Whither the Job Market?

We tapped a bevy of engineering “forecasters” to find out what fields will be hottest in the decade to come.

Surprising as it may sound, the most common undergraduate degree among today’s CEOs isn’t business or economics. It’s engineering.

More than ever, engineers are venturing into just about every niche of corporate America. Both Lee Raymond, who runs ExxonMobil, and Jack Welch, the man who famously brought GE back from the edge, have PhDs in chemical engineering. Philip Condit’s combined degrees in mechanical and aeronautical engineering helped him run Boeing from 1996 to 2003, and Gordon Harton, the retired president of the Lee jeans brand, didn’t study fashion design; he earned a degree in industrial engineering. Here at Johns Hopkins, both President William R. Brody and new Provost Kristina Johnson are electrical engineers.

It would be an understatement to say that the demand for engineers has broadened beyond labs and engineering firms. Without a doubt, engineers will continue to be needed to fill the roles we’ve come to expect—designing bridges, building robots, creating computer code. But today, the pace at which highly trained engineers are being sought by sectors of America’s non-engineering job market is increasing faster than ever.

The U.S. Bureau of Labor optimistically predicts a 9 percent to 17 percent increase in engineering jobs between 2004 and 2014 (with the caveat that the boosted job market “varies by specialty”), while a 2005 report to Congress from members of the National Academies predicts an alarming dearth of American engineers over the next 10 years. All of this comes at a time when U.S. companies, particularly in the fields of manufacturing and engineering, are moving significant portions of their operations overseas—from their customer help desks to their manufacturing facilities.
In such a dramatically shifting job market, young engineers collectively scratch their heads and wonder: In 10 years, how many jobs for engineers will exist in the United States, what will those jobs be, and how do we best prepare for them?

Gusts of Change

In 1853, a young man named Daniel Coit Gilman sailed to Europe to serve for two years as attaché of the American legation in St. Petersburg. During his time abroad, the newly minted Yale graduate became an arduous observer of the European educational system, visiting colleges in Britain and across Europe. But it was the German institutions that caught his attention, and he found himself attending lectures at the University of Berlin during the cold winter months of 1855.

The time in Germany had an impact. Gilman, who became Johns Hopkins’ founding president in 1875, built a university on the principles of German education, emphasizing research and scholarly publications. Gilman was a genius for his ability to understand society’s need for scientific study and professional training at an advanced level. Under his guidance, Johns Hopkins became the country’s first research university, setting the course for the development and future success of the university’s School of Engineering.

When admitting its first engineering students in 1912, Johns Hopkins adhered to its original mission of the pursuit of knowledge through research. For nearly a century, the School of Engineering has continued to fuse advanced scholarship with research and applied technologies, preparing students to think broadly and beyond the narrow constraints of a single field of study.

But that kind of research-based preparation isn’t the norm among American universities according to Bill Kelly, the manager of public affairs for the American Society for Engineering Education (ASEE). He points a disappointed finger at the “fairly slow” rate at which the majority of American academia has customized the education of engineers to match the rapidly advancing technologies of today’s world.

Kelly, who before joining the ASEE in 2007 served as dean of the School of Engineering for The Catholic University of America, explains that America’s trend toward outsourcing overseas has focused mainly on routine engineering work and says that, meanwhile, the “demand for expert thinking has grown.” As the work being performed in the U.S. becomes increasingly sophisticated and technology-dependent, he says that the marketplace will demand more engineers like those from Johns Hopkins who can apply concepts and theory in a highly innovative setting.

“Overall, change in engineering education is going to have to pick up the pace,” he says. “Advancing engineering education will require getting undergraduates into faculty labs, into internships and study abroad programs, performing work that isn’t routine, and gaining experience that reflects the type of work happening in the real world.”

Whiting School Dean Nick Jones couldn’t agree more and notes that Hopkins is ahead of the curve regarding this educational philosophy. “Here at Hopkins, we’ve always believed that engineering education should be highly conceptual and theoretical,” he says. “We’ve also placed a growing focus on the application of

Mock Interview Night: A Serious Approach to the Job Hunt

In November 2006, Zan Liu, MS ’06, PhD ’07, attended the Whiting School’s annual Mock Interview Night hoping to get advice on the job market and network with industry professionals. He ended up with that and much more, including, by the time he graduated, a job offer.

Sponsored by the JHU Society of Engineering Alumni (SEA), Mock Interview Night is an opportunity for current engineering students to practice their interviewing skills in an informal setting with volunteers who include JHU alumni and professionals from the business community. “Going to the mock interview night was absolutely very successful for me,” Liu says. After the event ended, Liu introduced himself to Russ Lindemann ’85, who graduated with a degree in mechanical engineering and is now product applications manager for Baltimore Aircoil Company (BAC).
practical experience. This includes required senior design courses, the chance to take part in mock interviews with alumni, opportunities to study abroad, engineering-related business courses, and collaborating with faculty on research. All of these activities prepare our graduates to succeed in the workforce by giving them a highly effective balance of theory and application.”

