100 CEO Leaders Discuss the Importance of STEM in U.S.
CEOs are concerned about the rapidly growing need for employees with skills in science, technology, engineering and mathematics (STEM). By 2018, there is expected to be a shortage 230,000 STEM employees—which presents a strategic challenge for U.S. companies and the U.S. economy. To explore these challenges, STEMconnector®, a leading organization for STEM education and careers, released a first-of-its-kind publication of ‘100 CEO Leaders in STEM’, presenting 100 corporate CEO profiles including their thought provoking views on the future of our national competitiveness and need for a STEM workforce. To gain additional insight into the survey, TCS’ Connected Marketing Solutions team analyzed and mined the CEOs’ responses to reveal additional trends, challenges and recommended solutions. This white paper presents the findings of the TCS analysis.

The 100 CEO Leaders in STEM represent companies that have a combined revenue of over $3.27 trillion, and employ over 7.59 million workers.
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Introduction

100 Corporate CEOs in America have grave concerns about the rapidly increasing need for employees with skills in science, technology, engineering and mathematics (STEM). They revealed their STEM concerns, and recommended STEM strategies and solutions, through the first-of-its kind publication of ‘100 CEO Leaders in STEM’ by STEMconnector®.

The challenge: STEM jobs are projected to grow 17% by 2018, and 71% of those jobs will be in computing. However, not enough U.S. students are developing STEM skills. Student enrollment and student achievement have been on the decline in the U.S. for some time—today only 17% of 12th graders are interested in STEM careers.

As skilled baby boomers retire, the U.S. faces a dearth of future STEM talent. By 2018, there is expected to be a shortage of 230,000 STEM employees. A lack of STEM skills has the potential to derail America’s technology leadership position, which would have a negative effect on the U.S. economy.

To explore these challenges, STEMconnector®, the lead organization for STEM education and careers, released a first-of-its-kind publication of ‘100 CEO Leaders in STEM’, presenting 100 corporate CEO profiles including their thought provoking views on the future of our national competitiveness and need for a STEM workforce.

To gain additional insight into the survey data, TCS’ Connected Marketing Solutions team conducted a detailed analysis of the CEO responses. The findings of the TCS analysis are presented in this white paper.

TCS Analysis Methodology

Each CEO was presented with 20 questions relating to STEM challenges and issues. Each was encouraged to answer 5 to 8 questions of their own choosing and to keep the responses between 600 and 750 words.

**STEM Questions Presented to Top 100 CEOs**

1. Why do you believe STEM education and workforce development are critical to our nation’s future?
2. How do you believe STEM education can improve a nation’s competitiveness?
3. Beyond standards, what are the first steps we should take to curb the STEM education crisis?
4. How do we encourage students to continue their study of STEM subjects, particularly women and underrepresented minorities?
5. What traits do corporate leaders need to effectively support and advance STEM education today?
6. How can we do a better job to strategically coordinate all those engaged in STEM across the company (across different departments)?
7. What do corporations need to do to create more STEM careers and fill existing jobs?
8. How has your corporation coordinated investments in education with future workforce needs?
9. What area of STEM are you most passionate about?
10. What principles do you apply to your professional and personal life to advance STEM education?
11. What is the key to smart STEM investments?
12. What STEM initiative that your company has supported are you most proud of?
13. Where do you see the biggest area of opportunity in advancing STEM jobs / careers?
14. How can we advance mentorships and apprenticeships in the STEM pipeline?
15. What is your advice to those involved in promoting STEM education?
16. What do we need in the U.S. to continue to be at the top of global innovation?
17. What is your advice on using private-public partnerships to tackle our most pressing education challenges in STEM?
18. How is your company connecting diversity initiatives with STEM initiatives? Is this a part of your comprehensive strategy?
19. How should those working to improve the STEM workforce measure success?
20. What counsel would you provide around "collaboration to achieve success" in STEM education and workforce?

The responses were reported in “100 CEO Leaders in STEM,” which STEMconnector® published in June, 2013. (Download the full publication at http://www.stemconnector.org/100CEOs).

TCS, an industry leader in business analytics and intelligence, used its Connected Marketing Solution’s Voice of Customer Analytics (VoCA) platform to analyze the responses of the CEOs of 100 leading companies across the US. VoCA churns out trends, sentiments, predictive and actionable insights from ad-hoc or unstructured Data Sources. In coordination with STEMconnector, TCS pooled the CEO responses in their VoCA platform, and prepared a taxonomy for categorizing the answers in various sectors. VoCA’s text-mining algorithms used this taxonomy to analyze each response, slot responses into categories, and extract key phrases, themes and opinions at various levels - first for each response, then for the entire set of responses to a given question, and finally for the entire questionnaire.

Based on the taxonomy and specific text-mining algorithms, VoCA revealed key themes and phrases, and common concerns and opinions. The system then identified patterns across the entire data set, extracted metrics and graphically summarized overall findings.
Top Five Focus Areas Emphasized by CEOs

TCS determined the top five focus areas by analyzing the number of times particular words were used by CEOs. The top 5 focus areas include:
#1: Technology (161 mentions) — The U.S. has long been regarded as the world’s global technology leader. Approximately 80% of the top 10 global Internet properties were “made in U.S.A,” including Google, Microsoft, Facebook, and Yahoo.

The general assessment among CEOs, however, is that U.S. technology development will suffer if there is a shortage of STEM talent. Simply put: you cannot innovate and implement technology solutions with a lack of STEM skills in cloud computing, big data, cybersecurity, app development, and other science and technology disciplines.

