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Changing technologies

DIVERSITY-MINDED COMPANIES EMPLOYING SYSTEMS ENGINEERS

Systems engineers play a part in most of today's technical disciplines

The systems engineering field, born in aerospace and defense, is moving rapidly into the commercial industries

"I work on multiple projects at a time and know what's going on across most of our projects." – Jayesh Shah, DRS Tactical Systems

By Sue Marquette Poremba
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In many companies the title of "systems engineer" implies you've aced several other engineering assignments on your career path. So says Pat Hale, president of the International Council on Systems Engineering (INCOSE, **www.incose.org**, Seattle, WA).

"Early on, systems engineers gather the needs of a project, which will often come in using non-engineering language, and translate the raw input into requirements and specifications that can be built into a product or system," Hale explains.

The systems field originated in aerospace and defense and rapidly moved into the commercial industries. "One of the important activities going on today in systems engineering is sorting through the semantics, so we can have a conversation without having to explain what we mean by certain words," Hale says. "Defense and aerospace use a great many acronyms that wouldn't make sense to a software or consumer company."

Moving into systems

Systems is a relatively new engineering discipline, established in the 1940s. At first it was mechanical and electrical engineers who moved into systems, but now all the engineering disciplines are developing systems engineers.

The job bank at INCOSE shows that systems engineering is a hot career, with a wide selection of companies looking to fill positions. Because the field is so young it tends to attract a more diverse population than more traditional engineering fields, Hale says. "If you're a person who gets excited about a field that's changing rapidly, systems engineering is for you."

EE Lisa Koppenhofer: mission management at GE Aviation


Lisa Koppenhofer.

Lisa Koppenhofer had served in the Royal Australian Navy for ten years when she was sent to Florida's Gulf Coast. Her stay in the U.S. was supposed to be temporary, but it didn't work out that way.

"I met my husband who's from the U.S.," says Koppenhofer. After a two-year long-distance relationship while she finished her military duty Koppenhofer left Australia and the Navy and moved to Grand Rapids, MI.

Her military background was in weapons EE. She trained at the Australian Defence Force Academy, part of the University of New South Wales (Sydney, Australia), which she says is like Annapolis. She got her BEE there in 1993.

Math and science were strongly encouraged at Koppenhofer's high school, and her father had a military background. "Both those factors encouraged me to join the military, and I liked the Navy uniform best," she says with a laugh.

After living in the U.S. for two years Koppenhofer discovered Smiths Aerospace, now a division of GE Aviation. "They were looking for a project engineer, and I knew the company name from my experience with Australian defense contractors," she says. She had to wait until her permanent residency was approved before she could get to work; she started late in 2006.

At GE Aviation Koppenhofer is a systems engineer in the mission management area. She works in stores and weapons management systems, and is currently the systems lead for a project in the Bell AH-1Z helicopter program. "The purpose of the project is to deliver a design documentation package to our customer," she explains. "We gather the data, develop new documentation if needed and correct any errors.


Koppenhofer's design documentation work is behind a variety of GE Aviation products.

"In my Naval career," Koppenhofer reflects, "My job was to understand the weapons systems on a ship. I was being trained to be in charge, so I had to have an in-depth knowledge of everything. That is similar to what I'm doing now, as far as how a system works and how a change in one part of the system affects other parts."

Princess Cooper-Brown: senior systems engineer at Raytheon


Princess Cooper-Brown.

A technical career always seemed like a good fit to Princess Cooper-Brown. Her dad had a physics degree from MIT (Cambridge, MA) and her mom had a career in higher education. As a kid she'd collect things like broken phones and try to figure out how to make them work again. "I always liked seeing how things operate," she says.

But she also had a passion for business. When it came time for college she went for a BS in international business with a concentration in information systems at Northeastern University (Boston, MA). She went on to grad school at Northeastern, and finished her MS in information systems in 2006.

"You could be as business-centric or as technology-centric as you chose," she explains. "It depended on the courses you took."

Cooper-Brown began her career with Raytheon Technical Services Co (Burlington, MA) as an engineering and IT intern while in grad school. When she was hired full time she moved into programs and business development, working on strategic proposals.

“You never know what the challenges are going to be,” she says. “With each proposal I was taking on new roles. I started to develop an affinity for the solution and strategy side, and decided I wanted to explore solution architecture.”

