perhaps ET bachelor’s degree holders, given their close association with technicians, are induced to move out of the field because they are not paid particularly well. Data from the nationally representative monthly Current Population Survey (CPS) confirm that the annual earnings of engineering technicians and engineering technologists are roughly comparable—$45,000–$55,000 a year—which is $30,000–$40,000 less than the typical engineer (figure 2).

Or is something else going on? Ronald Land (2012) finds that employers who hire both engineers and engineering technologists frequently do not distinguish between the two types of 4-year degree holders, so the weak connections may simply be attributable to ET and engineering graduates being hired to do the same work and labeled “engineers.”

These and many other questions can be explored in substantial detail using the NSCG, B&B, or ACS data, either in isolation or together.

**Engineering Technicians**

**Major Data Gaps**

The rich data available on the education and employment experiences of technologists and other bachelor’s degree holders are not available for engineering technologists—individuals working in the engineering technology space who have less than a 4-year degree. This is a problem across the datasets highlighted above.

- The NSF does not include STEM community college graduates in its survey of college graduates unless they subsequently complete a 4-year degree program.
- Similarly, the Department of Education has no “Community College and Beyond” survey to match its “Baccalaureate and Beyond” survey.
- As a nationally representative survey, the ACS includes a large number of associate’s degree holders but, unlike bachelor’s degree holders, these college-educated respondents are not asked anything about what subject
they studied in community college. As a result, community college graduates with degrees in engineering technology cannot be identified in the data.

Some federal surveys—such as the Department of Labor’s National Longitudinal Survey of Youth and the Census Bureau’s Survey of Income and Program Participation—do include information on the field of study of respondents with associate’s degrees. Both of these datasets are particularly valuable to researchers because they are longitudinal and contain detailed information on labor market experiences. Unfortunately, the number of individuals with associate’s degrees in engineering technology in these surveys is small—in the dozens—making them inadequate for forming a reliable picture of the technician workforce.

Two pieces of the puzzle on technicians are, however, clearly addressed by existing data. Much is known from the IPEDS about the kinds of sub-baccalaureate ET degrees being produced. There are also household surveys and employer surveys that allow for the implicit separation of respondents employed as technicians from those employed as technologists using information on their educational attainment.

What’s missing are data similar to the NSCG or B&B that can be used to explore the interface between ET education in 2-year institutions and the ET labor market. The lack of comparable data for technicians makes it impossible to answer even the most basic questions about supply and demand, such as “how many individuals working as engineering technicians actually have a 2-year degree in engineering technology?” If technologists are any guide to this question, the answer is likely to be a fairly low share for technicians as well.

But perhaps technologists are not a good guide for understanding technicians. After all, 2-year degree programs are often much more directly responsive to employer demand than 4-year programs. Moreover, technicians are, as an occupational group, better known and less easily confused with engineers than technologists. The point is, in the absence of better data, any answer is speculative.

The lack of information about individuals with sub-baccalaureate degrees and certificates in engineering technology and STEM generally goes well beyond basic questions about supply and demand. The NSCG has a number of probing questions about work experiences that are never asked of technicians. Such questions concern primary tasks on the job, receipt of and reasons for on-the-job training, job satisfaction, and even reasons for working outside a respondent’s field of study.

The Rise of Certificates
When the National Research Council published its report on engineering technology education in 1985, certificates were not even mentioned (NRC 1985). Circumstances have changed dramatically since that time. As figure 1 shows, certificates are a major feature of the ET landscape today. Although 2-year institutions are still at the center of this workforce, it is now probably unhelpful to think of an associate’s degree alone as the defining credential for the occupation. Engineering technicians can have both associate’s degrees and certificates.

One important limitation of the data on the increase in the number of certificates is that while one can be fairly certain that most individuals do not typically earn two associate’s or bachelor’s degrees, it is quite possible that an individual would earn two or more certificates. The strong growth in certificate awards, then, does not necessarily represent growth on the same scale in the number of individuals earning certificates.

The growth in certificates coincides with and may have been related to the Department of Labor’s Trade Adjustment Assistance Community College and Career Training (TAACCCT) grant program, which furnished community colleges with approximately $2 billion in grants awarded between 2011 and 2014. A range of career and technical training fields were targeted, including engineering technology. Grantees were
required to use a career pathways framework, which can increase the production of certificates awarded at various points along the career pathway (Eyster et al. 2016). Whatever its origin, the recent rise in the number of certificates awarded is clearly an important feature of ET education, although one that is probably even less frequently acknowledged than the 4-year ET degree.

**Steps Forward**

**Sub-baccalaureate Data Collection**

The NSF clearly has interest in the sub-baccalaureate STEM population generally and in engineering technicians and technologists specifically. Since 1993 it has funded the Advanced Technological Education (ATE) centers, which directly engage the sub-baccalaureate STEM population in technological areas such as security, IT, energy and environment, and agriculture. Nine centers focus specifically on engineering technology (table 2).

