BAYER FACTS OF SCIENCE EDUCATION XVI:

U.S. STEM Workforce Shortage – Myth or Reality? Fortune 1000 Talent Recruiters on the Debate

EXECUTIVE SUMMARY

Making Science Make Sense®
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Introduction

This year's *Bayer Facts of Science Education** survey, the 16th in the series, focuses on one of the major STEM (science, technology, engineering and mathematics) debates underway today in the United States: Is there, in fact, a STEM workforce shortage in the country or not?

Much has been made on either side of the debate.

At one end, there are those who argue the country is overproducing the number of Ph.D.s we need for research and development and academic posts[1]. The Economic Policy Institute, for example, cites fairly stagnant wages for mathematics-related professionals as an indicator of oversupply, as well as the fact that the job market for these professionals has been shrinking over the past five years[2].

At the opposite end, voices resonate about the larger pool of STEM workers. Here proponents contend that while the country may have enough Ph.D.s, there is a shortage of STEM workers who possess needed competencies acquired from two- and four-year courses of study that award baccalaureate and associates STEM degrees. This is a sizable portion of the nation's STEM workforce. In its *2012 Science and Engineering Indicators*, the National Science Foundation estimates that roughly three quarters of today's STEM workforce has a bachelor's degree or less.

Change the Equation's (CTEq) *Vital Signs* reports that presented state-by-state assessments of the STEM education and workforce landscape in all 50 states and the District of Columbia, concluded that even during the recent economic downturn, STEM skills have remained in high demand in every state. In a 2013 report, CTEq shows in the STEM occupations that job postings outnumbered unemployed people nearly two to one. In contrast, overall unemployed people outnumbered job postings in all occupations by nearly four to one[3].

Additionally, recent arguments have been made that the demand for workers with STEM skills and knowledge has been underestimated by official reports that track such demand, like those from the U.S. Department of Labor, because today there is growing demand for these workers to fill jobs not traditionally defined as STEM[4].

To help determine which arguments around supply and demand more accurately reflect the reality on the ground, this year's survey seeks the opinion of a cohort representing those with firsthand knowledge. Specifically, it asks talent recruiters at some of the country's largest employers – those included in the Fortune 1000 – to weigh in on current and future demand for new hires with two- and four-year STEM degrees.

Their perspective on this issue is important. As professionals responsible for scouting, recruiting and hiring talent at Fortune 1000 companies, both STEM and non-STEM alike, these individuals are on the frontlines, tasked with assessing and filling their companies' workforce needs. Bayer believes adding their voice to this debate is extremely valuable.

[1] *Survey of Earned Doctorates*, 2012, National Science Foundation
[2] *"Guestworkers in the high-skill U.S. labor market: An analysis of supply, employment, and wage trends,"* 2013, Economic Policy Institute
[3] *Vital Signs*, 2012, and *Vital Signs: STEM Help Wanted*, 2013, Change the Equation
[4] *STEM*, 2011, Georgetown University Center for Education and Workforce

These are just some of the questions the survey asks the talent recruiters:

- At their companies today, are new hires with two- and four-year STEM degrees as, more or less in demand for non-STEM jobs than their peers without STEM degrees? What do they expect demand to be 10 years from now?

- Are more STEM jobs being created today than non-STEM jobs at their companies? What is their prediction for 10 years from now?

- Can they find adequate numbers of qualified two- and four-year STEM degree holders today in a timely manner? Do they expect a shortage of such workers in the future?

- Within their industries, is competition fierce within particular STEM fields to fill open positions with highly qualified two- and four- year STEM degree candidates? If so, which fields are most competitive?

- Are unfilled STEM jobs bad for business? What exactly is the impact of unfilled STEM jobs on their companies?

- Are they seeing adequate numbers of qualified two- and four-year STEM degree holders who are female, African-American, Hispanic and American Indian?

- Do they view community colleges as an important component in the U.S. STEM education system?

CTEq's *Vital Signs* served as a catalyst for this survey in another sense, as well. While those reports noted demand for STEM skills and knowledge, they lacked a definition about what actual STEM skills and knowledge are most in demand by employers. To the extent possible, this survey attempts to codify these STEM competencies by asking talent recruiters about those they typically see in new hires with two- and four-year STEM degrees, those that are not needed, and those STEM competencies the talent recruiters wish these new hires possessed but don't. Among these graduates, the survey also asks if there is a mismatch between the STEM knowledge they possess and the knowledge they actually need to do their new jobs.