Jeff Immelt of General Electric says, “For any company or country to stay competitive, it needs two things: talent and technology. The foundation for both is a real investment and commitment to STEM education.”

#2: Women and Diversity (129 mentions) — “Women” and “Diversity,” when combined as a single term, were the second most-mentioned by CEOs, with good reason. Today, women and minorities represent 28% of the U.S. workforce—but only 7% of the STEM workforce. These groups present a significant opportunity for CEOs to source the needed STEM skills.

“I am passionate about finding ways to increase the number of women and minorities in the field,” says Dawne Hickton, of RTI International Metals, Inc. “Committing early to STEM education will build robust pipelines of future STEM employees.”

Where diversity is concerned, Steve Swad of Rosetta Stone says there is a high probability that many STEM students will have experience working on international projects. He says that language skills will be needed, as well as the ability “to think locally, as well as globally.”— that diversity is a key part of effectively collaborating with innovators across the world.

#3 Innovation (105 mentions) — CEOs agree that creativity and innovation across all industries and fields are the keys to future job creation and economic growth. Creativity and innovation will be driven by STEM talent.

"Job growth in STEM-related fields is growing at almost twice the rate of other fields," says Mark T. Bertolini of Aetna. “Our ability to continue to lead global innovation depends on our commitment to building a pipeline of the best and brightest doctors, engineers, scientists and developers.”

Ellen Kullman of DuPont agrees.

“The backbone of America’s economy is innovation and at the heart of innovation is science," she says. “From astronauts to social media, from Kevlar to the NFL — STEM careers are everywhere.”

William H. Swanson, Raytheon, explains “Science, technology, engineering and math are the foundation for innovation in this era of global competitiveness. Without STEM talent, the U.S. risks mediocrity, which would have unfortunate implications for our economy, industries and national security.”
#4 Economy (59 mentions) — While America’s unemployment rate remains stubbornly high, CEOs say STEM jobs are, and always will be, readily available. Over the next 10 years, an estimated 80 percent of the jobs in the U.S. will require technology skills, and by 2018, the U.S. will have more than 1.2 million new STEM-related occupations. More employees with STEM skills equates to a lower unemployment rate—a boon to the economy.

“In the last century, the economy was mostly driven by natural resources and manual labor,” says Facebook’s Mark Zuckerberg. “The economy of the future will be driven by knowledge and ideas. Science, technology, engineering, and math are going to be really important for everyone in this future.”

#5 Competitiveness (31 mentions) — There is wide agreement among CEOs that STEM education and development will be a win/win for the nation’s economic competitiveness. A technology-savvy workforce is the key to driving innovation, production, profitability, and economic growth.

Pierre Gauthier of Alstom U.S. and Canada, says, “We simply cannot preserve America’s role as an epicenter of innovation, create new jobs, and make our country more competitive on the global market without doubling down on efforts to train a more STEM-oriented workforce.”

John Chambers, Cisco, states that “Given the rapid speed of change in today’s global marketplace, a country must invest in its greatest asset – its people – and train them to excel in science, technology, engineering and math.”

STEM Jobs are projected to grow 17% by 2018.
Top Three Areas of Cross-Sector Consensus

TCS’ cross-sector analysis revealed strong CEO consensus on three key challenges:

**Consensus #1:** 40% of CEOs strongly support stem education of women and underrepresented minorities. In short, too few U.S. teachers have STEM skills. Approximately 30% of STEM teachers did not major in the field that they teach. Approximately 50% of schools do not have a focused STEM program. Approximately 50% of the nation's schools don’t offer calculus. And approximately 37% don’t offer physics.

CEOs have a strong desire to correct this problem by improving teacher skills and expanding STEM education.

“We need leaders, starting with teachers in primary school, who can create and sustain excitement for STEM subjects and celebrate individual successes in relevant fields, especially among young women and underrepresented groups,” says Marc Casper of Thermo Fisher Scientific.

**Consensus #2:** 35% of CEOs feel that technical training and innovation are essential for competitive advantage in the global marketplace.

“Enhancing our STEM education and workforce will improve the U.S.’ position in the global marketplace of ideas and commerce,” says Wick Moorman of Norfolk Southern Corporation. “And as an innovation leader, the U.S. will continue to attract individuals from a diverse range of backgrounds and skills, strengthening our competitive base.”

Andrew Liveris from The Dow Chemical Company shares that “In a world where countries are competing like companies, the best educated and most talented workforce is a critical factor for success.”

**Consensus #3:** 41% of CEOs feel that STEM education is important to train young students and professionals to meet future workforce needs.

Randall Stephenson of AT&T, Inc. says, “Developing STEM skills in young people will be increasingly important to this country’s ability to innovate and compete.”

Lowell McAdam of Verizon, says, “The demand is there. The real issue for Verizon and the country as a whole is on the supply side of the equation. Corporations need to develop and implement a concerted strategy for finding intellectual capital and investing in the education of our young people, so that we have a pipeline of capable workers to fill these knowledge-based jobs.”

McAdams notes that, “since 2000, the Verizon Foundation has invested over $900 million in its local communities, almost half of which has gone to support education initiatives.”

Jim Heppelmann of PTC states that “By getting today’s students passionate about careers in science, technology, engineering and mathematics, we create the pipeline of talent necessary to develop the leading technologies that will continue to be the backbone of our economy as well as our security and quality of life.”

Only 18% of US Bachelor Degrees are awarded to minorities, who represent 33% of the college age population.
Top Four CEO Recommendations

To ensure survival in a rapidly evolving global marketplace, CEOs recommend action in four areas:

**Recommendation #1: Grow and Develop a Strong STEM Workforce.** STEM development requires broad collaboration among public and private organizations, schools and universities, and other stakeholders.

