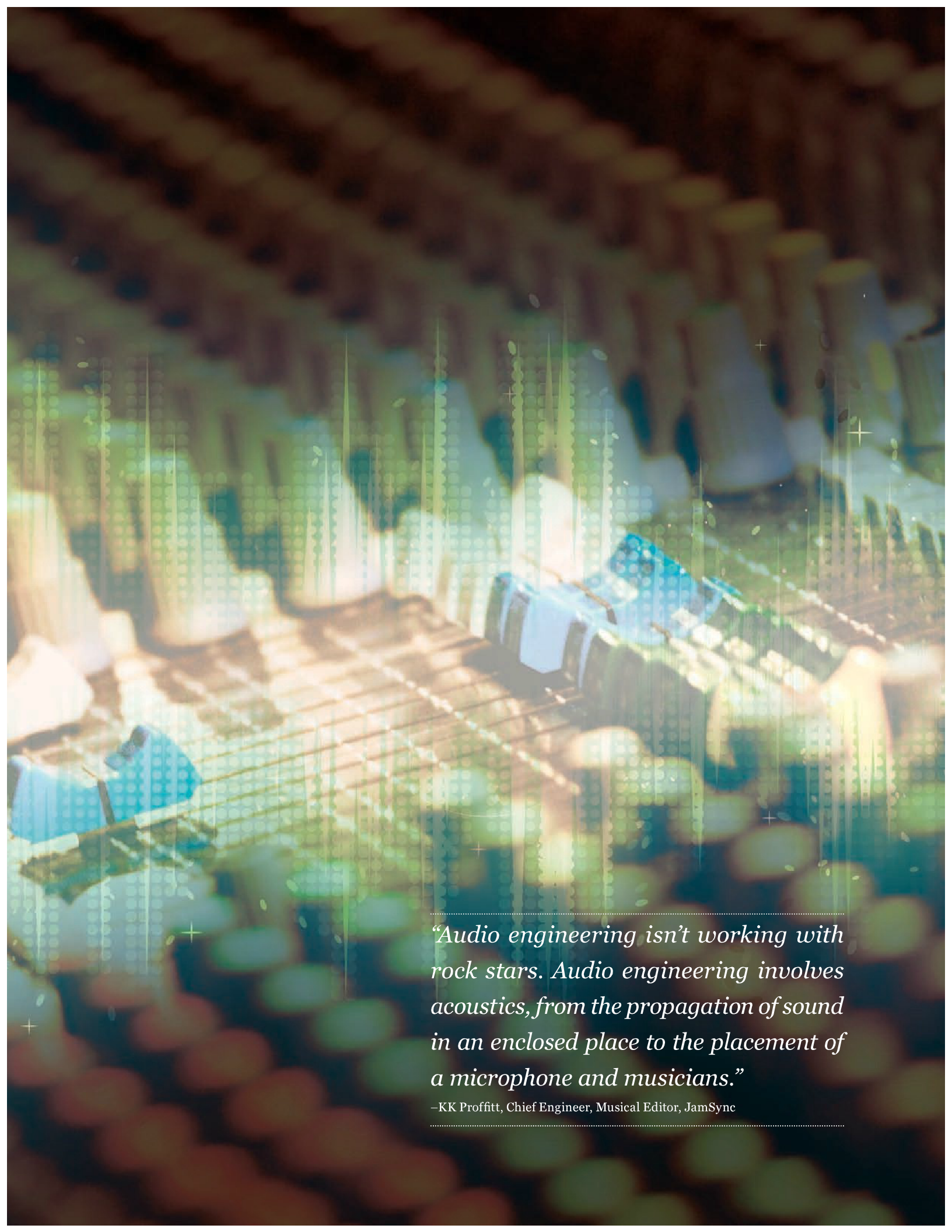




THE  
*Music*  
OF  
ENGINEERING

By Charlotte Thomas, SWE Contributor



*“Audio engineering isn’t working with rock stars. Audio engineering involves acoustics, from the propagation of sound in an enclosed place to the placement of a microphone and musicians.”*

—KK Proffitt, Chief Engineer, Musical Editor, JamSync

Emma Azelborn grew up loving music. Her high school stressed performing arts so she sang in choirs and played flute in the band. She also loved math and science, which her father and grandfather, both engineers, passed down to her. “I wanted to do something technical. I knew I would be an engineer but didn’t want to give up my love for music,” she recalled. She didn’t have to and will graduate in 2017 from the University of Michigan with a double degree in performing arts technology and computer science engineering. “Hopefully, I will be a software engineer in a company that makes software for musicians,” she said.