Such is the case with civil engineering major Zach Rosswog ’08, who supplemented his Hopkins coursework with two internships. “Interning after my sophomore year and my junior year really gave me an advantage,” he says. The first summer he worked for three months at STV Inc., a structural design firm in Baltimore, and the following summer at American Bridge, a building contracting firm in his hometown of Pittsburgh.

“At STV, I was involved with a lot of design projects, which included lots of analysis and office work,” Rosswog recalls. “At American Bridge, the work was much more hands-on. We did projects like bridge inspections, where we spread cables apart to check for corrosion before then re-compacting them. I learned a lot more when I was out in the construction site, experiencing everything in real life instead of designing projects at a computer.” He adds with a sheepish smile, “I like to be outside, not sitting behind a desk.”

Just a month after his internship ended last summer, American Bridge sent him a letter asking him to join them as a field engineer after he graduates in May. “I wasn’t expecting it at all,” he recalls. “They had told me to follow up with them in six months, so it was a real surprise.”

In addition to his civil engineering major, Rosswog pursued a minor in entrepreneurship and management, the most popular minor at Homewood according to Mark Presnell, director of Student Career Services on the Homewood campus. “I don’t know of another school that offers this—it’s like a business school within an engineering school,” Presnell says. “It produces engineers who have quantitative backgrounds and fantastic business skills.”

This preparation is particularly valuable in today’s job market. “I’ve noticed an increased demand for well-educated engineers from many business sectors”—including consulting firms and those on Wall Street, he says. “Overall, all of our graduates understand the theoretical base of engineering. And that conceptual engineering knowledge is enhanced by research-based coursework and through minors and concentrations in other areas that combine to give them, as graduates, an edge that their peers from other universities may not have,” says Presnell.

Sarah Parola is a prime example. She earned an undergraduate degree in Biomedical Engineering (BME) in 2001 and immediately landed a job doing bench research at Merck in Rahway, New Jersey. However, she says that her Hopkins BME background made her “want to see the bigger picture.” Soon, she was working her way up the ranks toward management.

“Now I’m in the manufacturing division in Whitehouse, New Jersey, doing strategic capacity management. We look at all of the assets in the company—all the vaccines we own, all the chemical-based drugs, all the facilities—and then we determine, for example, at what location new products should be produced.” In this larger role, Parola works on a team with other engineers to make those strategic decisions. Yet, she says, because she’s the only team member with a background in biology, she has a unique perspective that adds much-needed value to the group.

Parola’s desire to see the “bigger picture” hasn’t diminished. She’s already added a master’s degree in chemical engineering to her skill set and is broadening her focus even more by working toward an MBA at New York University.

In the view of Murray Sachs, who recently stepped down after 17 years as the director of
Hopkins’ BME department, Parola’s experience isn’t unusual. “Because of the breadth of their education,” he says, “and because of the evolution of the industry, BME graduates have more interesting careers than ever before.”

Elliot McVeigh, Sachs’ successor as department director, concurs. “Our graduates are fully prepared to enter rapidly growing industries like the medical device or pharmaceutical industries. There are thousands of companies to choose from, from small start-ups to big companies.”

**Top Five Starting Salaries for Engineering Disciplines Offered at WSE**

<table>
<thead>
<tr>
<th>Curriculum</th>
<th>Bachelor’s</th>
<th>Master’s</th>
<th>PhD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical</td>
<td>$53,813</td>
<td>$57,260</td>
<td>$79,591</td>
</tr>
<tr>
<td>Computer</td>
<td>$52,464</td>
<td>$60,354</td>
<td>$69,625</td>
</tr>
<tr>
<td>Electrical/electronics and communications</td>
<td>$51,888</td>
<td>$64,416</td>
<td>$80,206</td>
</tr>
<tr>
<td>Materials</td>
<td>$50,982</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Mechanical</td>
<td>$50,236</td>
<td>$59,880</td>
<td>$68,299</td>
</tr>
</tbody>
</table>

**Mostly Sunny With Scattered Clouds**

McVeigh predicts a robust job market for biomedical engineers over the next five years as the need increases for “people skilled in bioinformatics who can process and analyze the huge array of patient data that doctors gather.”

Already, he says, the amount of information hospitals collect is staggering and soon, “doctors will have more patient information than we know what to do with.” McVeigh believes biomedical engineers will be key to developing these tools.

Similarly, he predicts there will be a major push over the next 15 years toward a reduction in the cost of medicines. “As baby boomers age, economics will force us to turn our attention to more efficient, more effective, and less expensive delivery of advanced health care.” This trend will spur an increased demand for engineers who can successfully unite biology and business, including biomedical engineers, he believes.

McVeigh’s predictions are supported by a recent U.S. Bureau of Labor report, which forecasts job growth rates for the decade between 2004 and 2014. According to that report, the market for biomedical engineers in the pharmaceutical, manufacturing, and related industries is expected to grow by more than 27 percent. The report cites America’s aging population, the growing emphasis on health issues, and the rising interest in cost-effective medical devices as major drivers in American industry.