To develop a strong STEM workforce, business leaders must invest both financial and human capital to develop teachers, expand experiential education programs (cooperative education and internships) and have current STEM employees mentor students and expose them to the possibilities of technology-related careers.

“The only way to change the situation is through public–private partnerships,” says Klaus Kleinfeld of Alcoa. “Industry identifies the needed skills, schools provide the training, and the public sector creates a supportive environment through policy and funding.”

**Recommendation #2: Foster Continued Innovation.** Dr. Paul E. Jacobs of Qualcomm Incorporated explains why innovation by STEM employees is central to Qualcomm’s success.

“As a global leader and developer of advanced wireless technologies, our highly skilled employees are our most important asset,” says Jacobs. “Their ability to calculate, analyze and innovate is the cornerstone of our achievements, and their expertise in STEM subject matter is critical to our continued success.”

Brian Roberts of Comcast points out that if it’s not a natural resource, most likely it was innovated or built by an engineer. “It’s not enough to be users of technology. We need people in the country who understand how things work and have the creativity to dream up new things that we can’t even imagine.”

Michael Long of Arrow Electronics, agrees. “We need to create a generation of STEM-literate innovators… When the traditional lines between business, education and art are blurred, mega-innovation happens.”

**Recommendation #3: Provide STEM Training.** To overcome the shortage of STEM talent, companies are rolling up their sleeves and establishing strategic programs that will develop and nurture the specific STEM skills they need to be competitive.

Tom Linebarger of Cummins says, “Industry must take a stronger stake in education by taking part in developing schools’ curriculum, creating internships for talented students, and supporting communities with valuable education opportunities and resources… Education is the single most important factor in achieving U.S. innovative competitiveness globally.”

**Recommendation #4: Recruit and Develop Women and Minorities with STEM Skills.** To address the shortage of STEM talent among women and minorities, CEOs are stepping up collaboration with minority and women’s organizations, establishing scholarship programs that encourage woman and minority students to pursue STEM degrees, and partnering with minority firms that provide STEM services.
“We believe there are three aspects to encouraging women and underrepresented minorities to continue pursuing STEM studies,” says Francisco D’Souza of Cognizant. “First, focus on generating interest with this population, particularly through engaging learning opportunities that appeal to their interests. Second, provide more minority and women STEM mentors and highlight role models for these young people. And finally, make them aware of the tremendous opportunities to make a significant impact on our world, which in turn will lead to tremendous economic opportunity for themselves and their families.”
Top Five Commitments from CEOs

To motivate future generations to the world of STEM, CEOs cite their top five commitments:

**Commitment #1:** Understand which STEM skills and experiences their organizations need to succeed.

Keeping up with STEM needs in today’s complex, rapidly changing marketplace requires a strategic approach. “Our ‘Auditor of the Future’ initiative gives us a forward-looking understanding of the skills and experiences our professionals need to successfully serve clients,” says John Veihmeyer of KPMG U.S. “Many of these skills fall within the STEM disciplines, in areas such as data and analytics, IT systems, controls, and processes.”

**Commitment #2:** Invest in STEM education.

“Beyond setting standards, the first step we should take to strengthen K–12 STEM education is to provide additional resources to recruit and train STEM teachers,” he says. “Next, the U.S. should broaden access to computer science courses in high school to ensure that all students have the opportunity to gain this foundational knowledge and explore careers in computing.”

**Commitment #3:** Increase their employees’ awareness of STEM challenges and establish cross-functional and cross-departmental engagement to align STEM initiatives with the company.

For internal-company STEM initiatives to be effective and company investments to generate the greatest results, business leaders are implementing enterprise approaches. “We established an Education Stakeholders Team that meets regularly to bring together key employees whose jobs involve K-16 education and workforce development to discuss and coordinate such initiatives,” says Rich Templeton of Texas Instruments. “The cross-functional, cross-departmental engagement helps align various initiatives with the company’s overall strategy and focus investment and involvement on effective programs. Outcomes and data from this team are shared broadly with our more than 33,200 employees via our intranet system.”

**Commitment #4:** Encourage employees to get involved with STEM initiatives outside of work to motivate and guide future STEM employees.

CEOs know that some of their biggest STEM advocates are employees who donate their own time and passion to motivate future STEM employees. Business leaders must cultivate awareness of STEM challenges the country is facing and encourage participation in STEM activities when away from the office. Dr. Paul Jacobs, of Qualcomm Incorporated, says “We need corporate leaders to make the commitment to advancing STEM education…. Our leaders must invest resources and time to provide mentorship and guidance.”
**Commitment #5:** Change perceptions within their communities by educating students, teachers, career counselors and parents about the varied opportunities that will require STEM skills. Tom King of National Grid U.S. explains what leaders must do to change perceptions.

“Our next step is to inspire everybody—from families, to students, to small business owners, to big corporations—to do their part,” says King. “If you build it, they will come. It’s about being proactive—understanding what you need and working as a team to make it happen.”
Conclusion

Though it’s true that American students are currently behind on STEM education, when compared to students across other regions of the globe, it is also true that America can rise to the challenge and reverse current trends.

Although awareness of America’s STEM challenges is growing among business and government leaders, more American citizens need to be made aware of the dire circumstances our country may face if we do not come together to drive change.

Top CEOs agree that private and public organizations must move from ideas to a strategic call to action to successfully address the problem with the same vigor and passion with which they effectively address so many other business problems they face.