While Azelborn is beginning a career that combines her love of music and engineering, KK Proffitt has used her technical and music background in JamSync, a music studio she built, owns, and has operated as chief engineer and musical editor since 1988. Along with mixing and mastering music from classical to rap in a fully automated 5.1 channel digital environment, she plays the electric guitar, has recorded six solo albums, and is recognized as an expert in recording and computers.

“I’ve played piano since I was 5 years old and taught myself the guitar,” said Proffitt. “At 10 years old I recorded the Beatles when they played on Ed Sullivan’s TV show on a reel-to-reel tape recorder and then built a telegraph out of tin cans. I have always been interested in taking things apart.” Listening to the Beatles recording, Proffitt noticed that the sound from the speaker was not the same as the sound from a cheap recorder. At such a young age she had a keen ability to discern such differences.

Proffitt followed her love of music to study guitar performance and arranging at Berklee College of Music after which she completed a certificate of professional achievement in software engineering from Northeastern University State of the Art Engineering School.

The music department was small when Sile O’Modhrain, Ph.D., began studying music in Trinity College in Dublin, Ireland. She was asked to pick



PETER SMITH PHOTOGRAPHY

Emma Azelborn, far right, who will graduate from the University of Michigan in 2017 with a double degree in performing arts technology and computer science engineering, performs in an electronic ensemble with fellow students.

a second subject and chose computer science. Dr. O’Modhrain now holds an M.S. in music technology from the University of York in England and a Ph.D. in computer-based music theory from Stanford University.

*“Now I am working with some colleagues here at Michigan to create a programmable surface that might one day provide braille and tactile graphics such as sound waves on a tablet computer. We are already starting to see touch technologies in today’s devices, but this is just the tip of the iceberg in terms of what might be possible.”*

—Sile O’Modhrain, Ph.D., Associate Professor of Performing Arts Technology, the University of Michigan

“I’m visually impaired,” she said. “As a sound engineer with the BBC network radio, I wanted to solve the problems I was up against as a blind person.” She had no problem editing a reel-to-reel tape with a razor blade, but when the computer era came in with its digital

emphasis, her research changed. Dr. O’Modhrain is currently an associate professor of performing arts technology at the University of Michigan.

“My work at Stanford included creating a virtual bowed string, where you could feel as well as hear the string as you bowed it. Now I am working with some colleagues here at Michigan to create a programmable surface that might one day provide braille and tactile graphics such as sound waves on a tablet computer. We are already starting to see touch technologies in today’s devices, but this is just the tip of the iceberg in terms of what might be possible,” said Dr. O’Modhrain.

Though she played the flute, piano, and saxophone in rock and roll bands, Cosette Collier knew she couldn’t make a living in the music industry as a performer. With the encouragement of her father to combine science, sound, and acoustical engineering, Collier went on to receive a B.F.A. in commercial music and recording engineering and an M.A. in communication, film, and video production from The University of Memphis. She is now a professor and audio production coordinator in the department of recording industry at Middle Tennessee State University and has worked in the recording industry as a studio engineer



Emma Azelborn uses her music engineering skills on an API vision console in the student recording studio at the University of Michigan. After graduating, she hopes to use her degrees in performing arts technology and computer science engineering working for a company that produces software for musicians.

for Media General Broadcasting, as well as music mastering, audio restoration, and audio forensics.

