



No Shortage of Talent: How the Global Market is Producing the STEM Skills Needed for Growth

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The talent power needed for global economic growth comes from men and women armed with STEM skills – advanced knowledge of science, technology, engineering and mathematics. Many experts have raised the alarm to highlight looming shortages of such talent, raising the possibility of a diminished capacity for innovation and slower growth. But Accenture research shows that the supply of STEM talent is growing rapidly. The key is learning how to find it.

Scientists, technologists, engineers, mathematicians: these are the high-end knowledge workers who turn the wheel of the global economy.

Collectively, they share at least one thing in common, the STEM skills that are critical to economic growth. How critical? As the authors of a recent report put it: "Just as we would be unable to expand industry if we lacked the natural resource materials to build the factories (e.g., cement), or energy to power the plants, we cannot expand our technology economy without the needed human resources, in this case high-quality STEM graduates."¹

Many business leaders fear shortages of STEM talent in the coming years. For example, countless studies contend that the lack of people with the right skills could hold back economic growth, especially in developed economies.² And surveys show that

managers believe that they won't be able to find enough trained people to meet their needs.³

Consider that India produces one of the largest pools of engineers each year, but software association NASSCOM says that only 25 percent of them are readily employable.⁴ In the UK, two-thirds of senior executives from science, high-tech and IT firms say they can't find the STEM talent that they need.⁵ And in the US, concerns about the country's ability to "sustain its scientific and technological leadership" prompted a group of 15 prominent business organizations to join together with the goal of doubling the number of science, technology, engineering and mathematics graduates with bachelor's degrees by 2015.⁶

However, our research suggests that the problem is not one of shortages.

Instead, the problem is one of location mismatch: talented people are available but not always in the places where they are needed. For example, there may be a shortage of chemical engineers in Germany but a large and growing supply in China. What we are witnessing is the emergence of a truly global labor market for STEM talent – but one that lacks essential mechanisms for matching demand and supply of critical skills across geographic boundaries.

Location mismatch will force individual companies to venture well beyond their traditional hunting grounds – and the cost of search can be quite high. Gaps in labor market institutions will make it difficult for even well-heeled companies to find and keep STEM talent. For those reasons, we believe that there is a real opportunity for new "labor market intermediaries" (LMIs) to intercede in global labor markets.

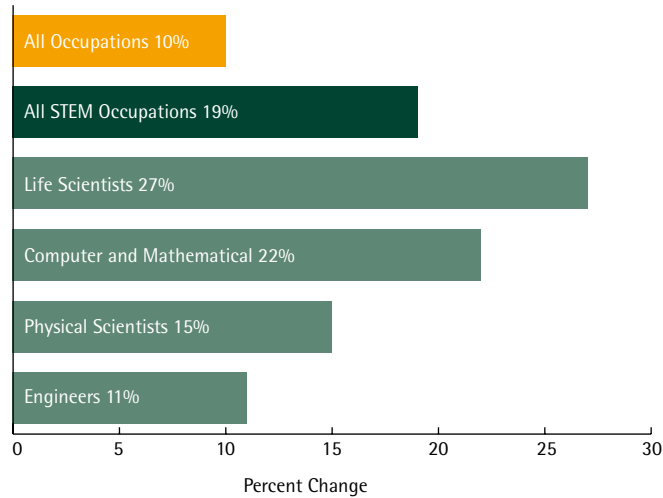
Explosive demand for STEM skills

With global economic growth expected to be driven by the life sciences, alternative energy, aging populations and consumption in emerging markets, the demand for STEM talent is set to explode in the next decade.⁷ In the United States alone, employment in STEM occupations is projected to grow almost twice as fast between 2008 and 2018 than employment in other occupations. (See Figure 1.) The size of India's tech sector will grow more than sixfold in seven years.⁸ The South Korean government is pumping \$200 billion into a new green smart grid project that is expected to create 500,000 tech jobs.⁹ In the UK, experts forecast an 80 percent increase in demand for biological science graduates and a 49 percent increase in demand for mathematical science and computing graduates between 2007 and 2017.¹⁰

Companies that rely on STEM skills are already in a frenzied grab for talent. In the United States, tech companies like Facebook, Amazon, Cognizant and Apple will need to fill upwards of 650,000 new jobs by 2018 to meet their growth projections. Two-thirds of the new hires will be STEM talent.¹¹ Google already announced it would "aggressively recruit" more than 6,200 workers in 2011 – mostly computer engineers.¹² In China, companies such as Baidu, Alibaba and Renren are swallowing up programmers, systems

Figure 1: Projected growth in the size of the US labor force 2008 – 2018 (percentage increase in employment)

Employment in STEM occupations is projected to grow almost two times faster than the average for all occupations.