STEMconnector’s “100 CEO Leaders in STEM” publication, as well as the refined analysis conducted by TCS, reveals the leadership actions top CEOs are taking to begin to resolve our STEM challenges. Our intent is to share top CEO insights with leaders across the business community, academia and government to spur increased awareness, communication and actionable STEM strategies and plans that generate results.
TCS Commitment to STEM

TCS' workforce development and community engagement strategies in the United States are focused on advanced and niche technology skill development and certification and the company is involved in numerous efforts to cultivate the talent that will make up the future technology workforce.

For example, in June of this year at CGI America, a nationwide gathering hosted by the Clinton Global Initiative in Chicago, Illinois, it was announced that TCS has joined US2020 as a Founding Leadership Partner. US2020 is a national STEM Education initiative that aims to engage one million science, technology, engineering and math (STEM) professionals in mentorship opportunities by the year 2020. TCS will be the lead partner in developing US2020's web-based matching technology that will help place STEM volunteers into high impact mentoring opportunities with top non-profits working across different grades, settings, and delivery models.

In June 2013, TCS sponsored STEMconnector’s 100 CEO Leaders in STEM publication, an unprecedented publication that presents 100 corporate CEO profiles including their thought provoking views on the future of our national competitiveness and need for a STEM workforce. TCS CEO N Chandrasekaran was one of the thought leaders in STEM featured in this seminal publication. TCS was also the Presenting Sponsor of the US News STEM Solutions Conference, a national gathering of over 2,000 leaders and visionaries in business, education, and government from around the United States.

TCS also announced the key issues and potential solutions to address STEM workforce issues, following the ‘Computer Science Executive Round Table on Education & Careers in the US’, that it hosted in partnership with STEMconnector®. This dynamic event held at the National Press Club in Washington, D.C. brought together executives, government officials and thought leaders sharing a common cause: increasing students’ interest and participation in computer science (CS), advocating for stronger educational policy, and implementing programs that will effectively excite and prepare students for computer science careers. The event was designed to assess the current status of computer science education and careers at a national and state level, and then create a blueprint for addressing the key issues through cross-sector collaboration.

TCS also recently kicked off the latest year of its own STEM education initiative – the TCS goIT Student Technology Program - a multi-tiered outreach program engaging students, parents, universities, and local government with the goal of increasing student excitement and participation in technology related careers. Since goIT’s launch in 2009, the program has evolved from a two-school camp to a national, year-long program that has influenced over 7,000 students across 35 school districts and this year will reach schools and students across 10 cities in the United States as well as Toronto, Canada.
STEMconnector®’s Commitment to STEM

STEMconnector® is “the one-stop-shop” for STEM information. With several products and services, STEMconnector® supports its members design, implement and measure their STEM strategies. Since its launch in 2011, we have been the leader in leveraging a network of STEM stakeholders and “making things happen.”

Our charge is to identify, inform and connect entities working in STEM Education & careers to assess smart STEM investments and results. Connecting the dots, collaboration, partnerships are the only way to get STEM education and STEM careers a reality and be effective. Resources must be maximized for STEM education and jobs. It takes collaborations at every level, starting in local communities and moving all the way to the national level.

STEMconnector® members and partners and media partners are totally committed to action. We have business, non-profit organizations, education, government and media all working together. STEMconnector® areas are to: Inform; Research; Recognize; Convene; Collaborate; Build Results. Our services such as STEMdaily®, EdTech Weekly; Special reports, Leadership publications and events; STEM Councils; Innovation Task Force; Food and Ag Council; STEM Results.

The CEOs in the 100 CEO Leaders in STEM pointed out in the emphasis on key words that technology was #1; that women and diversity was #2 and that innovation is #3. Thus, we are on all three subjects with vigor and discipline. We take the fact that by 2018 more than 50% of America ages 18 and under will be minorities. Women and are reported as of new data to only be less than 77 cents of a dollar compared to men’s wages with the exception of STEM jobs and then the difference is 92 cents.

Thus STEMconnector®, in partnership with many other organizations and corporations have formed Million Women Mentors (MWM) to support the advancement of women and minorities. STEM jobs are the economy of this nation and the fastest growing area. If we take each of the areas of STEM and apply to any industry, government or non-profit and select the skills needed – and identify the skills gap; we can then communicate the need to excite and train to maintain a competitive America.
Addendum: Detailed Analysis of CEO Responses to All 20 Questions

The TCS Connected Marketing Solutions examined and analyzed the CEO responses to each question in detail to identify specific terms used, determine trends and insights, and recommend specific actions that STEM advocates can take.

**Question #1: Why do you believe STEM education and workforce development are critical to our nation’s future?**

This question received 66 responses, more than any other question, a reflection of the passion CEOs have for supporting STEM education and development.

Michael Lamach of Ingersoll Rand, says “The future of any nation is dependent on having the right mix of workplace skills that are transferable and a steady supply of jobs.”

Tom Linebarger of Cummins says “Industry must take a stronger stake in education by taking part in developing schools’ curriculum, creating internships for talented students and supporting communities with valuable education opportunities and resources.”

The key insights identified in the CEO responses included the following:

- STEM education is the pillar for future occupational endeavors.
- Technological innovation and creativity will be required to survive in the competitive global market.
- Ability to understand and adapt to changing environment is the need of the hour.

The key terms they used included the following:

- Technical training, innovation, competitive advantage, technology-based, strong workforce

Based on our analysis of CEO responses, TCS offers the following suggestions to STEM advocates:

- U.S. students need to become more academically competent to be on par with their Asian counterparts and thrive in today’s global economy.
- Greater emphasis should be placed on improving science and math education for the upcoming generation of students.

