

Software Developer Profession Expanding

David Geer

Employment prospects for software developers are looking up. There's a greater number of developer positions globally than there are qualified software engineers to fill them. This gap will continue to increase as the number of available jobs increases. Meanwhile, remaining fears on the part of some students and their parents about IT job security after the dot-com fallout—while unwarranted—are negatively affecting software engineering enrollments, which will also temporarily widen the gap. In addition, fears surrounding outsourced SE jobs might be unfounded, as these are often lower-level positions in which software engineers wouldn't be interested.

The US

The US Bureau of Labor Statistics forecasts that increases in software engineer employment will be higher than average, despite recent downward market trends (www.bls.gov/k12/print/computer04.htm). However, this growth won't match that of the 1990s because the industry has matured and outsourcing has increased. Regardless, between 2002 and 2012, software engineering will be one of the fastest-growing professions, according to the bureau.

The bureau reports that in 2004, 460,000 applications software engineers and 340,000 systems software engineers were employed in the US. It projects a 48 percent increase in the former and a 30 percent increase in the latter by 2014 (www.bls.gov/emp/emptab21.htm).

Job growth doesn't, however, reflect the number of available jobs; the supply of software engineers won't keep pace with that

number. The gap between supply and demand will widen through 2012, says Donald Bagert, Director of Software Engineering at the Rose-Hulman Institute of Technology.

The 2005 and 2006 graduate figures will be low because students opted out of SE enrollment after the 2001 dot-com fallout, Bagert says. But this phase of declining enrollments is leveling off. Most people believe that we've bottomed out in the US, he adds.

Salaries might be one sign of a tightening job market. The National Association of Colleges and Employers (www.nacweb.org) fall 2004 and 2005 *Salary Surveys* report that the average starting US salary offer for software design and development positions in 2005 was US\$51,596, up from \$51,361 in 2004.

India

India continues to be the leading offshore IT destination, says Deependra Moitra, a Bangalore-based software executive (see the "Offshoring Trends" sidebar). One driver is the relatively low base pay for software engineers. According to a November 2005 press release from Mercer Human Resource Consulting (www.mercerhr.com/pressrelease/details.jhtml?idContent=1201340), the average annual base pay for software engineers in India is equivalent to US\$10,300.

Between now and 2010, India will see a growing increase in the number of available SE jobs, says Moitra. However, the gap between available jobs and suitable employees will widen. This is despite the fact that Indian SE employment is rising, he adds.

India employs 600,000 people in the soft-

Offshoring Trends

India is still king of IT offshoring destinations. According to India's National Association of Software and Service Companies, the country captured an estimated 44 percent of the offshoring market for software and back-office services in fiscal year 2004–2005; the associated revenues were US\$17.2 billion (www.nasscom.org/artdisplay.asp?Art_id=4377). In addition to the US, European and Japanese companies are offshoring to India, says Deependra Moitra, a Bangalore-based software executive. Countries competing with India for a slice of the overall offshoring market include China, Canada, Mexico, Russia, and some eastern European countries such as the Czech Republic, Poland, and Bulgaria, Moitra says.

Indian companies are also offshoring their operations. "They have their operations in China, and many Chinese companies are also operating in places like Bangalore," says Moitra.

The Chinese government has released a series of special policies to encourage Chinese companies to provide outsourcing services and to encourage foreign companies to outsource more work to China, according to Dehua Ju, vice president of the Shanghai Software Industry Association. These policies have stimulated high growth in the amount of work offshored to China, Ju says.

Japan is 61 percent of China's outsourcing market, says Ju. The US and EU markets constitute less than 15 percent, which forces China to focus on breakthroughs in those markets.

For that reason, in November 2003, the Torch Center, a high-tech development program started by the Chinese Ministry of Science and Technology, launched the China Offshore Software Engineering Project, says Ju. He states that the project's goal is to help service providers learn to improve their outsourcing business with the US and EU.