Source: US Bureau of Labor Statistics, Employment Projections, 2010, as reported in Atkinson and Mayo, 2010.¹⁴

analysts and software engineers. There is also swelling demand for STEM skills in nascent industries like business analytics services, a market that has seen remarkable growth in the past three years and will exceed \$53 billion globally by 2013.¹³

High-tech companies are not the only ones in search of STEM skills – though they may have the advantage of a more modern image. Many of the skills needed by flourishing Internet companies are also coveted by established financial services, utilities and chemical companies like John Hancock, AES, and Dow. For example, in the insurance industry employers are searching for math, finance, physics and engineering graduates who can do sophisticated predictive analytics and comprehensive risk modeling.¹⁵ The same is true for the

utilities industry, which is scrambling to find enough electrical engineers just to meet increasing demands for power, never mind to invent, design and operate clean energy and smart grid technologies.¹⁶ The utilities' and insurance companies' main competition for STEM graduates? The more alluring technology companies like Apple, Samsung and Twitter – not to mention others such as Zynga, Solar Winds and Riverbed Technologies that are only now in their infancy.¹⁷

"My biggest talent imperative today and going forward is to ensure that our skills are sourced globally and not just locally. The right talent could be anywhere in the world."

— Rohit Tandon,
Worldwide head of analytics for HP

To complicate things further, developed market companies may increasingly find themselves in direct competition with emerging market companies for the same STEM talent. Two factors are important here. First, shifts in the global economy have led many emerging market companies to think seriously about moving into more profitable segments of the market by competing on product features rather than on labor-cost differentials. Pharmaceuticals in India are a case in point: for many years global majors like Pfizer and GSK sourced their products from generics manufacturers in India, but lately the latter (for example, Dr. Reddy)

have been positioning themselves to compete in the much more profitable prescription or patent drug business.

Second, economic growth in developing economies inspires entrepreneurship and creates new professional opportunities. Evidence of this can be found in the returning diasporas: the increased number of Indian, Chinese and Koreans who went abroad for education but have returned home to work.¹⁸ Even if the highly skilled are inclined to move, national governments may impose limits on their mobility or create incentives (such as have been initiated in Malaysia) to keep them inside their borders.¹⁹ Developed market countries that rely heavily on high-skill foreign STEM talent – the US awards more than 50 percent of engineering and computer science doctorates to foreign students—may find it more difficult to attract the world's best and brightest STEM talent.

Booming supply of STEM skills

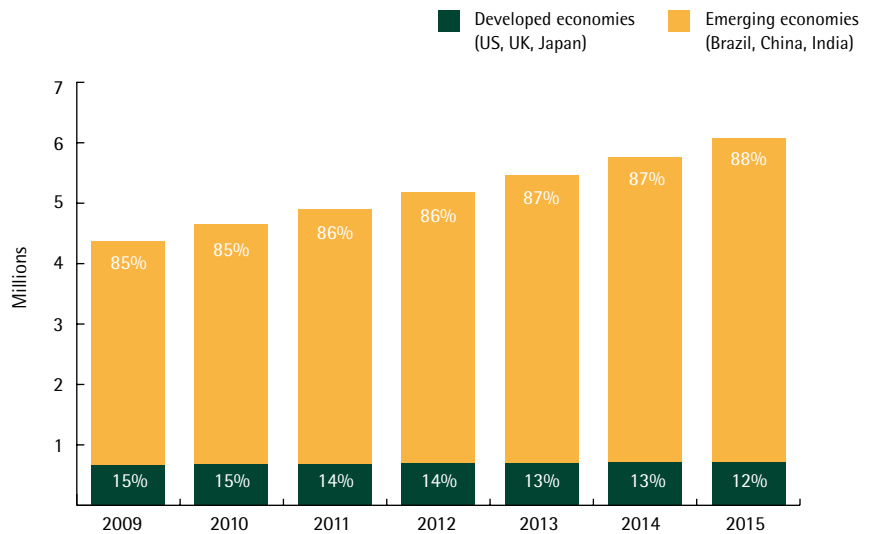
Despite general recognition of global growth in demand, it's highly unlikely that universities in developed economies will be able to simply turn up the dial and produce more STEM graduates in the next decade. Consider that the US graduated 88,000 visual and performance arts majors in 2008 but only 69,000 engineers.²⁰ The number of STEM graduates in the US would need to increase by 20 to 30 percent between 2006 and 2016 to meet the country's projected growth in science and engineering employment alone.²¹ That would require a collective effort on par with the one fueled by the space race between the United States and the Soviet Union in the late 1950s and early 1960s. And as many have observed, it would also require considerable innovation in STEM education and training – a challenge that some institutions are trying to meet. (See "Higher education: Producing 'business-ready' STEM talent.")