### The engineering of music: how technology is creating sound

Each of these four women combined their passions for music, engineering, physics, and science. “I love putting a system together, seeing it fly, and hearing it for the first time,” said Proffitt. For Collier, audio engineering mixes problem solving — finding out why something sounds bad or good — and the inspiration of those creating it. “You need to solve problems but you also need to understand music and how to communicate with musicians,” she pointed out. Some examples: a musician asking an audio engineer to go to the bridge of a song or knowing when a piece of music changes keys; or figuring out whether a problem exists in the placement or design of the microphone or whether there is a need for digital processing.

While Azelborn also thinks it’s important to know how instruments work so

that the audio engineer can connect with musicians and internalize their vision, she points out that a supervisor at the university’s audio studios doesn’t play music at all but got into audio engineering because of his focus on designing systems and equipment for the best-quality sound.

Whether live or recorded, all music involves engineering. “Audio engineering isn’t working with rock stars,” said Proffitt. “Audio engineering involves acoustics, from the propagation of sound in an enclosed place to the placement of a microphone and musicians,” she commented. “It’s the construction of systems, like conducting a giant experiment and the outcome is audio. The recording studio is your experimental design.”

She also points to the constant changes from new technology and new restrictions in broadcasting. The process of going from analog to digital requires a lot of engineering, and when it’s not right, Proffitt compares the resulting sound to nail files scratching against plastic.

Azelborn recently discovered how programming connects to music. “For a long time, it was like I had two separate lives as a beginning student programmer and playing music. Only recently have I really seen that combination,” she observed. Dr. O’Modhrain knew about that connection from its inception. “In the late ’80s, computers were struggling to produce real-time audio. If you wanted to perform, you ran up against the limits of the computers,” she explained, adding that there is a limit to what analog instruments can do; however, today’s composers are breaking boundaries with electronic music. Electronic dance music, for instance, is based on algorithms and hardware developed by early electronic music composers. She sees this field growing and diversifying.

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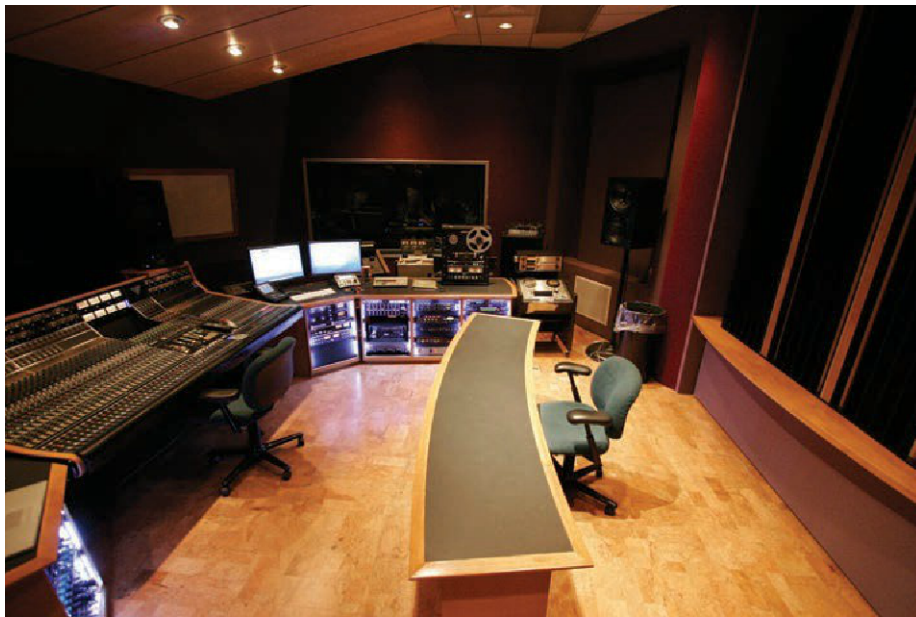
*“People are still improving algorithms for processing signals. Electronic music is transitioning from being just for people who work in studios with famous artists producing million-dollar records.”*

—Emma Azelborn, Graduating 2017, Performing Arts Technology, Computer Science Engineering, University of Michigan