She’s now a senior systems engineer at Raytheon, working on the company’s Air Traffic Controller Optimum Training Solution (ATCOTS) program. ATCOTS is a program to help the FAA train more than 14,000 air traffic controllers and optimize the training process. She’s been working on it for two years.

When she first came to the project she was officially the transition lead, but filled a number of other roles too. She facilitated working sessions to develop proposal strategies and technical solutions, and worked closely with several teammates, writing white papers and developing customer demos.

Once the proposal phase got under way she was in charge of the staffing models. “It was something new that I hadn’t done before, but my data analysis and technical skills led to the role.

“Our business solution is related to our technical strategy,” she explains. “It determines who
we partner with, how we structure our solutions and whether or not we’ll go after a job.”

R. Curtis Eng works on Boeing’s 787


R. Curtis Eng.

When your grandfather is an aviation pioneer and you are actually named after another pioneer, it’s not surprising to develop a fascination with airplanes. “My grandfather worked for Hughes and then Douglas, which eventually merged with Boeing,” Eng explains. “He was one of the main designers of the first retractable landing gear for aircraft, and he pioneered aviation engineering opportunities for Asian Americans.”

Despite his engineering degree, Eng’s grandfather had to come into Hughes as a draftsman, Eng says. “He was working late one night when Howard Hughes walked by and they began chatting. A few weeks later my grandfather was offered an engineering position; Howard Hughes had realized his capability and recognized the advantages of diversity.”

Eng himself went to Webb Institute (Glen Cove, NY), which offers degrees only in naval architecture and marine engineering. “The degree work covered a complete systems approach to the design of vessels, which turned out to be the technological basis of aircraft design as well,” he notes. He graduated in 1982, the first Asian American to graduate from the school. He worked in ship and boat design at several companies until 1986, when Boeing (Seattle, WA) hired him as a naval architect. Eng has been with the company ever since.

Eng was able to continue his education while working, first with an MS in engineering management from National Technology University (part of Walden University, Minneapolis, MN) in 1993, then with an MBA in technology management from the University of Washington (Seattle, WA) in 2003.

He is now a manager in systems and software engineering at Boeing. It's his job to look at the customer's overall requirements, from which "the most suitable design is generated," he says. "We understand what the requirements are, verify the systems and synthesize solutions that meet the customers' needs."

He is currently managing work on a test simulator for the new Boeing 787 aircraft, making sure the new components function well together. "The approach is to make sure the airplane system meets its performance targets and that the risks are minimized when the new aircraft undergoes real ground and flight tests. That's what makes a well-validated product."

Eng believes that systems engineering is taking on a more global scope. "We're seeing the need to tap into many information sources and team with diverse people around the world, and do it faster than ever," he says. "We're going for solutions with plug-and-play aspects rather than tailoring work for only one mission."

Besides his work, Eng is involved in Boeing's Asian American Professional Association. He also leads one of the division's diversity councils and does a lot of mentoring.

Charles Bridges: sharing information at Booz Allen


Charles Bridges.

Charles Bridges grew up in inner city Baltimore, raised by his grandmother. The family quickly learned that he was the one to turn to if anything needed fixing around the house.

So when it came time for college, engineering seemed like the right direction. He decided on Morgan State University (Baltimore, MD), which had just begun offering engineering programs, because it allowed him to stay close to his grandmother.

When he received his BSEE in 1998 Bridges went to work for Booz Allen Hamilton (McLean, VA). After a few other jobs he returned to Booz Allen three years ago and is now an associate. He has completed an MS in systems engineering at Johns Hopkins University (Baltimore, MD).

He likes the broad scope of systems engineering. "You have to balance many individuals in this job," he says. "You pull back and look across the gamut. That's a big challenge because in engineering you are very detail-oriented. It's a difficult skill, but necessary, and I think it fits my personality."

As an associate he's in a leadership position. "I'm a consultant, bridging to executive management," he says. "With 9/11 and other events happening there's a drive to share information more efficiently and more effectively. A lot of my duties revolve around that."

He works with a joint office set up between the Department of Defense and the Director

of National Intelligence. “We help guide research and reciprocity between federal government communities,” he explains.

Bridges was recently named “most promising engineer of the year” in the Black Engineer of the Year awards (BEYA). “I was involved with BEYA informally for years,” he says. “I never thought I’d be considered for the award, let alone win it.”