The STEM talent situation looks very different when we take a global view. China, India and Brazil are producing more and more of the world's STEM graduates. (See Figure 2.) In China, 41 percent of all new university degrees awarded are in science and engineering.²⁴ Comparable figures are 13 percent in the US, and 22 percent in the UK.²⁵ (See Figure 3.)

The emerging market economies are accelerating their production of STEM graduates much faster than the US and other developed countries. According to our projections, the number of engineering degrees awarded in China will grow from

Figure 2: Share of STEM talent: Emerging and developed economies

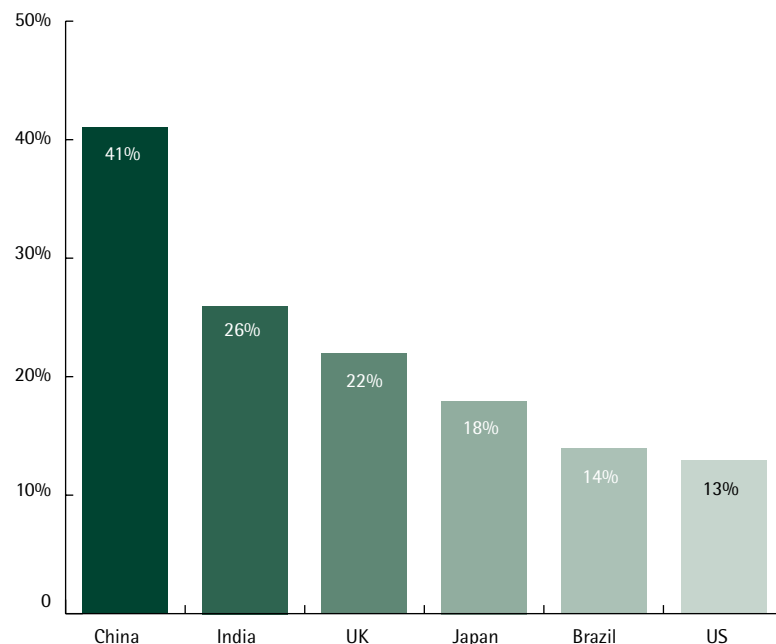
The three largest emerging economies already produce more STEM talent than three of the world's largest developed economies, claiming a higher percentage every year.



Source: Accenture Institute for High Performance analysis.

Figure 3: STEM degrees as a percentage of all degrees (2011)

In China, more than 40 percent of all degrees awarded are STEM degrees. In the US, just one in eight is a STEM degree.



Source: Accenture Institute for High Performance analysis

Higher education: Producing "business ready" STEM talent

One way to quickly produce more business-ready STEM talent is through innovation in education. In the 1990s, a new credential was introduced in the US higher education system: the Professional Science Master's degree, or PSM. These degree programs integrate science courses with business courses at about a 70 percent-30 percent ratio. An umbrella organization for PSM programs characterizes them as "science plus" and notes that they emphasize writing and communications, and generally require students to complete a team project as well as a "real world" internship at a business or in the public sector.²²

Today there are more than 230 PSM programs at 110 institutions in the United States. Total enrollments are still relatively small, however, with about 2,600 students enrolled per year.²³

Entirely new courses of study can also help fill market needs for STEM talent. At North Carolina State University in Raleigh, students can complete a Master's of Science in Analytics at the Institute for Advanced Analytics. Founded in 2007, the Institute was designed to equip students with the quantitative analysis and team-based decision-making skills increasingly needed in the business world. Employer demand for the Institute's graduates has risen every single year. Students in the class of 2011 secured an average of 14 job interviews, and more than 70 percent of the class received two

or more job offers. Over 90 percent were placed in jobs by graduation for the fourth straight year despite a lagging economy. Given its success, the Institute is doubling the size of the program from 40 to 80 students in 2012.