Bayer believes that the research findings presented here will help clarify the debate currently underway. In doing so, we hope it serves today's students as well as they make important decisions about their education and career paths. We also hope it helps the U.S. higher education system – both four-year colleges and universities, and two-year community and technical colleges – better understand the workforce needs of American employers as they work to educate the next generation of American workers.

Methodology

A total of 150 online (91) and telephone (59) interviews were completed of talent recruiters (TRs) at Fortune 1000 STEM and non-STEM companies.

While Fortune defines its companies in terms of industry (e.g. chemical, communications, etc.), it does not characterize them as STEM companies. In order to create such a list, Fortune 1000 companies with high R&D employment and expenditure were identified by matching companies on the 2011 Fortune list with a list of the 1,095 top non-European Union R&D intensive companies prepared by the European Commission. Companies appearing on both lists were included in the sample. The sample was then expanded to include other Fortune 1000 companies in each industry category in which at least half of the companies were listed in the EU listing. This was done in order to establish high R&D industry categories within the Fortune 1000 list, and thus define them as STEM companies. The two data sources used for the selection were:

- Fortune Datastore 2011 Fortune 1000 database; Fortune Datastore, NY, NY.
- 2012 EU R&D Investment Scoreboard; Luxembourg: Office for Official Publications of the European Communities, October 2012.
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In the survey responses, then, a respondent was classified as working at a STEM company if that company met one of the two criteria outlined above; i.e, they appeared on the EU list of high R&D investment companies or were in a Fortune 1000 industry category where more than half of the companies also appeared on the EU list.

Talent recruiters are a difficult group to reach. In order to do so, a formal letter was first sent to the senior human resource (HR) executives at all 1,000 companies from Jerry MacCleary, President of Bayer MaterialScience, LLC. It explained the purpose of the survey and invited the company to participate by having its talent recruiters complete the online survey. Included in the letter were multiple unique links so that multiple talent recruiters/managers at each company could access the online survey.
Reminder emails and calls were made several weeks after the initial letter was mailed.

Additionally ICR obtained several other supplemental lists of talent recruiters/managers at Fortune 1000 STEM and non-STEM companies. ICR contacted these talent recruiters/managers by telephone and via email to invite them to take the survey.
At the close of the field period, 150 individuals representing 117 unique companies participated in the survey, resulting in a 12 percent response from the Fortune 1000 overall.

Qualified respondents were screened to confirm that they were indeed talent recruiters/managers for a Fortune 1000 company. Based on the sample size, the statistical reliability achieved is +/- 8% margin of error at a 95% confidence level.

Demographic and Firmographic Profiles

The following summarizes the demographic profile of the talent recruiters at the Fortune 1000 companies polled in this survey (n=150).

- Talent recruiters responded proportionately to the actual distribution of STEM (33 percent) and non-STEM (67 percent) companies among these Fortune 1000 firms – non-STEM TRs = 60 percent and STEM TRs = 40 percent.

- The vast majority (76 percent) of the TRs are responsible for recruiting both STEM and non-STEM employees. Some 18 percent recruit STEM employees only, while six percent recruit only non-STEM employees.

- Few of the TRs have a degree in a STEM field – only 21 percent compared to 78 percent who do not have a STEM degree.

- Survey respondents are assigned a range of titles by their companies. One-third (36 percent) have recruiting titles, such as Manager Recruiting, Senior Recruiter and Corporate Recruiter, while one-quarter (24 percent) have talent acquisition titles like Director or Senior Director Talent Acquisition, Manager Talent Acquisition and VP Talent Acquisition. Some 17 percent hold Human Resource titles.

- Most of the TRs are seasoned. On average, they're 43 years old and have worked 14 years as a talent recruiter. Fully two-thirds (65 percent) have 11 years or more experience.

- Roughly half the TRs are female (52 percent) and roughly half are male (47 percent).

Firmographic profiles are as follows:

- The industries in which these TRs specialize run the gamut of those represented across the Fortune 1000. They include Financial Service/Real Estate/Insurance (12 percent); IT/Technology (11 percent); Manufacturing (10 percent); Engineering (9 percent); Sales/Marketing (8 percent); Energy/Utilities (6 percent); and Healthcare (5 percent), etc.