In 2004, the Chinese Ministry of the Information Industry announced six state software export bases: Shanghai, Dalian, Shenzhen, Tianjin, Xian, and Beijing. The government will provide these bases with policies and special support to promote their outsourcing business, according to Ju. Also, to improve the software industry's image, Chinese software enterprises have rushed to achieve ISO9000 and CMM certifications, says Ju.

Argentina is also rising as an offshoring destination. For example, Intel is going to open a software development factory in the province of Cordoba. Cordoba promised Intel a 7.5 percent subsidy for salaries over eight years and US\$1.5 million for building the lab, according to *NewsFactor Magazine Online* (www.newsfactor.com/story.xhtml?story_id=39805).

In Ireland, US-owned companies provide approximately 50 percent of software industry employment, according to Robert Cochran, principal consultant for Catalyst Software. This is an effect of Ireland successfully marketing itself as a base for those companies' European operations. The largest single operation there is the Microsoft EMEA (Europe, Middle East, and Africa) headquarters.

Still, Donald Bagert, Director of Software Engineering at the Rose-Hulman Institute of Technology, contends that much of the US market's offshoring is for jobs that software engineers with four-year degrees wouldn't take, such as computer programming. But the US does need software architects, says Bagert. "The question is whether the public at large really realizes that."

People who are getting computer science and SE degrees aren't having much trouble getting a good job in the US, according to Bagert, especially if it's a good computer science program.

"Our students are getting good jobs and salaries. With the software engineering graduates at Rose, we had 100 percent employment at the time of graduation," he says.

ware industry but falls short of meeting demand, says Moitra. Reflecting the current demand, IT industry salaries increase by about 15 to 18 percent annually, according to Moitra; within those figures, software developers receive some of the highest raises.

China

SE is the hottest profession in China based on demand, says Dehua Ju, vice president of the Shanghai Software Industry Association. He notes that 720,000 software employees are working in China today.

Reflecting this trend, the average salary for Chinese IT professionals rose

7 to 8 percent in 2005; the average annual salary of SE college undergraduates was 3,000 yuan (US\$370), up 500 yuan (\$62) from 2004, says Ju.

While software companies in China are looking more to Chinese university graduates to fill their increasing need for developers, only 90 percent of the top universities' graduates are being hired, says Ju, because the others aren't qualified.

To mitigate the gap between jobs and available talent, the Chinese Education Ministry decided in 2001 to build 35 pilot software institutes, each of which plans to recruit 500 BS students per year and offer SE MS degrees. By the end of

2003, those institutes had enrolled 30,597 students (17,194 BS and 13,403 MS), according to Ju.

Ireland

In 2003 and 2004, 25,000 software engineers were employed in Ireland, down from 32,000 in 2001, says Robert Cochran, principal consultant for Catalyst Software. This represents a 22 percent decrease. The fact that the figures were the same for 2003 and 2004 might indicate that the downward trend has leveled off. These figures represent a significant part of Ireland's population, which is four million. If the US had the same proportion of software developers

Related Reading on the Software Engineering Job Market

“Software Jobs Are Going Unfilled,” *Waterford News and Star*, 20 Jan. 2006; www.waterford-news.com/news/story.asp?j=20517—This newspaper article looks at the Irish software job market.

S. Bradshaw, “Looking inside the Hot Jobs on the Market Today,” *Poughkeepsie Journal*, 29 Jan. 2006; www.poughkeepsiejournal.com/apps/pbcs.dll/article?AID=/20060129/BUSINESS/601290344—This article includes specific data about software jobs.

www.developers.net—This site provides resources and a job board for software developers.

www.ieee.org—This site provides career information and a job board for software developers and other engineers.

number of students opting to take IT-related courses in Irish universities, which is now causing a shortfall in the number of qualified IT graduates, says Cochran.