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<thead>
<tr>
<th>ATE Center</th>
<th>College</th>
<th>State</th>
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<tbody>
<tr>
<td>Center for Advanced Automotive Technology (CAAT)</td>
<td>Macomb Community College</td>
<td>Michigan</td>
</tr>
<tr>
<td>Southeast Regional Center for Laser and Fiber Optics Education (LASER-TEC)</td>
<td>Indian River State College</td>
<td>Florida</td>
</tr>
<tr>
<td>Marine Advanced Technology Education Center (MATE)</td>
<td>Monterey Peninsula College</td>
<td>California</td>
</tr>
<tr>
<td>National Research Center for Materials Technology Education (MatEdU)</td>
<td>Edmonds Community College</td>
<td>Washington</td>
</tr>
<tr>
<td>Midwest Photonics Education Center (MPEC)</td>
<td>Indian Hills Community College</td>
<td>Iowa</td>
</tr>
<tr>
<td>National Center for Optics and Photonics Education (OP-TEC)</td>
<td>Network of Colleges</td>
<td>Texas</td>
</tr>
<tr>
<td>National Center for Supply Chain Technology Education (SCTE)</td>
<td>Norco College</td>
<td>California</td>
</tr>
<tr>
<td>Southeast Maritime Transportation Center (SMART)</td>
<td>Tidewater Community College</td>
<td>Virginia</td>
</tr>
<tr>
<td>National Resource Center for Aerospace Technical Education (SpaceTEC)</td>
<td>Eastern Florida State College</td>
<td>Florida</td>
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Source: Data from www.atecenters.org/et/.

Policy Measures

More substantive policy priorities emerge from recent research on ET education than simply that the federal government should collect better data. Educators and policymakers can make progress by (1) building capacity to respond quickly to shortages, (2) ensuring that engineering technology becomes a vehicle for diversity and inclusion, and (3) supporting the recent explosion of certificate awards.

Although engineering technology is an essential and underappreciated field, there are no clear signs that the workforce faces general or persistent shortages (see Frase et al. 2017, pp. 129–138). Nevertheless, some employers run into trouble recruiting a sufficient number of technicians and technologists, and temporary or local shortages are always a risk. In the face of these uncertainties, a better approach than manipulating the actual number of engineering technicians or technologists would be to instead build institutional capacity to respond nimbly to changes in demand.

Capacity building was a major focus of the TAACCCT grant program, to ensure that the impact
of a grant would extend past the end of the grant period. Capacity building is also at the heart of the ATE model, which focuses on developing innovative instructional programs at ATE centers that are then pushed out to colleges. Continued support for the ATE program and capacity building support through new grant programs similar to TAACCCT can help ensure that employer needs are met before large shortages emerge.

Another theme that emerges in the NAE report is that ET students are more diverse than those in engineering, offering a potential vehicle for advancing equity and inclusion. Although roughly the same shares of ET and engineering graduates are White, a higher share of non-White graduates are underrepresented minorities (Frase et al. 2017, p. 60). More research is required to understand why engineering technology is so accessible to these students, but it likely has to do with the relative affordability and access to community colleges, as well as the unintimidating use of mathematics in the classroom. The representation of underrepresented minorities is promising, and may suggest that engineering technology offers a valuable access route for them into the STEM workforce.

Nevertheless, to be effective ET programs must provide ample opportunities for interested students to transfer or matriculate into other STEM programs, including engineering science. The goal of empowering underrepresented student groups would be undermined if students ended up with restricted career options simply because engineering technology was the most welcoming STEM field when they first explored their postsecondary education options.

Finally, educators and policymakers should embrace the rise in ET certificate awards. Certificates—both in career and technical education generally and in engineering and engineering technology specifically—are valued in the labor market (Bahr 2014; Bahr et al. 2015; Dadgar and Trimble 2015; Jepsen et al. 2014). Strengthening credential options can also increase student completion of associate’s degrees, because stacked and latticed credential programs and career pathways make it easier for students to advance by pursuing more manageable educational goals (Bailey et al. 2015).

Conclusions
The recent NAE report considerably expands the knowledge base on the engineering technician and technologist workforce, but also highlights important data gaps that hamper study and understanding of the field. These data gaps are particularly notable for engineering technicians, who have less than a bachelor’s degree. This sub-baccalaureate sector of higher education is already relatively neglected by policymakers and STEM advocates, a neglect that is aggravated by the poor data on these students and workers.

Good data matters because data guide educational planners and policymakers, and better data are needed on engineering technicians. Nevertheless, there are more than enough data to take some important first steps forward.

Educators and policymakers should continue efforts to build the capacity for engineering technology education to respond to unanticipated demand growth. They should also cultivate engineering technology as an entry point into STEM for underrepresented minorities. Finally, educators and policymakers should be cognizant and supportive of the rapid growth in ET certificates, and take advantage of the flexibility of this type of credential for investing in the STEM workforce.

References