Clearly, these new types of programs and courses of study are only making small dents in the talent-supply problem so far. Over time, however, such innovations could do much more to fill the global need for STEM graduates who are also ready to step into business roles.

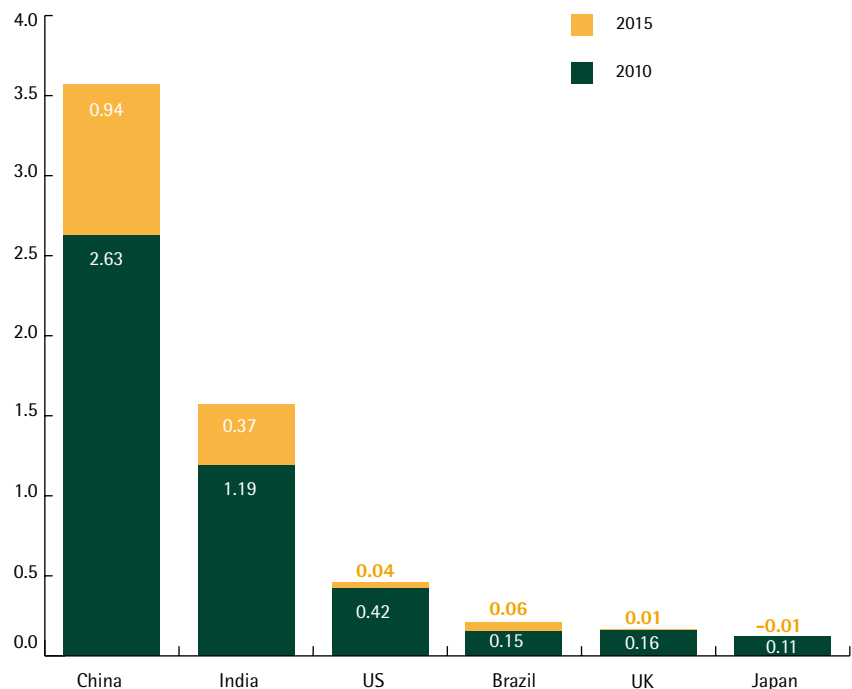
2.6 million in 2010 to 3.6 million in 2015.²⁶ (See Figure 4.) Chinese and Indian universities may not all be of comparable quality to each other, let alone to top universities in developed countries, but they still graduate most of the world's STEM talent.

Brazil has seen a tenfold increase in the number of PhD degrees awarded in the last two decades.²⁷ The country's new engineering graduates, though dwarfed in numbers by India and China, will grow 68% between 2009 and 2015, with the number of new PhDs estimated to more than double in that time (to 8,800, as compared to 9,933 in the US).²⁸ In fact, by our estimates, Brazil will produce more PhD engineers than the US by 2016.

Of course, there are persistent debates about how many STEM graduates from universities in developing countries are actually qualified for employment with domestic firms, let alone global

Figure 4: Technical/associate, graduate, post-graduate and doctoral STEM degrees (in millions), 2010 and 2015

China and India lead the way.



Source: Accenture Institute for High Performance analysis

multinationals.²⁹ Even if just one in five STEM graduates in China will be suitable for global employment (that is, approximately 720,000 would be candidates to work for multinationals), China is still producing more qualified STEM talent than the US, which will award 460,000 science, technology, engineering, and math degrees in 2015.³¹

Given this growth in supply, an absolute shortage in STEM talent does not appear to exist. The real problem for employers is a location mismatch: talent may not reside where it is needed. Accenture's 2010 High Performance Workforce Study revealed that in companies where R&D is a critical workforce, 24 percent of executives said that STEM skills were located in countries other than those in which they are needed.³² Only 21 percent said that the supply of skilled talent they need is extremely small or non-existent. For employers relying most on STEM talent, location mismatch is already a bigger problem than shortage. And as companies expand their global footprint, location mismatch is likely to become a problem for *any* company that relies on STEM talent.