The award is a tribute to his work, his community activities and his mentoring. Mentoring is very important to Bridges. “I know the struggles it takes to get here,” he says. “Mentoring gives me the chance to give back.”

Fredda Lerner leads a virtual team at BAE Systems


Fredda Lerner.

Fredda Lerner really longed to be an astronaut, but “Back in those days girls couldn’t be astronauts,” she recalls wryly. Fortunately, she also wanted to be an engineer. “My uncle was an engineer and I always thought that was really neat,” she says. “He got to travel a lot, and that was neat, too.”

So when she entered the Georgia Institute of Technology it was simply a matter of what type of engineering to go for. When she got her BSME in 1981 she found a job working on the space shuttle in Florida. It came quite close to her old dream:

“I was a test engineer and worked on the first four shuttle flights,” she says.

From there she moved to electrical/ mechanical design. “In those days computers had to be custom-made for a flight,” she says. She eventually got into computer integration.

Today Lerner works at BAE Systems (Reston, VA). She has two complementary jobs: product manager: “That’s the production side”; and engineering manager: “That’s the functional side.”

As product manager she’s a subcontractor for the government, leading a virtual team of techies located in California, Pennsylvania and New York. Of course no team can be 100 percent virtual, so she often travels to work face-to-face with team members. “The project manager is the glue that holds the team together, and they need to see me and know who I am,” she says. She also brings the whole team together from time to time.

As an engineering manager she has four functional reports, and nurtures their careers by giving them direct access to the system. She was given the job for her technical skills, but like many managers she finds the work is more administrative. “I’m no longer hands-on technical,” she says.

When she graduated from college, she notes with a smile, she never conceived of all the opportunities that have developed. “We didn’t even have laptops then,” she says. “But the changes in technology really helped me morph my career. I think I’ve adapted well!”

The year she started college was the first year the military service academies allowed women in. “The remote facility at the Space Center where I worked didn’t even have a ladies’ room when I started,” she says with a smile.

Sarah Cuy "runs the task" at Electric Boat


Sarah E. Cuy.

When Sarah Cuy got her BS in aeronautics at MIT (Cambridge, MA) in 1986 she found a job in California, working on a TRW missile program. "It was a simulations program and we worked on changing from one computer language to a different language," Cuy says.

Cuy also worked on the "Star Wars" missile defense system and the C-17 in-flight control simulations. "All those things brought me to submarines at Electric Boat," she says.

Cuy has been with General Dynamics Electric Boat (Groton, CT) since 1995. She came to the company to work on the *Virginia*-class submarine program, writing software for ship controls. Now she's an engineering specialist, working with hydrodynamic simulations and verifying the control and performance of the *Virginia, Seawolf* and other nuclear subs. "I look at the hovering, how they perform, stuff like that."

She's currently leading a task to improve the *Virginia's* hovering system. "That involves coordinating engineering and the designers who modify drawings. I make sure we're on schedule. Mainly my job is to run the task."

The *Virginia* class is already fitted out with the best equipment, but it's Cuy's task to make
it better. "There are always new technologies out there," she says. "Things are always improving."

There's probably no more sophisticated machine than a submarine. Over the years Cuy has seen amazing technology changes. The *Virginia* ship controls, for example, were changed from analog dials to touch screens virtually overnight. "Computer systems are faster. Technology is faster, smaller, more improved. What used to take an hour now takes minutes."

Cuy began her career when few women were going into the field, but she has never found her gender to be an issue. John P. Casey, president, says, "The future of General Dynamics Electric Boat depends on our ability to develop a diverse workforce to help resolve complex engineering challenges, and help us identify and seize opportunities in a rapidly changing economy.

"Diversity drives innovation, and innovation is the reason Electric Boat has succeeded for 110 years."

Darryl Gomez: systems engineering Fellow at Northrop Grumman


Darryl Gomez.

Darryl Gomez is a Filipino who grew up in Hawaii, where his mother's folks worked on some of the large sugarcane plantations. He learned the importance of hard work from them, but it was his years in the Air Force that taught him the value of education.

He joined the Air Force right after high school, spending eight years working on radar systems. He completed his associates degree from the Community College of the Air Force, and went on to a BSCS from

Oklahoma City University (Oklahoma City, OK) in 1987.

After graduation he looked for a career that would combine his in-depth radar experience with his CS degree. “What was then Westinghouse and is now Northrop Grumman (Baltimore, MD) offered me a position as a software engineer where I could use my radar background, too, so I was happy to grab it,” he says.