**Question #2: How do you believe STEM education can improve a nation’s competitiveness?**

There is wide agreement among CEOs that interest in STEM careers will determine the success of our nation.

Pierre Gauthier, of Alstom U.S. and Canada, says “We simply cannot preserve America’s role as an epicenter of innovation, create new jobs and make our country more competitive on the global market without doubling down on efforts to train a more STEM-oriented workforce.”

The key insights identified in the CEO responses included the following:

- STEM education is a win/win for the nation’s economic competitiveness.
The economy of the future will be driven by knowledge and ideas.

Innovation in STEM-related fields is driving national economic policies.

A highly educated and skilled labor force is what drives innovation and production.

The key terms they used included the following:

- Technologically-savvy workforce, economic competitiveness, STEM education and labor force

**Question #3:** Beyond Standards, what are the first steps we should take to curb the STEM education crisis?

This question received 20 responses, which was the median number of responses across all questions. CEOs agree that curbing the STEM education crisis begins with teachers.

“The first step is to strengthen the talent base of our teachers in K-12,” says Dr. Wanda Austin of the Aerospace Corporation. “We also need to get the word out on the fabulous STEM careers for young people and how math and science lay a foundation for those careers. We don’t want them to opt out unknowingly.”

The key insights identified in the CEO responses included the following:

- STEM education should be made accessible to all students at all levels.
- Training and recruiting quality teachers is essential to make STEM education successful.
- The entire STEM ecosystem must work in tandem to improve students’ performance.

The key terms they used included the following:

- Shared vision, career success, stem concentrations, academic requirement, motivating students, training teachers

Based on our analysis of CEO responses, TCS offers the following suggestions to STEM advocates:

- Invest in programs and technologies that introduce young people to STEM disciplines at an early age, and continue that focus all the way through high school and college.
- Enlighten students to see the link between their STEM studies and the skills they need for a successful 21st-century career.

**Question #4:** How do we encourage students to continue their study of STEM subjects, particularly women and underrepresented minorities?

As stated earlier in this white paper, one of the biggest trends identified by the survey is the increased focus on STEM development for women and minorities.

The key insights identified in the CEO responses included the following:

- Women and some minority groups are underrepresented in STEM fields.
- We should increase the numbers of women and minorities in STEM fields; without their contributions, the U.S.’ economic and societal potential will not be reached.
The key terms they used included the following:

- Quality programs, student populations, society meetings, language skills, role models

Based on our analysis of CEO responses, TCS offers the following suggestions to STEM advocates:

- Showcasing the future opportunities in STEM-related careers for students, parents and teachers.
- Generating genuine excitement in STEM subjects within, and outside of, the classroom for today’s generation.
- Providing mentorship, especially to encourage women and minorities to embrace STEM development.

**Question #5.** What traits do corporate leaders need to effectively support and advance STEM education today?

CEOs agree that the key traits leaders need to advance STEM education are understanding and commitment. Tom King of National Grid U.S. explains what leaders must do to advance STEM education.

“Our next step is to inspire everybody—from families, to students, to small business owners, to big corporations—to do their part,” says King. “If you build it, they will come. It’s about being proactive—understanding what you need and working as a team to make it happen.”

The key insights identified in the CEO responses included the following:

- Leaders must have an understanding of the skills and experiences their organizations need to succeed.
- Leaders have to advance STEM education to create a pipeline they can use to continually renew their companies with current and fresh ideas.

The key terms they used included the following:

- STEM education, STEM discipline, talent development strategy, business models, changing environments

Based on our analysis of CEO responses, TCS offers the following suggestions to STEM advocates:

- Leaders must have an understanding of the skills and experiences their organizations need to succeed.
- Corporate leaders must convey passion, creativity and a willingness to engage in an effort to guide future generations to the world of STEM.

**Question #6:** How can we do a better job to strategically coordinate all those engaged in STEM across the company (across different departments)?

CEOs are aware that their STEM initiatives will only be effective within their companies if they receive broad collaboration across all departments.

“It’s critical to get employees involved,” says Greg Brown of Motorola Solutions. “When employees experience first-hand the joy of engaging a student in a field that could affect his or her future, they can’t help but get excited. Ongoing mentorship programs and after-school activities are a good way to do this, but one-day classroom volunteer events can have an immediate impact too. Our employees volunteered more than 55,000 hours in their communities.”
last year. Many of those hours were spent working with students on STEM projects. This inspired the students to enter STEM careers, and also inspired many of our employees to believe in the importance of the work we do.”

The key insights identified in the CEO responses included the following:

- Establishing STEM education and investment is a priority that begins at the top.
- Cross-functional, cross-departmental engagement helps align various initiatives with the company’s overall strategy and focus investment and involvement on effective programs.

The key terms they used included the following:

- Emerging STEM technology, diverse workforce, functional teams, volunteerism, social responsibility

Based on our analysis of CEO responses, TCS offers the following suggestions to STEM advocates:

- Evolve a central strategy that ties STEM education to corporate workforce needs.
- Create a list of regional projects that focuses on innovative approaches to STEM education.

**Question #7:** What do corporations need to do to create more STEM careers and fill existing jobs?

Greg Brown of Motorola Solutions explains what corporations must do to cultivate STEM knowledge and capabilities among their employees.

“Leaders have to advance STEM education to create a pipeline they can use to continually renew their companies with current and fresh ideas,” he says.