So, despite what we anticipate to be a growth in the supply of STEM skills globally, the challenge for developed and emerging market companies alike will be finding and gaining access to talent that resides in different countries. Rohit Tandon, worldwide head of analytics for HP, notes that "my biggest talent imperative today and going forward is to ensure that

our skills are sourced globally and not just locally. The right talent could be anywhere in the world."³³

Of course, finding talent on a global scale and then employing it productively is not a simple chore. The costs of searching for skills in a global talent market can be prohibitive. And the risks associated with setting up outposts in countries with unsettled governing institutions will give even the most adventurous executives a reason to pause.

The real problem: location mismatch

Companies face twin challenges as they seek to source talent globally: an "information problem" in which they often lack the information about where skills are located and an "access problem" in which they may know where skills exist but have difficulty getting access to it.

Many CEOs see the challenge of locating and forecasting talent availability in emerging markets as a major hurdle to growth.³⁴ For instance, the CEO of a large international consumer goods company has said that "finding the appropriate talent to take advantage of the growth prospects of emerging markets is one of the biggest challenges we face."³⁵ The COO of a global airline echoed that complaint to us when he said that the lack of information about engineering talent in key emerging-market cities made it difficult to forecast his company's expansion to new growth centers with any level of confidence. A company seeking to open an office in Sao Paulo may know at a high level

that the country is churning out new engineers. But actually reaching those people is extraordinarily difficult in practice without any "boots on the ground." While it is possible to find STEM skills around the world, many employers lack the competency to search effectively in a global labor market.³⁶

On the other hand, even when companies know where STEM skills are available, accessing those skills can be problematic. Individuals' preferences are an important constraint; some people won't want to move, for example. However, there are also systemic barriers, such as government policies, employment and immigration laws, and infrastructure inadequacies that render skills in remote locations inaccessible.

The information and access problems are classic ones but they illustrate how the local focus of most companies leads them to declare the existence of a shortage when labor supplies dry up in their home markets. And they illustrate the relative immaturity of thinking and experience about global labor markets.³⁷

Perhaps not surprisingly then, most companies judge themselves ill-equipped to solve the location mismatch of talent demand and supply on their own. For example, an Accenture study featuring electronics and high tech firms reveals that few – only 17 percent – feel they are well-positioned to source talent worldwide.³⁸ The rest will struggle to find the STEM talent they need in their home markets.

Connecting talent supply and demand: The new intermediaries

What can companies do to secure the STEM skills they need? Companies have a few basic strategies for acquiring skills: build them internally through investments in training and development; buy them on the external labor market (this could, at times, involve “borrowing” skills from other firms by means of alliance or joint venture); or substitute for them with technology or work simplification.

Substitution is difficult because the flexibility, creativity and judgment that makes STEM talent so productive is impossible to program into software. In the long run, it is possible to imagine more STEM skills being simplified – in much the same way that analytical skills have been programmed into advanced diagnostic equipment in the pharmaceuticals business. But that is in a very long run.

To date, companies have largely focused on “build” or “buy” solutions, but neither solution is particularly satisfying. With the extended period of learning and preparation needed to acquire advanced STEM skills, it would simply take too long for companies to build advanced STEM skills internally.

That leaves most companies today forced to buy STEM skills on the open market – a task already fraught with information and access challenges that will become increasingly difficult as more employers join the hunt in what’s arguably a “massive, messy, moving” global talent market.³⁹

In the short run, there is a real opportunity for new intermediaries to intercede in the labor market and improve employers’ ability to find and access STEM talent wherever it is available. In some cases, these labor market intermediaries will be entirely new entities; others, however, will be new combinations of familiar organizations.

Companies have long relied on labor market intermediaries such as staffing agencies and online job boards to help them find employees.⁴⁰ However, over the past decade, several new types of intermediaries have emerged.

