TRENDS FOR THE FUTURE OF SOFTWARE ENGINEERING

The software engineering field has exploded, with ever more complex and shifting challenges that we could not have dreamed about — nor planned to defend against.

Demand for talented software engineers is racing ahead of supply: at any given moment, there are more than 10,000 vacancies for this role in the metropolitan New York City region alone. Nationwide, according to the Bureau of Labor Statistics, employment of software developers is projected to grow 17 percent from 2014 to 2024, exceeding the average growth for all occupations.

The discipline has become omnipresent and much more diversified; the potential impact of an individual software engineer on an enterprise has soared; business considerations and decisions have become much more involved.

This change in the industry presents a tremendous opportunity for those entering the field to amass a critical new skill-set that will enhance performance and employability.

Those already within the industry will need to keep abreast of the rapid pace of technological and market change in the field and to understand where this discipline is headed and where the opportunities lie.

These four trends will dramatically shape software engineering in the years to come:

1. **Computing will continue to be everywhere.**

   We are in the pervasive/ubiquitous computing era — the third era of computing, after the mainframe and personal computer eras. Computers are in our phones, our shoes, our refrigerators, our thermostats and our cars. These are robust, networked devices whose function is to support our daily life activities. The scale for these devices ranges from large interactive displays and robots to “smartdust,” wireless microelectrical mechanical systems (MEMS) that can detect temperature, chemicals, sound and light.

   There will be continued growth in the area of smart technology. Smartphones are used in new environments and contexts, along with these devices and others. Wearable technology and interactive environments will create opportunities for systems never before dreamed of. Smart clothes that monitor health and alert the wearer (or healthcare provider) instantly are not yet mainstream, but they will be. Refrigerators with smart technology will go beyond creating shopping lists and sending them to the grocery store for delivery. User experience will be critical to the success of these systems, which will become alert, responsive and interactive with their surroundings. Even security will become context-aware.

2. **Software engineers will become the builders of the 21st century.**

   Software has become the building material of choice in the 21st century. Cheap mobile devices, seemingly unlimited bandwidth and storage, the transformation of media into digital information, and fast and cheap processing create an amazingly rich and fertile ecosystem for new and amazing systems.
A new Mercedes-Benz contains more than 100 million lines of code. The number of apps in Google Play has reached 3 million; 100 million active players play League of Legends every month. Software is surging businesses at an increasing rate. Amazon was just one of the first disrupters...there are now more Uber cars in New York City than taxis.

Airbnb is transforming the hotel industry. All of these systems are based on software. Software is the building material of choice today. Software engineers, the professionals who create software-enabled systems, have become the builders of the 21st century.

**3 Software engineers will increasingly become systems integrators.**

Increasingly, new systems will be built by integrating disparate systems and equipment with software. Small teams will create new and complex systems, frequently by integrating existing systems, smart sensors, software applications and disparate data sources into new systems, with the Internet and the cloud providing the communications and computing services. The development of new code will decrease, while the use of already written code will increase. Many new systems will be short-lived, as concepts and market approaches are tried and discarded.

The need for speed and the ability to get to market first, will provide impetus to this activity. Architectural frameworks that enable easy and rapid integration will continue to gain in importance — as will the value of software architectural and integration skills.

Rapid advances in miniaturization, speed, power and mobility have led to the pervasive utilization of networking and information technologies targeted to Cyber-Physical Systems (CPS). These technologies are combined with elements of the physical world (e.g. machines, devices, structures) to create smart or intelligent systems that offer increased effectiveness, productivity, safety and speed, and enable functions not previously possible. Software will be the glue that pulls all these technologies together.

**4 Small teams will continue to transform the software engineering industry — and business itself.**

Crowdsourcing will become a business imperative. Software experts long believed that small teams of programmers produced better quality products than large teams, but for truly large-scale projects, large teams were essential simply due to the workloads. However, experts now realize that the advantages conferred by very small teams are huge. This is further confirmed by the emerging paradigm of software crowdsourcing, in which magnitudes of improvement on productivity can be achieved through online, competitive software tasks.

According to a 2012 report in the Journal of Software Technology, these differences may be profound: a study of more than 1,000 software projects reported that large project teams (five or more members) produced two to three times as many defects as small teams working on development projects, while only saving slightly on total project time. Larger projects exacerbated this difference in defect rate even further.

An increasing new trend is freelance software developers who are accessible on online crowdsourcing platforms. Examples of such software crowdsourcing platforms include TopCoder, eLance, oDesk, Guru and Taskcn.

TopCoder has more than 1 million registered design and technology experts. A number of extraordinary benefits have been linked to the general use of crowdsourcing, including reduced cost, shortened time and enhanced quality.

The implications of these findings for industry are enormous. It is not anticipated that larger companies will downsize software engineering personnel counts, nor project loads, in response. Rather, as industry leaders become aware of the new research and act upon it, they will trend toward creating and managing increasing numbers of smaller, core software project teams within larger corporate units, as well as identifying and utilizing crowdsourcing options when possible.

In addition, small and medium-sized technology companies will become increasingly important and competitive across industries. It is well documented that sector technology leaders such as Twitter and Facebook had their geneses in very small teams of engineers, and this trend will continue to accelerate.

This transformation of the way teams are built and deployed will affect software engineering education profoundly. Graduate-level education in "agile" and lean methodologies — as we call the art of functioning and performing at a high level in smaller teams — will become critical both to individual engineers’ career paths and to corporate competitive performance.