

**Chani Welch**  
**Engineer**  
**CRT Engineering Group, Sony Technology Center, San Diego, California**

**Job Description**

As an engineer who recently joined the CRT Engineering Group, Chani designs optical lenses that are used in the production of CRTs (cathode ray tubes). She also works on other projects and activities related to the design of CRTs.

**CONCEPT: Light/optical systems**

What I do is I make optical lenses. That's my primary function. I make optical lenses that aid in printing phosphors onto the screen of the CRT. You get images on the face of a CRT [cathode ray tube--a screen for television or computer] from the emission of electrons from the cathode of the CRT, which are then accelerated to form a beam. The beam hits phosphors that are printed on the screen. When the phosphors absorb the electron energy, they emit light corresponding to the color of the phosphor - red, green, or blue. Different combinations [intensities] of red, green and blue make up the other colors that you see on your TV. My job is ... to develop lenses that will print stripes on the screen that match up with the electron beam from the gun of the CRT.

When I'm designing a new lens, my first step is to get the most recent landing data from the person who did the measurements on the CRT --that's the data that I use to base new lenses on. And if there is a design coming up, then I just take the data, and I run it through the program and perform the necessary calculations on it. Then I convert that data into a code that the milling machine reads to make the lenses.

**CONCEPT: Fourier analysis**

Fourier analysis, or one of the main applications for Fourier analysis, is to analyze something that's complicated by way of sines and cosines. So say that you were analyzing a sound coming out of a French horn and the horn's sound waveform is a spiky-looking thing, you can use Fourier analysis to approximate it using sines and cosines and it will allow you to analyze the different components, such as the frequencies, in the particular sound that's being reproduced.

So without a concrete example of this, the concept is hard to understand. If you're learning this in math class and they just show you the formula, which is really disgusting--usually the formula, you look at it and say, I have no idea what this applies to. I don't know why I'm learning it, and I really don't care. And you have to do proofs based on this formula. You have to analyze and pick apart this formula. You have no idea what it does. So all these people in my math class were sitting here looking at this strange weird formula and having no idea what it did. And I had just taken a physics class... a class on music in computers that had shown me exactly how to use this formula. So I went in my math class, you know, I aced the entire section on the test because I had a concrete example in my head. I knew what I was looking at, you know, because I compared the formula to something that was concrete. It was beautiful. I was like, oh, yeah, I completely understand this. And people would look at me like I was crazy.

**CONCEPT: Matrices**

I get a numerical matrix that calculates thicknesses at different points and it connects the dots to make the surface. Once I get that, I have to convert all of this data to make the surface into language that the numerical control machine downstairs will be able to understand. So I go downstairs to lens fab. They take my disks that I save all this data on. They plug it into the computer, and their program does a surface for the mold.

[The landing data is a measurement of] where the electron beam is hitting the phosphor, and figuring out how far off the beam is from the phosphor, because in an ideal situation, the beam is supposed to hit dead on to the phosphor (for maximum brightness and picture quality). Now, there are certain magnetic forces working on the electron beams inside of the CRT (a good understanding of physics is needed to get this), which affect the beam's path to the screen. So instead of changing that, which is extraordinarily difficult since, well, the earth's magnetic field is a big, constant, on-going thing, they have me reprint the stripe on the screen to match up with where the beam is striking. That's where the landing data comes in.

**WORK SKILLS: Accountability**

The hardest part of my job is worrying about messing up. The design that I work with is incredibly intricate. But there was an instance where I had made a tiny, tiny, tiny little error on one of the programs with a little piece of data. I had messed up a decimal point and it ruined my entire design, and when I got it out, I was all ready to send it down to lens fabrication to be made and I realized, one decimal point ruined this entire design. If they had put it in production, it would have been two weeks before they could have realized the mistake and taken it off and redone it and done testing and all these people would have had to come in and someone would have had to pay for the hours and the redoing of the lens, and I realized, I affect a lot of people.

And there was another time when I made a small mistake and I didn't catch it, and that one actually went into production and it was something that had to be a rush and they came back and said, this is your fault. And I said, oh, my...I felt horrible...I had only been there three or four months. I thought they were going to scream and yell at me, and instead they yelled at the person who trained me. I realized that, you know, because I am an associate engineer and there's somebody training me, that they're accountable right now while I'm in training. And since I am really fond of this particular person, I made, you know, an extra special effort not to mess up anymore because I didn't want him getting yelled at for my mistakes.

**WORK SKILLS: Challenge**

There are 12 or 13 programs involved in the main program, and a lot of the stuff..well, not a lot of it--ten percent of the stuff is written in Japanese. So if I ever had to troubleshoot this program, it would be frightening because first of all, it's written in a programming language that I don't know. I know several programming languages, but this particular one I don't know. It's on an operating system that I'm not familiar with, and part of this stuff is written in Japanese, which I don't read. So that's challenging there.