The key insights identified in the CEO responses included the following:

- Change perception by educating students, teachers, career counselors and parents about the varied opportunities that may require STEM skills.
- Develop and implement a concerted strategy for finding intellectual capital and investing in the education of young people so that they have a pipeline of capable workers to fill these vital knowledge-based jobs.

The key terms they used included the following:

- Knowledge-based jobs, role-specific job opportunities, STEM-related student teams, academic learning

Based on our analysis of CEO responses, TCS offers the following suggestions to STEM advocates:

- Offer STEM-specific job opportunities within companies, including internships, and provide career progression plans that specifically address the STEM fields.
- Corporations should look at the whole pipeline of talent, including apprenticeship programs for high school students or GED grads, internships for undergraduate students and development opportunities for mid-career professionals.
**Question #8:** How has your corporation coordinated investments in education with future workforce needs?

CEOs are fully aware they must invest time, money and commitment to grow a STEM workforce. Rich Templeton, of Texas Instruments explains that STEM is just like any other business investment that will generate business results. "We must move from being great philanthropists to being strategic investors who are looking for return on investment—with the ROI in this case being student achievement," says Templeton.

He further notes that STEM solutions take more than money. “They take investment and involvement,” says Templeton.

The key insights identified in the CEO responses included the following:

- Experiential education programs (cooperative education and internships) are invaluable ways for students to get a better understanding of their particular field of study and also to gain real-world, hands-on experience.
- Encouraging and supporting employees who mentor students and expose them to the possibilities of technology-related careers will go a long way in ensuring success of STEM initiatives.
- Providing STEM education to children and young adults, particularly women and minorities, is vital to building a diversified and innovative workforce for the future.

The key terms they used included the following:

- STEM opportunities, business leaders, workforce needs, work environment, quality learning, development programs, mentoring youth

**Question #9:** What area of STEM are you most passionate about?

The data reflects a growing passion among CEOs to support STEM initiatives. Mark Bertolini, of Aetna, says “I am more passionate about technology because technological advancements are driving discovery in all of the STEM disciplines.”

Carlos Rodriguez, of ADP, shares the sentiment: “I am personally very passionate about education as a path to advancement,” he says.

The key insights identified in the CEO responses included the following:

- Education is a path to advancement in an organization.
- STEM education is a way of empowering people, and making sure that everyone gets a chance to share the opportunities today.
- Corporations should prepare employees for roles of increasing responsibility and, in turn, providing educational assistance as part of comprehensive benefits package.
The key terms they used included the following:

- Workforce development, innovation and entrepreneurship, technological advancement, continuous learning

Based on our analysis of CEO responses, TCS offers the following suggestions to STEM advocates:

- Reconceptualize diversity as a recruiting tool and open the door to skilled and educated women and minorities.
- Empower educators with complete teaching solutions and affordable technologies so they can create interactive classrooms that capture students' interest and talents.

**Question #10:** What principles do you apply to your professional and personal life to advance STEM education?

Many CEOs are embracing STEM not only in their professional lives but in their personal lives as well.

“Personally, recognition of the importance of math and science skills is a family affair,” says Thomas R. Voss of Ameren Corporation. “STEM was central to my education, and Carol, my wife, is a former high school teacher. We encouraged STEM education with our children, and our daughter became a nuclear engineer. Now, we’re encouraging our grandchildren to embrace math and science. Professionally, our company has several programs in support of STEM education and many of my colleagues are very devoted to advancing its importance, particularly for women and minorities.”

The key insights identified in the CEO responses included the following:

- All respondents to this question have adopted, in their professional and personal lives, one of the guiding principles of STEM (i.e., “Realize One’s Potential”).
- Advancing STEM education, advancing diversity and inclusion are closely tied to one another.

The key terms they used included the following:

- Innovation, career training, continuous learning, encouraging students, good intentions

**Question #11:** What is the key to smart STEM investments?

CEOs offer a wide range of approaches to invest smartly in STEM programs and initiatives.

Anita Zucker of The Intertech Group says that for STEM investments to be smart, they “should have a specific purpose with a focus on a long-term, exponential impact. As we invest in STEM education initiatives, we increase visibility, which builds a workforce and a cache of future educators.”

Steve Bennett of Symantec says “the key to STEM investments is to seek partnerships with programs that have demonstrated measurable results.” He further comments on the importance of investment in sustainable programs and guaranteeing proper funding for STEM initiatives. “Together, we can turn the tide.”

The key insights identified in the CEO responses included the following:

- Investing in STEM education initiatives will increase visibility by building a workforce and a cache of future educators.
The key terms they used included the following:

- Collaborative investment opportunities, impact analysis, investment opportunities, employee development

Based on our analysis of CEO responses, TCS offers the following suggestions to STEM advocates:

- Identify scalable STEM opportunities, initiatives that are already working across regions or states, and invest in those.
- Forecast talent demand as an integral part of talent acquisition and management strategy.
- Augment use of staffing agencies and online job boards with new kinds of intermediaries, such as online platforms and networks of retired scientists and engineers. This will make it easier to match STEM demand with supply.

**Question #12: What STEM initiative that your company has supported are you most proud of?**

This question received the second-most responses among all 20 questions asked. This reflects a great deal of pride that CEOs have in supporting STEM development.

“The Girl Scouts National STEM hands-on learning program, IMAGINE Your STEM Future, is one of the most impressive initiatives I’ve seen,” says Randall Stevenson of AT&T. “The program is designed to inspire high school girls to pursue STEM studies and careers. Close to 900 volunteers, including many AT&T employees, helped reach more than 6,000 high school girls in economically disadvantaged communities across the country. And we found that girls who participated showed increased interest in science and math courses and STEM activities outside of school. They also improved their confidence, along with their critical thinking and problem-solving skills.”

