How can we increase the quantity, quality and knowledge transfer of the current STEM workforce, education pipeline and labor supply?

By the year 2030 the proportion of the labor force made up of 45 to 59 year-olds is projected to increase from 25.6 percent to 31.8 percent, while the share of workers ages 60 and over is projected to rise from 4.7 percent to 7.8 percent.

A good example of the pending shortage is in the aerospace industry.

At The Boeing Company:
- 18% of employees are currently eligible to retire
- The current annual retirement is approximately 2%
- The percentage of employees eligible for retirement is projected to reach 25% in the next 5 years
- The annual retirement to increase by 50% over the next 5-6 years
- Over the next 15 years resignations and retirements will exceed current headcount – 150,000+
- Roughly a quarter of the nation's 637,000 aerospace workers could be eligible for retirement this year

Nationally by 2018, roughly 35 percent of the STEM workforce will be composed of those with sub-baccalaureate training, including:

- 1 million associate degrees
- 745,000 certificates, and
- 760,000 industry-based certifications

While a bachelor’s degree will remain a requirement for many STEM jobs, more than 30 percent of all jobs in STEM through 2018 will be for those with less than a bachelor’s degree. (Source: Kimberly A. Green, *The Career Pathways Effect*, joint publication of the Center for Occupational Research and Development and the National Association of State Directors of Career and Technical Education)

STEM wages are high and have kept up with wages as a whole over the last thirty years.
- Two-thirds (66%) of STEM workers with an associate degree make more than the average for workers without an associate degree.
- Wages for engineers and engineering technicians have grown 18 percent since the early 1980s.
It is important that industry better understand the specific skills required of engineering technicians and technologists. The degree profile below highlights the need to understand the national demographics of professional engineering and engineering technicians.

The example below defines the Skills Definition for General and Materials Technician. Competencies vary between different industries (Advanced Manufacturing vs. IT) a similar yet broader approach should be considered as part of the survey to map the skills requirements of employers back to engineering technology curricula. (Source: Data from National Resource Center for Materials Technology)
Finally: It might be interesting to understand the “dynamics over time” including the large numbers of people with STEM talent or degrees that divert from STEM occupations (both Professional and Engineering Technicians) either in school or later in their careers.

Our K-12 education system produces enough talent in math and science to fill our need for traditional STEM workers, but more than 75 percent of those students do not enter STEM majors in college. (Source: Career Pathways for STEM Technicians by Dan Hull)
Knowledge Capital, Human Capital creative ecosystem:
How do we move the U.S. K-12 Education System to a leading position by global standards? Where would you invest?

Population 65 and over is projected to increase from 39 million in 2010 to 69 million in 2030. (U.S. Census)

76% of High School Graduates did not meet entry-level readiness benchmarks in mathematics, science, reading and English. (ACT, 2009)

Industry current retirement rate will exceed 8% per year starting 2010

15.7% of the aerospace workforce is composed of 25-34 YO
60% of the workforce is 45 years and older (AIA)

167,936 total STEM graduates Note: Only 67,092 in engineering (IES, Table 285)

730k still interested in STEM (Grismore, et al., 2003)
1.2 million drop out by 12th grade (IES)
68% of U.S. State prison inmates are high school drop-outs (Bureau of Justice, 2003)

590k still interested in STEM (Grismore, et al., 2003)
340k declare STEM major (Grismore, et al., 2003)

Stephens-Scott-Richey 2010
Internships

Internships are one strategy to develop a strong future workforce.

Generally, an internship consists of an exchange of services for experience between the student and an organization. The internship agreement balances the intern's learning goals with the specific work the organization needs to have completed. Students can also use an internship to determine if they have an interest in a particular career, create a network of contacts or gain school credit. Some interns find permanent, paid employment with the organizations for which they interned. This can be a significant benefit to the employer as experienced interns often need little or no training when they begin regular employment and have been vetted by an internal team.

Interns, even at low experience levels, can do real work at a favorable labor rate. Offering interns real (even at low levels) work to do is a key element to a successful program – morale soars, the interns gain knowledge and the company gains a resource.