- In addition to being categorized as STEM and non-STEM, the companies were further categorized by industry using Standard Industrial Classification (SIC) code definitions. The four primary industries that the companies fell into are "Manufacturing" (37 percent); "Business and Professional Services (Services)" (21 percent); "Transportation, Communications, Utilities (TCU)" (16 percent) and "Finance, Insurance, Real Estate (FIRE)" (13 percent). Others industries include "Retail Trade," "Wholesale Trade" and "Mining."

- The lion's share of STEM companies are included in the Manufacturing industry category (31 percent) and Business and Professional Services (7 percent).

Key Survey Findings

STEM Degree Graduates = Preferred New Hires for Fortune 1000 Companies Now and in the Future

Today, STEM skills are in demand by employers for jobs that are traditionally considered non-STEM, with demand for two- and four-year graduates equipped with these skills exceeding demand for their counterparts who don't have these skills -- a trend that will continue a decade from now.

- Nine- in-10 (89 percent) of the talent recruiters (TRs) say today four-year STEM degree holders are "as/more" in demand than their counterparts without STEM degrees, with six- in-10 (59 percent) saying they are "more in demand."

- Eight- in-10 (79 percent) of the TRs say today two-year STEM degree holders are "as/more" in demand than their counterparts without STEM degrees, with nearly half (44 percent) saying they are "more in demand."

- Nine- in-10 (90 percent) TRs say 10 years from now four-year STEM degree holders will be "as/more" in demand than their counterparts without STEM degrees, with seven-in-10 (69 percent) saying they will be "more in demand" than their counterparts without STEM degrees.

- Three-quarters (73 percent) of the TRs say 10 years from now two-year STEM degree holders will be "as/more" in demand a decade from now, with roughly half (47 percent) saying they will be "more in demand" than their counterparts without STEM degrees.

STEM Degree = Access to a Range of Job Opportunities Now and in the Future

More STEM jobs are being created today than non-STEM jobs at both STEM and non-STEM companies, a trend that is expected to continue a decade from now.

- A large majority – fully two-thirds (67 percent) – of the TRs polled report that at their companies today, there are more new STEM jobs being created than non-STEM jobs.
    - While more TRs at STEM companies said this is true (87 percent), more than half of the TRs at non-STEM companies also said this was the case (53 percent).

- Even more of the TRs (75 percent) predict that, 10 years from now, there will be more STEM job creation than non-STEM job creation at their respective companies.
    - Again, this is something TRs at both STEM (85 percent) and non-STEM companies (68 percent) believe.

- Where will the jobs be in the future? When asked to predict the highest growth job at their companies a decade from now for two-year and four-year STEM degree holders, the TRs named information/computer technology and engineering (not IT/computer-related).

Highest Growth Job at Company 10 Years from Now		
	Four-Year **STEM Degree Holder (n=150)**	***Two-Year*** **STEM Degree Holder (n=140)**
Computer/Information Technology	41 percent	31 percent
Engineering (NOT IT/Computers)	34 percent	11 percent

Today's Need for Qualified Job Candidates with STEM Degrees

Finding an adequate number of qualified job candidates with two- and four-year degrees is an issue for many Fortune 1000 STEM and non-STEM companies.

- Only half of these Fortune 1000 TRs say they can find adequate numbers of qualified job candidates with either two-year (55 percent) or four-year (50 percent) STEM degrees in a timely manner.
    - TRs in the manufacturing industry (55 percent) in particular say it is difficult finding adequate numbers of four-year STEM degree holders.

- Of those who say they cannot find adequate numbers of qualified STEM job candidates, the vast majority believe it is because there is a shortage of qualified candidates - both two-year (90 percent) and four-year (94 percent) degree holders - who have the necessary STEM job skills.

- The lack of qualified candidates has led to a significant number of open, unfilled jobs at Fortune 1000 companies, particularly for four-year STEM degree holders. Of those TRs who say they can't find adequate numbers of qualified new hires with STEM degrees, nearly seven-in-10 (68 percent) report their companies have a significant number of open, unfilled STEM jobs for four-year STEM degree holders, while half (48 percent) report vacancies for two-year STEM degree holders.
    - Unfilled STEM jobs for four-year degree holders are more likely in the manufacturing industry (71 percent).

Tomorrow's Need for Qualified Job Candidates with STEM Degrees

While demand for two- and four-year STEM degree holders will continue to be strong in the next 10 years at both STEM and non-STEM companies, new hires with four-year STEM degrees, in particular, will be in short supply.