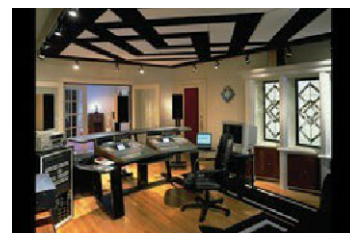
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Collier agrees that live sound reinforcement, the equipment involved, and its design aspects require electrical engineering skills and an understanding of acoustics. She pointed out that “with live sound reinforcement, there are a lot of new developments making huge strides to provide sound that is equally good for all seats in a space.” Advancements in digital signal processing have greatly improved sound quality in concert venues, movie theaters, as well as home theater environments. For instance, she notes that using psychoacoustics research, engineers can manipulate where people think sound is originating. A microphone is placed in front of a sound source, but with psychoacoustic processing people will perceive sound coming from behind them. Surround sound

MARGOT SCHULMAN PHOTOGRAPHY, COURTESY OF THE UNIVERSITY OF MICHIGAN



A multifunctional center at the University of Michigan provides critical space for electronic music composition and performance; developing music and sound for film; and independent student project work.



KK Proffitt in the control room of JamSync, a music studio she built, owns, and operates as chief engineer. Proffitt does all the mixing and mastering at JamSync — from classical to rap. Among the many services JamSync offers are mix multichannel surround sound and stereo, sweetened soundtracks, audio post production as well as turning stereo into 5.1, transferring and archiving audio, authoring DVDs, and editing video.

codes are also based on psychoacoustics. The engineering of sound is adding many other applications as well, such as controlling sound within a car or airplane to architect firms who hire specialists in acoustics to control sound within a building. Collier sees the scope of recording engineering broadening, becoming more available for audio production and enabling people to record in nonstudio environments such as in their garages.

Technology is definitely changing recording engineering. Azelborn sees the biggest leap being in technology that makes user interface design and music recording available to the general public. “People are still improving algorithms for processing signals. Electronic music is transitioning from being just for people who work in studios with famous artists producing million-dollar records,” she explained, adding that simple laptops are powerful enough now to do “cool stuff.” Software is making music production more available to people with less experience because of user interface design.

### Opinions about music and technology run the scale

With the impetus of technology, is the field of audio engineering growing? Ac-

cording to Dr. O’Modhrain, “Absolutely. I think about the early days of computer music when you had to go to centers with powerful computers and expensive speakers. People had to teach you how to program languages.” Now mobile phones and laptops have those same capabilities to download and mix and even make a podcast from a phone. She calls it the democratization of technology, as previously audio engineering was only an academic pursuit because of the availability of powerful computers in the academic institutions. “Now, hardware is embedded in society,” she said.

On the other side of this discussion, Proffitt has seen a decline in the need for audio engineers. “It’s due to technology,” she contended. “If you don’t have the right protocols in the next 10 years, you will fold. The stuff that gets on the airwaves that makes money is the hip-hop you can do in a home studio. Everyone claims to be an audio engineer,” she said.

### Where are the women audio engineers?

While engineering music and audio technology combine the creativity of music and the fascination of technology, why are there so few women in this

field? “Nationally, the odds are roughly one in 10 that a sound engineering technician is a woman, the most recent U.S. Department of Labor numbers show,” reported Ali Killian in a Feb. 13, 2015, article titled, *In Music Industry, Women Are Behind the Mic, but Rarely Running the Board*, which appeared in The University of Texas at Austin School of Journalism’s *Reporting Texas*. As a young woman coming into this industry, Azelborn sees firsthand that women are a minority in performance technology and computer science, but she has not felt any outright discrimination.

*“The creative aspects of combining music and technology are part of the reason for the increase in women. Creative people want to learn the engineering aspects so they can better create.”*

—Cosette Collier, Professor and Audio Production Coordinator, Middle Tennessee State University

Though women are obviously in the minority, she has not felt excluded at all. “I am respected and have had good experiences here in the performing arts technology program,” she stated. “Young people know men and women should be treated equally and realize it’s bad to be sexist.” On the other hand, when she does encounter bias, she feels it is mostly unconscious or unintentional. “You have to prove yourself as a woman and show you deserve to be here. It’s what I want to do, so I’ll keep on showing people I’m competent and know what I’m doing,” she said.