Ireland is taking steps to increase enrollment in computer science and SE courses. Cochran states that “both the government and industry and professional associations are running programs aimed at restoring interest in technology careers in general and in computer science and software engineering in particular, in an attempt to encourage more students back into computer science and software engineering courses.” However, “this only benefits the industry three to four years after the [enrollment] increases, when they graduate,” he notes.

Despite the shortfall in qualified IT graduates, by mid-2005 software developer base salaries were down from previous years to about 40,000 euros (US\$48,000) per year, according to Cochran. “New graduates straight out of college were getting on average about 23,000 euros to start (US\$27,500),” says Cochran. Average salaries will tend to grow more slowly or even decrease when companies are in difficulty—for example, during the recent slump, he says.

An interesting factor in the Irish SE employment market is migration. “We have never met our own demand, and have generally used migration as a market regulator,” says Cochran.

“Migration in and out is a long-term feature of the Irish labor market in general,” he says; “we have a fluid software labor market, with flows between ... the local industry sectors, and into and out of Ireland itself.” Migration out of the country isn’t due primarily to local job circumstances but rather because some people will always be attracted to opportunities in large economies such as the US, according to Cochran.

Local demand does, however, affect the influx of software developers into Ireland. And, with the European Union’s expansion in 2004 to include 10 additional countries, Ireland has a much larger available labor market externally, says Cochran. “Some of the new EU member states with good technical

to population, it would have 2.36 million developers—almost three times the actual number.

Nevertheless, the employment talent gap in computer science and SE is growing in Ireland, with as many as 8,000

job vacancies, Cochran says. This is despite the fact that the number of IT job openings increased by as much as 40 percent in 2005, he adds.

This growing gap is partly because the dot-com fallout greatly reduced the

John Vlissides, 1961–2005

John Vlissides died at his home on 24 November 2005 after battling a brain tumor for more than a year and a half.

John was an IBM Research staff member since 1991 and a member of the IBM Academy of Technology since 1998. To the computer science world, he was best known for his part in creating the field of software patterns. His first book, *Design Patterns* (Addison-Wesley, 1995), coauthored with Erich Gamma, Richard Helm, and Ralph Johnson (known in the field as the “Gang of Four” or “GoF”), has sold over 350,000 copies in a dozen languages and is recognized as the seminal work on the topic. It has ranked among the top 50 computer science books at Amazon.com for nearly a decade and has served as the basis for innumerable courses in most major undergraduate computer science curricula. This led to a series of books for which John served as consulting editor for Addison-Wesley. John and the rest of the Gang of Four recently received the ACM SIGPLAN Programming Languages Achievement Award for their work on design patterns.

Capping off his impressive list of accomplishments for the object-oriented software community, John served as general chair of the 2004 ACM Conference on Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA 04), running a successful conference even while undergoing chemotherapy and fighting his disease.

The essence of John’s greatness wasn’t in his technical accomplishments—it was in his humanity. John was a pleasure to work with. He was a friend, a teacher, and a colleague to us all. In the end, John faced death much the way he faced life: with strength, dignity, and courage. John’s family has asked that any contributions in his name go to his favorite charity, the Children’s Cancer Fund (www.childrenscancerfund.org). In addition, his worldwide friends have created a wiki to collect stories and memories of him—please feel free to contribute at <http://c2.com/cgi/wiki?JohnVlissides>.

—Brent Hailpern

pedigrees are ripe sources of labor—for example, Hungary, the Czech Republic, and Estonia,” he adds.

Latin America

In the past few years, the number of IT students in South America has been on the rise, particularly in Brazil, according to Kathy Mandelstein, the IBM Software Group’s director of independent software vendor and developer relations.

According to the *2005 IDC Worldwide Professional Developer Model*, by Stephen Hendrick and Dennis Byron, Latin America had approximately 873,500 software developers at the end of 2005. The model predicts the number of software developers to grow to nearly 1.3 million by the end of 2009.