Other programs CEOs are most proud of include:

- GoIT Student Technology Program, a multi-tiered outreach program with the goal of increasing student excitement about and participation in IT and technology related careers.
- Massachusetts Math + Science Initiative (MMSI), a $30 million initiative organized jointly by Mass Insight Education and Commonwealth of Massachusetts to help close the achievement gap for underserved students.
- Wolf Trap Early Learning Childhood STEM Learning Through the Arts program, an endeavor that integrates elements of the performing arts into existing school curriculum to teach science and mathematics to young children.
- Tech Girls Rock, an initiative that aims to inspire “tween” and teen girls to discover an interest in technology and tech-related educational opportunities and careers.
**Question #13:** Where do you see the biggest area of opportunity in advancing STEM jobs/careers?

CEOs see the most opportunity in advancing STEM jobs among two categories of people who currently represent a small percentage of STEM employees: women and minorities.

Dr. Chris Nelson of Kemen Industry says “The biggest opportunity will come through the recruiting and engagement of more women in science. We know women have the intelligence, creativity and ability, but areas of STEM continue to be male-dominated. I believe much of our future success will hinge on doubling the number of students interested in STEM-related areas of study, and that means a focused effort on programs to engage girls and women.”

The key insights identified in the CEO responses included the following:

- Communication needs to be done by the private and public sector alike about the huge array of jobs that require STEM education and skills.

- A smooth transition should take place between the exit of baby boomers and the inculcation of Gen Y employees into the organization without increasing the skill gap.

The key terms they used included the following:

- Baby boomers, ecommerce operations, career goals, learning environment, technological boom

Based on our analysis of CEO responses, TCS offers the following suggestions to STEM advocates:

- Provide teachers with tools to spark the imaginations of young students and guide them toward STEM careers.

- Give the students a solid math and science foundation and the knowledge that they can make a difference in society; this will go a long way toward attracting more people into STEM careers.

**Question #14:** How can we advance mentorships and apprenticeships in the STEM pipeline?

CEOs agree that corporate leaders need to get more creative in the way they establish and manage mentorships and apprenticeships.

According to Lowell McAdam of Verizon Communications, Verizon works with partners who are focused on this very issue, such as the National Academy Foundation (NAF). NAF establishes academies in underserved schools and provides students with specialized curricula in fields like engineering and IT.

“Verizon employees are very committed to the NAF program,” says McAdam. “They get involved by mentoring students, serving on local NAF advisory boards and hosting students at Verizon work locations where they hear from engineering, finance and IT professionals about academic and career paths in the STEM field. We also offer internships to NAF students, who have an opportunity to work for a Fortune 100 company, build their resumes, sharpen their skills and develop professional contacts, while Verizon helps to shape future industry leaders.”
The key insights identified in the CEO responses included the following:

- Sharing best practices about STEM-related partnerships and programs are key to helping grow mentorships and apprenticeships in the STEM pipeline.
- A program that helps companies establish effective apprentice programs, coupled with the matchmaking necessary to connect them with the most needy students – many of whom are in rural or inner city areas—could be helpful to significantly increase the availability of apprentice programs and the exposure of students to these real-world environments.

The key terms they used included the following:
- Internship programs, career opportunities, apprenticeship program, shareholder value

**Question #15: What is your advice to those involved in promoting STEM education?**

CEOs offer multiple solutions to STEM advocates to promote STEM education.

“I would tell companies that they already have the resources to promote STEM education and careers—their people,” says Jorge L. Benitiz of Accenture. “When Accenture engineers or software developers speak to students and describe their career paths, they help those students envision their own futures in STEM careers. I would also advise companies to team with nonprofits in relevant areas. There is incredible work going on all around the country, and, together, companies and nonprofits can make a difference in STEM and in careers for our young people.”

The key insights identified in the CEO responses included the following:

- Develop meaningful, long-standing partnerships with businesses in order to understand what types of STEM skill sets are needed in the workplace.
- Strike the right balance between technical and personal skills by putting equal emphasis on textual knowledge and people skills.
- Make the connection between what appear to be purely academic topics and exciting, practical, real world projects; this is what makes STEM exciting.
- Inform students at a young age what careers they can pursue with STEM education so they can take a full array of math and science classes in high school and beyond.
- Encourage leaders to take equal interest in promoting STEM education by investing resources and time to provide mentorship and guidance to students of all ages, and to encourage an entrepreneurial spirit and innovative way of thinking.

The key terms they used included the following:
- Career paths, teamwork mentality, encouragement program, STEM education
**Question #16:** What do we need in the U.S. to continue to be at the top of global innovation?

With an estimated shortage of 230,000 STEM workers by 2018, there is great concern among CEOs about America's ability to remain a global leader in technology innovation. This sentiment is summed up by Mark T. Bertolini of Aetna, Inc.

"Job growth in STEM-related fields is growing at almost twice the rate of other fields," says Bertolini. "Our ability to continue to lead global innovation depends on our commitment to building a pipeline of the best and brightest doctors, engineers, scientists and developers. Over the next 10 years, an estimated 80 percent of the jobs in the U.S. will require technology skills, and by 2018, the U.S. will have more than 1.2 million STEM-related occupations. Unlike many fields, STEM jobs will be readily available."

The key insights identified in the CEO responses included the following:

- In order to continue to lead, it is critically important to focus on three key areas: building capability and capacity, enhancing quality, and improving employability in STEM education.
- The intersection of technology and education is a key driver of innovation and a necessary component for the U.S. to maintain its status as a global leader.