- In the next 10 years, a large majority – 68 percent – of TRs expect there will be a shortage of qualified job candidates who hold four-year degrees in STEM.
    - More than three-fourths (78 percent) of STEM company TRs expect such a shortage; six-in-10 (61 percent) of the non-STEM company TRs do.
    - More TRs at companies in the manufacturing (75 percent) and services (77 percent) industries predict a shortage of qualified four-year STEM degree candidates.

- While fewer of the TRs believe there will be a shortage of qualified two-year STEM degree holders, fully one-third (32 percent) do expect such a shortage.

Unfilled STEM Jobs are Bad for Business

The inability of Fortune 1000 companies to fill vacant STEM jobs with two- and four-year STEM holders has had various impacts on their businesses.

- Roughly half of the TRs report that unfilled STEM jobs at their companies have resulted in "lower productivity" (56 percent) and "limits to business growth" (47 percent).

- The TRs were split on the effect these vacancies have had on their job recruitment efforts. Some 46 percent say it has led to increased recruitment of job candidates from other countries.
    - STEM company TRs are more likely to report this type of recruitment activity (58 percent) than TRs at non-STEM companies (38 percent).

- One-third (35 percent) of the TRs say unfilled STEM jobs have led to "lower revenue" for their companies, compared to slightly more (38 percent) who said they have not.
    - TRs at service industry companies (53 percent) were more likely to report unfilled STEM jobs are linked to lower company revenue than the TRs at companies in the other industries.

Fierce Competition and Programs to Attract Qualified STEM Degree Graduates

Twice as many TRs state competition is fierce for four-year STEM degree candidates to fill open STEM jobs than it is for two-year STEM degree candidates.

- While nine-in-10 (89 percent) of the TRs report a high level of competition for four-year STEM degree holders, they're split over the level of competition for two-year STEM degree holders, with four-in-10 (43 percent) reporting fierce competition for these new hires.
    - Competition for four-year STEM degree holders is fiercest among STEM companies (97 percent) and those in the manufacturing industry (95 percent).

- Among TRs who report competition is stiff for two- and four-year STEM degree holders, they name these fields as the most competitive.

Most Fierce Competition for New Hires	
Four-Year **STEM Degree Graduates (n=134)**	***Two-Year*** **STEM Degree Graduates (n=51)**
Engineering outside of computers/IT (54 percent	Computer/Information Technology (57 percent)
Computer/Information Technology (50 percent)	Technicians (28 percent)
--	Engineering outside of computers/IT (24 percent)

- Virtually all Fortune 1000 companies have programs in place to find qualified four-year STEM degree graduates. Half of the TRs report having similar outreach programs aimed at two-year STEM degree holders.

- TRs at companies in the manufacturing industry are more likely to offer summer employment/job programs (89 percent) and partnerships and/or co-op programs (80 percent) for students at four year colleges and universities.

Programs Offered to Students to Find Qualified STEM Job Candidates		
	Four-Year **Colleges/Universities (n=150)**	***Two-Year*** **Colleges/Technical Schools (n=150)**
Offer Any Program (Net)	99 percent	53 percent
Internships	95 percent	29 percent
Recruitment Programs	91 percent	37 percent
Summer Employment or Job Programs	81 percent	32 percent
Partnerships and/or Co-op Programs	71 percent	28 percent
Scholarships	45 percent	10 percent

Desired Workforce Skills for Job Applicants

On the whole, four-year colleges and universities are successfully equipping STEM degree graduates with basic and advanced STEM competencies.

Four-Year **STEM Degree Holders (n=150)**	**Skills Actually Possess**
Basic mathematics skills	83 percent
Basic problem solving ability	82 percent
Active learning skills	79 percent
Mathematical reasoning abilities	74 percent
Basic science skills	74 percent
Advanced mathematical methods skills	69 percent
Inductive and deductive reasoning abilities	68 percent
Programming skills	65 percent
Creativity	64 percent
Critical thinking skills	61 percent
Communication skills	59 percent
Advanced science and science methods skills	56 percent
Team building skills	51 percent

Basic operating, maintenance and repair skills	51 percent
Advanced systems analysis and evaluation skills	50 percent
Complex problem solving skills	47 percent

Likewise, in general, community colleges and technical schools are equipping two-year STEM degree holders with basic STEM competencies.

Two-Year **STEM Degree Holders (n=96)**	**Skills Actually Possess**
Active learning skills	63 percent
Basic problem solving ability	62 percent
Basic mathematics skills	53 percent
Basic operating, maintenance and repair skills	53 percent
Basic science skills	52 percent
Communication skills	51 percent
Team building skills	48 percent
Critical thinking skills	46 percent

- Very few TRs – 19 percent or less – say these various STEM competencies are not needed by two- and four-year STEM degree holders.