Interns can become ambassadors for a company back on their campus. Positive “peer to peer” advertising cannot be bought.

When establishing criteria for interns consider the following:

- Skills and qualifications
- Relevant coursework or class projects that relate to the internship
- Other internships and/or work experiences
- Extracurricular activities
- Leadership positions
- Honors and achievements

Also consider:

- Writing skills (proper spelling and grammar)
- Submission of a cover letter (shows an interest in the internship)
- Specific talents indicated in the application/resume as well as observed in the interview process, (such as being a self-starter, creative, positive, an achiever, adaptable, etc.) (Source: InternNE.com)

Keep in mind that you are working with a pool of students who may not have all of the desired qualifications/skills you seek since they’re still in school and may have little work experience. However, if you select students who have the right talents for the job, with some training, students may be able to learn these desired skills and even bring fresh, new perspectives and ideas. Choose candidates you feel have the most potential; then begin the interview process.

Diversity needs and targets can be handled directly (within the limits of supply available in the overall academic system) [Example: By conscious effort, the Boeing (BCA)
Summer intern Program was able to include a % of women three times the national average of engineering degrees granted, twice the average of African-Americans, and about the national average of Hispanics each year.

A choice of job sites can be provided if an enterprise-wide, multi-year corporate intern program is established. This amounts to transferring an initial “job rotation” program from a “difficult to do” new hire base to a more informal intern base – with much of the same positive benefits to interns and the company.

A carefully organized intern program can provide about 80% of what can be had from a standard co-op program – at a lower cost and with no disruption of a student’s graduation date. A supplemental co-op program for the “best” and/or neediest interns remains an open option to complement the basic intern program as resources are available for it. These benefits are not theoretical. Such a program can pay for itself, and everyone (interns and the company) wins.
Case Study:

Boeing’s Material Science Internship Program

Boeing Materials Manufacturing Structure and Support (MMSS) & Edmonds Community College Material Science Technology Educational Exposure Experience Program was developed to address identified needs on the part of both organizations.

M&PT laboratories require Technicians with specialized skills and knowledge unique to the aerospace industry. Current workforce consists mainly of “Senior” Technicians; and very few “less experienced” technicians are being nurtured within the organization. Material Science students needed to gain industry experience, both to excel in their program and to prepare for post-graduation placement.

- Students are required to be co-enrolled in the College program.
- Students rotate through the MMSS Laboratories over 11-weeks. Each student enrolled in the Program spends 8 to 12 hour per week (consisting of two 4-hour days) at 3 Boeing Sites.
- The students are exposed to the following areas within Materials & Processes Technology (M&PT):

<table>
<thead>
<tr>
<th>Interiors laboratory</th>
<th>Flammability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bonding</td>
<td>Mechanical testing</td>
</tr>
<tr>
<td>Composite lay-up</td>
<td>Composite repair</td>
</tr>
<tr>
<td>Cross sectioning</td>
<td>Photomicroscopy</td>
</tr>
<tr>
<td>Metallurgy</td>
<td>Non-destructive investigation</td>
</tr>
<tr>
<td>Thermal analysis</td>
<td>Analytical chemistry/failure analysis</td>
</tr>
<tr>
<td>Fuels and lubricants</td>
<td>Inorganic/organic finishes</td>
</tr>
<tr>
<td>Environmental</td>
<td>Residual stress</td>
</tr>
</tbody>
</table>
During the internships students acquire: An overview of M&PT Laboratories, interactive “live” training with senior technicians, basic laboratory skills in each lab assigned during internship and a fundamental understanding of how each technology applies to the Aircraft/Aerospace Industry.

A collaborative internship model is highly recommended. Identifying a team activity between complementary industries or corporate divisions to engage an intern in a broad spectrum project with a clear outcome, is an ideal learning mechanism and one that can be measured by the stakeholders. Interns can rotate through a variety of environments with different mentors, all designed to enhance learning and give employers an opportunity to preview potential skill levels for future employability.  (Source: George A. Parker, Associate Technical Fellow, Technical Lead Engineer, The Boeing Company)

This work is part of a larger project funded by the Advanced Technological Education Program of the National Science Foundation, DUE #1400619