The key terms they used included the following:

- Diversity initiatives, recruitment and development strategies, community obligations, inclusion initiatives

Based on our analysis of CEO responses, TCS offers the following suggestions to STEM advocates:

- Develop and support rigorous math and science curricula in all American elementary and secondary schools so that there is a wide and deep pool of graduating seniors that are genuinely prepared for technical school and college-level STEM studies.
- Cultivate an environment where innovation is rewarded and can flourish. That will require government and the private sector to work together to fund research and support quality education in science and technology.

**Question #17:** What is your advice on using private-public partnerships to tackle our most pressing education challenges in STEM?

CEOs show strong agreement that collaborative teams comprised of multiple private and public stakeholders are essential to resolve the STEM challenge.

Klaus Kleinfeld, Alcoa, explains why partnerships are critical.

"We are woefully behind," says Kleinfeld. "The only way to change the situation is through public-private partnerships: Industry identifies the needed skills, schools provide the training and the public sector creates a supportive environment through policy and funding."

Rex Tillerson of ExxonMobil says that "no one organization or company can address the issue alone. It requires a collective effort, and we are proud to play our part by partnering with leaders in the field and advancing programs that make a difference."
Alan Mulally of Ford Motor Company says “the most important thing is that we work together in partnership with leaders in education, government and business.”

The key insights identified in the CEO responses included the following:

- Private-public partnerships can enable the biggest, most sustainable results. Businesses need to help educators understand their needs for future employees by providing real-world experiences.
- Public-private partnerships are an essential component to creating a successful education-to-employment system because they allow for the marriage of supply and demand.

The key terms they used included the following:

Scholarship program, public-private partnerships, education-to-employment system, STEM talent

Based on our analysis of CEO responses, TCS offers the following suggestions to STEM advocates:

- A program that leverages the strengths and talents of each organization is the best way to create a complementary solution.
- Private-public partnerships can pool talent and resources to make a real difference, but participants need to communicate openly and candidly, make balanced contributions and be committed to seeing the initiative through.

**Question #18:** How is your company connecting diversity initiatives with STEM initiatives? Is this a part of your comprehensive strategy?

As discussed in this white paper, CEOs are clear on the need to reach out to women and minorities to identify new STEM talent. Their answers to this question also reveal that they understand the value of a more diverse workforce that expands their ability to grow globally.

Steve Swad of Rosetta Stone says there is a high probability that many STEM students will have experience working on international projects. He says that language skills will be needed, as well as the ability “to think locally, as well as globally”—and that diversity is a key part of collaborating with innovators across the world.

The key insights identified in the CEO responses included the following:

- Diversity in STEM education is a current problem and a future opportunity. Today women and minorities are 28% of the workforce, yet only 7% of it is STEM workforce. The earning potential of the population that is STEM trained is significantly higher (by 75%) than non-STEM jobs, which would give the companies opportunity for social inclusion at regional and national levels.
- Innovation is critically dependent on diverse human experiences, and a diverse STEM-trained workforce can be a significant competitive asset for a corporation.

The key terms they used included the following:

- Company’s diversity initiatives, sustainability target, STEM education strategy, talent development, women engineers
Question #19: How should those working to improve the STEM workforce measure success?

CEOs offered different metrics to measure the effectiveness of STEM programs and initiatives.

“When measuring the effectiveness of STEM investments and improving the STEM workforce, I would apply the same standard we apply to everything else,” says Jeffrey Immelt of GE. “That is: what are the outcomes? Are more girls and underserved minorities pursuing careers in math, science and technology, and are more jobs available for them? Is our manufacturing base growing and vibrant, and connected to that, can American manufacturers find the talent to fill the jobs? Are American companies as innovative, if not more so, than our international competitors?”

The key insights identified in the CEO responses included the following:

- Companies should pay attention to outcomes of investing in STEM practices.
- We should help foster an increase in girls and underserved minorities pursuing careers STEM, as well as career opportunities for these groups.
- Corporations should also attempt to measure levels of innovation within an organization and compared to its competitors.

The key terms they used included the following:

- STEM workforce, success, program assessment, education programs, business decisions, outcome data

Based on our analysis of CEO responses, TCS offers the following suggestions to STEM advocates:

- Appropriate program assessment, such as collecting output and outcome data and conducting thorough assessments at regular intervals, can determine which STEM education programs and strategies are effective and which need improvement. The process would also serve to direct funding to the most effective programs while still retaining the flexibility to invest in new and innovative programs.

Question #20: What counsel would you provide around “collaboration to achieve success” in STEM education and workforce?

All CEOs agree that collaboration among diverse private and public stakeholders is the key to success.

“This will require effective interventions on a number of levels,” says John C. Lechleiter of Eli Lilly and Company. “This work will go beyond the scope of any one organization, so effective collaborations are, by definition, essential. In my judgment, the main thing is to ensure that the collaborations are relentlessly focused on driving measurable results, and that they align resources and advocacy efforts behind what is working.”
The key insights identified in the CEO responses included the following:

- As business collaborates with academia, needs get identified and skills and experiences get transferred more efficiently and effectively. So organizations should get involved with the STEM initiatives taken to strengthen the link between real-world issues and what gets taught in the classroom.

- Companies should build relationships with their employees to increase both employees' morale and companies' bottom line.

The key terms they used included the following:

- Mentorship support, employment training program, research programs, curriculum development

Based on our analysis of CEO responses, TCS offers the following suggestions to STEM advocates:

- Companies should develop private-public collaborations.

- Companies should work together in partnership with leaders in education, government and business.
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