Collier also has seen an increase of women in music engineering, even though when she first began in this field she knew of only one other woman engineer. At the beginning of her career in the field, she was told that the recording studio is no environment for women but observed that things have changed. “Since then, I walk into studios and see more women. The numbers are still extremely low, but there are more.”

Having been to several panel discussions about why there aren’t more women audio engineers, she has heard that it’s not so much a glass ceiling. Rather, women aren’t choosing this for a career. In the department of recording industry at Middle Tennessee State University, Collier reported they have 10 to 15 percent women enrolled at an undergraduate level, and she is seeing more women come into the graduate program. “The creative aspects of combining music and technology are part of the reason for the increase in women,” she said. “Creative people want to learn the engineering aspects so they can better create.”

Terri Winston, executive director of Women’s Audio Mission (WAM), a recording studio begun in 2003 and run entirely by women and girls, offers another perspective on the opportunities for women in audio engineering. Its mission is to “change the face of sound” by offering hands-on training, experience, career counseling, and job placement to women and girls in media technology for a wide variety of jobs in music, radio, film, television, and the Internet.

Winston received a B.S. in electrical engineering and founded WAM while she was a tenured professor and director of the sound recording arts program at City College of San Francisco from 2001-2011.

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*“It’s important to get more women behind the glass in recording studios, making content decisions, and shaping the media that we consume on a daily basis.”*

—Terri Winston, Executive Director, Women’s Audio Mission

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Speaking about the male-dominated industry, Winston noted that even though women face discrimination particularly in science, technology, engineering, and mathematics (STEM) careers, this nonprofit organization “chooses to focus on the positive.” The organization has already placed more than 200 women in companies that deal in music technology such as Pixar and Dolby Laboratories. “It’s really amazing to watch the shift in the industry and to feel supported in that way. I want all women to experience that support that is there in the industry,” she mentioned.

However, it’s not only discrimination that women might face in music engineering. After talking to women engineers who have left the industry, Collier finds that it is the hours and work load of music production that discourages many. “It’s a tough environment for women who want to have a family,” she said. In the field of popular music, long hours are often the norm as musicians in a recording session often don’t want to stop creating even late into the night. Music engineers must be there before the session gets started to set up and are involved in the editing and back up of projects at the end. “This means extremely long hours for recording engineers as it can take months to record an entire project,” advised Collier, though she noted that advanced technology has

made it so that not as many hours are required today.

In addition, recording engineers on the road with musicians have the added jobs of planning where equipment goes and adjusting the correct sound for each venue, thus some of these kinds of jobs can last months. Editing music for movies and TV programs, however, is more promising with a 9 to 5 schedule.

### Keep the music going

Winston added that women shouldn’t let these barriers stop them. “It’s important to get more women behind the glass in recording studios, making content decisions, and shaping the media that we consume on a daily basis; so absolutely, we feel like music engineering and other careers in the recording arts are incredibly important fields for women to enter.”

Another positive note from Collier was her observation that women are at nearly 50 percent enrollment in the latest class of master’s degree students in the MFA degree program in the department of recording industry at Middle Tennessee State University. She observed that the courses there are based on science and engineering but also appeal to creative people. “This is a combination of engineering and the creative aspect of music production — an open marriage of the technical and creative,” she said.

Proffitt, who has handled her share of negativity during her audio engineering career, sums up how she dealt with it. “If you want to do it, have the attitude that nobody’s going to stop you.” She wasn’t stopped and neither were Azelborn, Collier, Dr. O’Modhrain, or Winston, and neither will the women who are currently using their talents in audio engineering who are preparing for careers in a field that is changing music. ■

For more information about Women’s Audio Mission:  
<http://www.womensaudiomission.org>  
<http://www.facebook.com/womensaudiomission>  
<http://www.twitter.com/womensaudio>