An example is Kaggle, an online platform to which companies post data sets and problems to be analyzed and answered by Kaggle’s global community of more than 10,000 scientists.⁴¹ Founded in 2010 in Australia, Kaggle draws in scientists from quantitative fields such as computer science, statistics, econometrics, maths and physics, and from over 100 countries and 200 universities. The Heritage Provider Network, a California physicians group, has partnered with Kaggle to offer a \$3 million prize to the contestant who creates the algorithm that best predicts which patients are likely to be hospitalized in the coming year; the aim is to help Heritage offer preventive care. An executive with the physician’s group notes that \$3 million might let

him hire 20 or 30 PhDs. But, with a prize offered in that amount, “you’re going to get a lot more than 20 people participating.”⁴²

Another new intermediary is YourEncore, which focuses on engaging a growing segment of experienced talent: retirees. YourEncore maintains a network of “Experts” – retired scientists and engineers – who are called on to work on projects at more than 50 companies, such as P&G, Eli Lilly, and General Mills. One YourEncore Expert, a retired chemical engineer who had spent 35 years specializing in color for Kodak, helped a consumer-products client solve a color challenge with a new hair-care product.⁴³

More and more, innovative intermediaries like Kaggle and YourEncore are helping employers find the talent they need, especially STEM talent. In a world of mismatch between supply and demand, labor market intermediaries will be an essential component of the most successful companies’ global sourcing strategies.

Looking ahead: A research plan

The Accenture Institute for High Performance has embarked on a study of demand-supply mismatch and new labor market intermediaries in the global market for STEM talent. The intent of this investigation is not simply to document the problem of location mismatch or to explain how labor market intermediaries may bring about a better match between demand and supply. It is to show how the use of widely scattered data and new analytical techniques can help employers and policymakers understand how and where to find, access and develop essential talent.

Given the wide variety of occupations and skills that fall under the STEM category and the scarcity of data that would allow for meaningful comparisons on a global scale, we narrowed our empirical investigation to a slice of the STEM talent pool: analytical talent. By analytical talent, we mean people who use statistics, rigorous quantitative analysis and information-modeling techniques to shape and make business decisions.⁴⁴ Because math plays a "rapidly increasing role as a universal language for science," people with advanced quantitative skills participate in perhaps the closest thing to a truly global labor market.⁴⁵

We are collecting previously unavailable data in order to test our hypothesis about the existence of a "location mismatch" in the market for analytical talent in six industries and seven

countries. The industries – banking, insurance, communications technology, oil and gas, pharmaceuticals and analytics services – are all major users of analytical talent. The countries – US, UK, Japan, Singapore, China, India and Brazil – represent a mix of developed and developing economies and, more important, each is both a producer and a consumer of analytical talent.

We are collecting new data in four ways:

Talent supply mapping on a global scale. We are examining current supplies of two analytical talent pools in each of the seven target countries. First, we are tracking the analytical talent already present in the six industries in each country. Second, we are tracking the fresh talent coming out of universities with bachelor's, master's and PhD degrees in math, statistics, operations research and other quantitative fields. We then use economic forecasts and data from employers and universities to estimate the supply of and demand for analytical talent over the next five years in each country and industry.

Industry case studies. Company records, interviews with labor market experts, and secondary sources will help us ground the investigation in an industry and individual enterprise context. Our industry-specific approach will add unique perspectives on the exact nature of the talent mismatch as well as provide insights for firms that want to know what kind of analytical talent they need and where supplies are located.

Country analyses. Each country offers a different vantage point on the supply of and demand for analytical talent.

Some, like the US, the UK and Japan, are likely to face a shortfall in the domestic supply of analytical talent. Others, like China, India, and Brazil are likely to become net exporters of analytical talent – unless, of course, their own indigenous demand exceeds local supply. For each country, we will describe the landscape of talent creation and assess the major institutions that produce analytical talent.

Matching mechanisms. Once we have completed the analysis of supply and demand, we will examine alternative strategies that companies, governments and social-sector organizations can use to resolve the location mismatch in the market for analytical talent, with a particular focus on understanding the role of new labor market intermediaries. This assessment will provide a dramatically new look at the STEM skill situation on a global scale.

Whatever their form and function, institutions that aid individual employers and job seekers in finding a match of appropriate skills and talent are poised to become important players in global labor markets in the next decade. For individual firms and global economic growth alike, their role in resolving the location mismatch of STEM talent will be critical.

About the authors

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About Accenture

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