On an early project the company paired software engineers with systems engineers to identify radar system improvements. Gomez was one of the software engineers. “I learned a lot from the systems engineers I worked with,” he says.

Eventually an opportunity opened in systems engineering and Gomez was asked to move in. He’s now a systems engineering Fellow at Northrop Grumman.

Gomez took advantage of an in-house radar engineering systems course, and earned an MS in systems engineering at Johns Hopkins University (Baltimore, MD). He graduated in 2002 and is now working on a PhD in systems engineering from George Washington University (Washington, DC).

All the time he was learning he was working. He’s currently on two airborne surveillance radar projects.

Gomez is also part of Northrop Grumman’s Asian Pacific professional network, and a mentor
to young engineers. “I think the transfer of knowledge is valuable and I’m happy to share,”
he says.


Jayesh Shah.

Jayesh Shah: senior principal engineer at DRS

In 1977 Jayesh Shah received his BSEE from the University of Bombay, India, and came to the U.S. for grad school. He completed an MSEE at Stevens Institute of Technology (Hoboken, NJ) in 1979.
After graduation he took a job with a company in Melbourne, FL, developing computers and high-speed peripherals. Over the next twenty-five years he worked as a design engineer for computers and broadband communications equipment for military and commercial apps. Four years ago he joined DRS (Melbourne, FL), a defense-related company, as a systems engineer and he’s now a senior principal engineer.

Shah’s job is at DRS Tactical Systems, which makes rugged computers and display units for the military. He’s currently working for the VP of engineering in the advanced technology office. “We’re a small group of senior engineers who look at the emerging technologies that we can incorporate into products for our military and industrial customers,” Shah explains.

Shah moved to DRS because he wanted to go beyond his long career in design and work in systems engineering. “I thought I’d done enough design work and wanted a bigger picture of the company and the products,” he says. “When you’re working on a product

your visibility is limited to your immediate task, and I wanted a wider horizon."

Now Shah works with marketing, engineering and more. "I help define processes that the younger engineers use for product development," he says. "It gives me the opportunity to use the experience I've gained."

DRS has a large portfolio of military and industrial products and Shah is usually working on multiple projects at a time. "I pretty much know what's going on across most of our projects," he says with pleasure. He also gets into proposals and quotes.

Back in his undergrad days there weren't many computers in all of India. Shah still remembers how, as a student, he visited a research company that had one of the few computers in Bombay. It took up the entire floor of the building.

"Today I probably have as much computing power in my PC as that giant computer did," he says. "Whenever I think maybe we're reaching the end of what computers can do, something new is developed.

"Of course, all these improvements help the military work I do."

Allison Barto: looking into space with Ball


Allison Barto.

Allison Barto remembers going camping with her family as a child and gazing up at the stars. "When I was nine I was ready to get my PhD in astrophysics," she recalls with a smile.

But as she progressed through Harvey Mudd College (Claremont, CA) she realized that academic life might have too narrow a focus. She had interned at the Jet Propulsion Lab (Pasadena, CA) and decided that aerospace could combine her interests in math, science and astrophysics.

So she proceeded to a 1998 BS in physics and found a job at Ball Aerospace & Technologies Corp (Boulder, CO), where she could contribute to work with the James Webb Space Telescope.

She came in as a signals processor, but from the beginning she was working to move into systems engineering. "I'm a 'big picture' thinker," she says. "I want to step all the way back and look at all the interactions and understand the whole program."

In 2002 she formally moved into systems engineering; she's currently a senior systems engineer. She's the integrated product team lead for the systems engineering group, manages the group and serves as systems verifications lead. That gives her responsibility for optical verification of the James Webb Space Telescope, working closely with ITT and Northrop Grumman. "We do some administrative work, but our focus is on technology and problem solving," she explains.

"It's a bit of a challenge to show how this large cryogenic telescope will work in space, since it's so large and needs to be so cold. It's hard to test on the ground," she says. "The mirror on the telescope is 6.5 meters, so we can't send light through the entire thing!"

One of the contributions worked out by Barto and her systems team is a test that helps them better understand the telescope's ability and estimate its performance while in space.

Ball is a fine place for diverse techies, Barto believes. Its executive diversity council supports an inclusive environment that strengthens and leverages company culture and contributes to company success.

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