As an aside, Argentina is producing top-quality software engineers. For example, Sergio Sancho, the Google Code Jam 2004 winner, is a Universidad de Buenos Aires computer science student (www.google.com/intl/ro/press/pressrel/codejamwinners.html). Also, a team from UBA ranked 12th in the ACM 2003 International Collegiate Programming Contest and was the Latin America regional champion (<http://icpc.baylor.edu/past/icpc2003/Finals/Standings03.pdf>).

Canada

Developer salaries in Canada have remained relatively flat, but this is slowly changing. “It’s looking like 2006 is shaping up to be a much better year for developers than it has been for the past five years,” says Curtis Gittens, senior research analyst at Info-Tech Research Group, a Canadian IT research firm.

According to the Robert Half Technology 2006 Salary Guide (www.roberthalftechnology.com/html/downloads/rht2006s_guide.pdf), Canadian software engineers’ starting salaries are forecast to increase 3.2 percent from 2005 to 2006. According to the same data, 2005 salaries ranged from Can\$57,250 to \$84,000 (US\$50,141 to \$73,570); 2006 salaries are expected to range from Can\$58,750 to \$87,000 (US\$51,455 to \$76,197).

According to Gittens, baby boomers filled most technology jobs 20 years


ago and have held onto them. As these baby boomers—a high-population generation—leave these positions, the following generations—smaller in population—can’t fill them all, says Gittens. In response, IT programs will aggressively recruit women to help make up the shortfall; “we are already starting to see this,” he states. In the interim, Canadian companies might fill some positions from outside the country.

Canadian universities turn out just over 5,000 computer science graduates per year (developers also come from among the self-taught and from vendor certification programs). Students who enrolled at the peak of dot-com success and graduated in 2003 and 2004 are meeting the current SE demand. However, fewer students enrolled in computer science or SE programs after the dot-com fallout in 2001, so there will also be fewer graduates after 2004 to fill these positions.

As companies continue to innovate, the remaining supply of software engineers will dry up, says Gittens. But,

with SE employment increasing, students will go to universities to make sure they get high-paying jobs, he concludes. So, although the supply of software engineers will dry up initially, it will eventually increase again.

Moitra, Bagert, and Gittens agree that upward and downward trends in the SE profession are cyclic and not unusual. However, the overall demand for software engineers will continue to increase globally, outpacing increases in the supply of good developers for at least the next eight years.

Rapid growth in the number of available SE jobs is the primary reason for this gap between the demand for developers and the supply. Other factors are giving way or don’t have as much impact as they might seem to. Fears about employability after the dot-com fallout are fading. And, while in many countries, more jobs appear to be moving abroad, most of these countries will see the number of available domestic openings outpace domestic developer numbers. 

James E. Tomayko, 1950–2006

James E. Tomayko died on 9 January 2006 after a long illness. He was 56.

Known as “Coach” to his friends, students, and colleagues, James worked at Carnegie Mellon University for more than 16 years. He was a teaching professor in the university’s School of Computer Science and director emeritus of its Master in Software Engineering program. He also initiated a successful distance learning program and was a part-time senior member of the technical staff at the university’s Software Engineering Institute. He previously led the Academic Education Project at the SEI, creating courses on managing software development and overviews of software engineering that are still some of the most widely distributed in the SEI Academic Series. Earlier in his career, James founded the software engineering graduate program at Wichita State University in Wichita, Kansas.

James pursued many interests. He was especially interested in the history of technology, researching and publishing on the topic and serving on the editorial staff of *IEEE Annals of the History of Computing*. James was also active in alumni affairs at CMU.

As a testament to his dedication to the university, James received the “Coach” award, established in his honor, last summer at the Master in Software Engineering program’s 15th anniversary celebration.

James is survived by his wife, Laura, two children, Gabriela and Alison, and brother, Jack. The family asks that any contributions be made to the Jim Tomayko Memorial Fund, c/o Inst. for Software Research Int’l, Carnegie Mellon Univ., 5000 Forbes Ave./Wean Hall 5321, Pittsburgh, PA 15213-3890.