- While the talent recruiters are fairly confident about the STEM competencies possessed by two- and four-year STEM degree holders, a notable number indicate several competencies they wish new hires possessed but don't. In fact, three of the top four are shared by both groups.

Skills Do Not Possess But Wish They Did		
	Four-Year **STEM Degree Graduates (n=150)**	***Two-Year*** **STEM Degree Graduates (n=96)**
Leadership skills	50 percent	45 percent
Conflict resolution skills	47 percent	42 percent
Complex problem solving skills	37 percent	44 percent
Team building skills	36 percent	-
Communication skills	29 percent	-
Advanced operating, maintenance, repair and troubleshooting skills	28 percent	-
Critical thinking skills	27 percent	-
Advanced systems analysis and evaluation skills	27 percent	42 percent
Advanced science and science methods skills	-	33 percent

Advanced mathematical methods skills	-	37 percent
Inductive and deductive reasoning abilities	-	29 percent
Mathematical reasoning abilities	-	29 percent

Does a STEM Knowledge Mismatch Exist?

To some extent, yes, a mismatch does exist between the STEM subject knowledge two- and four-year STEM degree holders have upon graduation and that which is needed for them to perform their new jobs. Further, employers who report such a mismatch often provide support programs to address it, particularly to four-year STEM degree holders.

- About three-quarters (72 percent) of these Fortune 1000 TRs state there is a mismatch between the STEM subject knowledge job candidates have upon graduation versus what is necessary to perform the job for which they are hired, regardless of two-year or four-year STEM degrees; only five percent or less say it is a "significant" mismatch.

- Of those reporting a knowledge mismatch, most say their companies typically address it by conducting internal training or mentoring/job shadowing for both two- and four-year degree STEM holders.

Programs to Address Mismatch	
Four-Year **STEM Degree****	**(n=117)**
Mentoring/job shadowing	40 percent
Internal training	27 percent
Non-site specific training	27 percent
External training	16 percent
Nothing/NA/Don't hire without skills	20 percent
Don't know	3 percent

** *Multiple Responses*

Programs to Address Mismatch	
Two-Year **STEM Degree****	**(n=73)**
Internal training	30 percent
Mentoring/job shadowing	26 percent
Non-site specific training	22 percent
External training	10 percent
Nothing/NA/Don't hire without skills	23 percent
Don't know	6 percent

** *Multiple Responses*

Underutilized STEM Resources and Talent

Community colleges are an often overlooked but essential part of the U.S. education system, especially when it comes to basic technical skills.

- Fully three-quarters (76 percent) of TRs at both STEM and non-STEM companies agree with a recent National Academies of Science report that says community colleges are "an often overlooked but essential component in the U.S. STEM education system. Community colleges provide not only general education but also many of the essential technical skills on which economic development and innovation are based."
    - TRs who see two-year STEM degree candidates (90 percent) and those at manufacturing industry companies (84 percent) are more likely to agree with this statement than TRs at service industry companies (64 percent). In fact, one-in-five (19 percent) of service industry TRs disagreed.

STEM underrepresentation of women, African-Americans, Hispanics and American Indians is still an issue among two- and four-year STEM degree holders.

- At their companies today, very few TRs at Fortune 1000 companies (16 percent or less) are seeing adequate numbers of qualified African-American, Hispanic and American Indian male and female job candidates who have two- and four-year STEM degrees.

- While more talent recruiters report seeing adequate numbers of Caucasian (33 percent) and Asian (39 percent) female job candidates with four-year STEM degrees than both females and males with these STEM degrees of all other minorities studied, the numbers are still well below those of Caucasian (67 percent) and Asian (59 percent) males.

See Adequate Number of Qualified New Job Candidates Who Are…		
	Four-Year **STEM Degree Holder (n=150)**	***Two-Year*** **STEM Degree Holder (n=99)**
Caucasian Male	67 percent	58 percent
Caucasian Female	33 percent	29 percent
Asian Male	59 percent	39 percent
Asian Female	39 percent	29 percent
African-American Male	13 percent	15 percent
African-American Female	11 percent	10 percent
Hispanic Male	15 percent	11 percent
Hispanic Female	11 percent	9 percent
American Indian Male	16 percent	10 percent
American Indian Female	10 percent	6 percent