Of course, biomedical engineering isn’t the only discipline expected to flourish. The report predicts that as society shifts its focus from solving environmental problems to preventing them, companies across the country will increase compliance with environmental regulations and find ways to clean up existing hazards. As a result, the demand for environmental engineers will also increase by more than 40 percent.

Another way to predict which fields will be hot? Identify industries that are investing in employees by funding their graduate degrees. Allan Bjerkas, associate dean for the Whiting School’s Engineering and Applied Science Programs for Professionals (EPP), says that 95 percent of EPP’s 2,200 students receive company- and government-sponsored tuition reimbursement.

“Our fastest growing master’s program over the last five years is Systems Engineering,” he says. “These engineers develop, manage, and oversee technical solutions for companies and the government. Because they need to understand and satisfy the operational needs of the end user, the schedule and cost constraints of the customer, and the technological options available for the design, they need strong technical management and interpersonal skills along with superior technical know-how.

“In the next decade, I suspect information science and engineering will continue to be
growth areas, with information assurance and information security presenting especially high demand,” Bjerkaas says. “Where and how data is kept and the need to maintain and verify its integrity will create an increasing demand for computer scientists and electrical and computer engineers.”

According to Bjerkaas, another area ripe for growth is modeling and simulation. As companies look to increase effectiveness and cut costs, he says, there will be a growing need for engineers who can build mathematical models for everything that is really hard, expensive, or risky to do with real objects such as “simulating global climate change or building a training module for operating a submarine.”

Growing at a speed inversely related to the size of its products is the field of nanotechnology. Electrical, computer, chemical, biomolecular, materials science, and mechanical engineers are needed to create everything from drug delivery systems that can target specific parts of the human body and “smart” materials that can change their characteristics depending on their environment to analyzing the potential impact of nanotechnology on the environment.

Robotics, as well, has grown beyond machines that build cars or enhance factory production lines. Robots now perform critical tasks in places that are considered too dangerous, impractical, or unfeasible for humans to enter, from inside the human body to the oceans’ depths and outer space.

Across the country, top engineering schools are focusing on these burgeoning areas and Hopkins Engineering, too, is investing heavily, with three new research centers launched in these areas in the past two years.

James Pitts ’73, MS ’78, the corporate vice president and president of Northrop Grumman’s Electronic Systems sector, directs the operations of more than 21,000 engineers. His biggest concern for the upcoming decade is the “significant and worrisome” trend of an aging workforce heading toward retirement. In the coming decades, job opportunities that rely on science, engineering, technology, and mathematics skills will continue to increase. However, it is predicted that the retirement of baby boomers will deplete our nation’s science and engineering workforce by 50 percent.

“Effective knowledge transfer and management will be a critical activity for most companies to help us preserve precious intellectual property and engineering know-how critical to our business success going forward,” he noted recently.

From his vantage point overseeing thousands of engineers in an aerospace and defense industry that is, more than ever before, driven by computing and network architectures, he sees a dramatically increased need for engineers who can effectively process and manage massive amounts of data and engineers to provide network security. Also needed, he says, are systems and software engineering capabilities that enable the creation of knowledge, with special emphasis on image processing and recognition.

According to the ASEE’s Kelly, engineers today need to be innovative, expert in their thinking, and equipped to operate in a global marketplace. To do this, he says, engineering education must create industry leaders.

Hopkins Engineering graduates are up for the challenge. Consider the case of Rami Subramaniam, who graduated as a mechanical engineer from Hopkins last May. He signed on with S&B Engineers and Constructors Ltd. in Houston, where he joined a team of consultants working for oil and natural gas companies. “Right now, I’m working on a project to help design a transport system to move massive amounts of propane through underground pipes to storage facilities,” he says.

With responsibilities that include not only determining the client’s requirements, but conducting complex stress and wind analyses and performing computer-generated design, he is expected to perform advanced, analytical work that applies theoretical and conceptual thinking to real-life projects—as an entry-level engineer.

Well over a century ago, Gilman set forth to establish a university education steeped in theory and rich with practical knowledge. Today, Johns Hopkins continues that mission, producing engineers who are fully prepared for the demands of an ever-changing job market.

“As a student, you learn how to think like an engineer,” Subramaniam says. “Then you get out there, and learn how to work like one.”

Blue Skies Ahead

The Bureau of Labor Statistics projects that from 2004 to 2014, the number of engineering jobs in the U.S. will increase by 15 percent. Listed at right are some of those expected increases.

- Environmental 40.5%
- Computer Software 38.4%
- Biomedical 27%
- Chemical 26.8%
- Mechanical 17.4%
- Electrical 17.4%
- Industrial 17.3%
- Computer Hardware 17.2%
- Civil 17.2%
- Aerospace 17.1%
- Materials 17.1%
- Agricultural 15.1%

(SOURCE: The National Association of Colleges and Employers, 2005)

———