**WORK SKILLS: Using math**

Once I got the correlation between math and, like, physical applications, I was all ready to go and apply this to all sorts of things. I was curious. I wanted to see how I could use this in the real world. I wanted to use all my skills and put them together and see how I could apply this. So, I decided I was going to work as an engineer.

A lot of the stuff that I learned was easier to me because I was very mathematically-based. And because I had those skills behind me already, it was a lot easier for me to go through electronics and robotics and programming, especially. Oh, programming is a lot like math in the way that you set up a problem and go about solving it--you just pick apart little pieces of it and try to analyze it. And so a lot of this was a lot easier for me than it was for other people because they didn't have the necessary analytic skills.

**JOB/CAREER: Job overview**

I work for Sony Electronics in display device division. We make TVs and monitors. Our division works on the CRTs. It's the television and the monitor before all the electrical components are put in, so basically it's just the cathode ray tube, and my group is the group that works on designing or redesigning anything involving the CRTs.

**JOB/CAREER: Typical day**

I usually get here any time between 7:30 and 7:45, and then the first thing I do is go to my computer and check all my messages because I've got a lot of e-mail ... that I've got to take care of and answer.

When I'm designing a new lens, my first step is to get the most recent landing data from the person who did the measurements on the CRT. So if I do have [a design] it takes typically four hours out of my day. If there's a problem with it or if it doesn't come out the way it's supposed to, it can go into six plus hours, depending on the complications involved. Usually if I don't have a design to do that day, then I'll end up attaching myself to another project that somebody else is working on in my group and learn whatever I can from them. I still have a lot to learn. You know, you take that project and you go as far as you can with it ... they basically won't give you something else to do. You have to wander around and find something to do. And so I figure that if I go and I work with other people on their projects, then I'm learning something.

Typically a Sony day is supposed to last from 7:30 to 4:30 and when I first started here, my day went from 7:30 to 4:30, but recently because we have a new production line that's going up, I could be here anywhere from 5:00 to 7:30, depending on how long meetings last and how many problems there are and if I'm needed to discuss solutions to particular problems or whether or not I'm not needed until the next day.

**JOB/CAREER: Background**

So I went into a program at San Diego City College, automated equipment technology, and it taught you how to work with robots and how to troubleshoot automated equipment and taught you things about hydraulics, pneumatics, NC milling machines. I got to work in the machine shop and make partson lathes and work with vertical mills It was very interesting. We also had courses on digital logic and microprocessors and just a wide range of things that were applicable to industry, and it was there that I realized that math was a really useful tool in building analytical skills, that all this math that I had learned prior to this had taught me to like pick apart problems and analyze them in a methodical way.

**JOB/CAREER: Struggles with math**

I think my first calculus class I got a C and which was unusual for me because I always got As and Bs all the way through high school. And then in my second calculus class--when you get out of high school, your social life kind of steps up and I was failing it. I had to withdraw and I had to take it over. The same thing happened for calculus III, too. I was failing it and I had to retake the class. And so I think a counselor tried to talk me out of math as a major, and all the way through junior college most of my math classes were Cs or Bs or classes that I repeated. Then I transferred to San Diego City College because even though math was my major, I wasn't sure what I could do with it. Most people were telling me, oh, you're going to teach, right? I was thinking, I don't want to be locked into this teaching. There's got to be something else I can do with a math degree.

**JOB/CAREER: Job search**

I put together a resume and I went over the Internet and I went through places like headhunters and all sorts of companies and I called up their names and I found their e-mail addresses to submit resumes. I must have submitted 50 or 60 resumes by way of e-mail, and I got some responses that way, but not very many and they weren't very serious. When I got my response from Sony, I had actually already submitted three different resumes.

I sent it to one of the managers here, a personal letter saying I would be valuable to your team, please look over my resume--it was the same resume that I had sent three other times, but I had sent it to a manager. About a week later I had a phone call saying, hey, let's bring you in for an interview.

So I went into the interview and I was extremely scared. I had prepared for two weeks for this interview. I was completely frightened... I went in there and I was prepared for all these technical questions and all these difficult questions... I was asked very many questions that revolved around how I related to others and my teamwork skills and problems that I solved and how I went about solving these problems. Not one question that was technical; not one question was, you know, a problem that they put something down in front of me and said, here, solve this. Basically they said, you know, how do you get along in teams? How do you solve problems? How do you work well with others? What have you done that's challenging? Tell me about yourself. They basically wanted to know about me and how I was going to function with others. And based on that, they hired me. My first interview.

So with my math major and my physics minor, and my A.S. in automated equipment technology-- I have a B.A. actually in mathematics. They usually don't hire an engineer unless they have a B.S., but they hired me with a B.A. I was very excited.