Electrical Distribution Technology: What it Takes to Make it Go

Robert Broadwater could be called "the reluctant entrepreneur." A computer engineering professor, he is currently also serving as president of Electrical Distribution Design, Inc., a firm that helps the Electric Power Research Institute (EPRI) market and support software for electric utilities. The firm has a sound fiscal base, has six full-time employees and several part-time employees, and provides support for two Virginia Tech graduate students.

However, Broadwater would like to replace himself with another president, and did not want to be actively involved in the business activities when the firm was established.

In 1995, a Virginia Tech research team led by Broadwater developed workstation software that could save a medium-sized electric utility $1 million a year. The DEWorkstation software helps improve the design and analysis of large electric distribution systems. The software takes data, such as load research data, circuit measurements, and customer data that are stored throughout the utility and relates it to a circuit model. Fifteen different analyses applications can then be used to analyze the utility's circuit model. DEWorkstation helps improve reliability, reduces cost, makes better use of engineers' time, helps engineers solve problems they previously couldn't analyze, and serves as an error filter for utility data. The workstation is used by utilities in the United States and in foreign countries, including Chile and Thailand.

EPRI licensed technology from Virginia Tech for its member utilities, and EDD was established to support the software. EDD is not a commercial outfit, Broadwater said. "We operate more as a support arm for EPRI." EPRI provides the DEWorkstation to its member utilities at no cost. Getting it operational, however, costs between $500,000 and $1 million. "It's a significant investment for a utility, even though it typically pays for itself in a year," Broadwater said. The utilities hire EDD for training, user support, software maintenance, customized features, and large-scale implementation.

Although it was initially ordered by more than 100 electric utilities across the United States, the DEWorkstation has been implemented in only a very small fraction of that number. "One of the critical issues was that EPRI did not provide for long-term support," Broadwater said. "Members were thus concerned about what would happen if they left the organization." Another issue was that during the first few years most EPRI members were not even aware that EDD was available for support. Even today, many EPRI members do not know of EDD. Part of the early lack of recognition was due to the software being shipped for EPRI by a third party.

Getting a sufficient installed client base was not

the only problem for EDD. EDD suffered initially from its own management challenges. "Initially I was not interested in starting up the business," Broadwater said. "As a faculty member, I did not have the time to be involved." However, after encouragement from the university administration and start-up company specialists at the Corporate Research Center, he agreed to serve as a technical resource. "Unfortunately, after approximately 18 months of operation, I was forced to take charge of business matters."

"We started EDD on a shoestring," Broadwater said. He shares ownership with initial investors and the founding students. Some of the founding students worked for just $2,500 a month, which is well below the starting salaries for advanced degrees in electrical engineering. "I get compensated now," Broadwater said, "but I have spent 18 months working at no cost — that's the reality of a start-up where you don't have much money."

"We almost went out of business," Broadwater recalled. "We reached a point where we were two months away from running out of money when we got our first real customer besides EPRI research.

"It's been very tough timewise," he said. "I spent most of my waking hours working — a tremendous number of Saturdays and Sundays. When you have a responsibility like that, you work all the time. I tried to stay out of that mode early on, but it fell in my lap. I either had to take charge, or let it fail." The motivating factor was the technology. "If we hadn't been involved and able to support it, the technology would have fallen by the wayside," he said.

In addition to learning a number of important business lessons, Broadwater said that his involvement in the company has been a boon to his role as a professor. "For the first time in my career at Virginia Tech I have a place to meet with my graduate students. I never really had lab space, and while the workstation was being developed, I had five graduate students working out of a single office originally designed for one person. Now we meet in the company offices; we meet much more often; and my interaction with the students is better," he explained.

"I've also been exposed to many interesting problems I would not have encountered otherwise," he said. He cited examples ranging from utility construction to dealing with hybrid systems that have been developed over different decades. "For example, we've had to model some utilities that have a switch that goes dangerously from phase A to phase C. We have also solved looped systems where part is three phase and part single phase," he said.

"We've run into all kinds of issues with impedance. Utilities often have as many as 10 three-phase circuits in parallel. Unfortunately, nobody models it accurately." His research team has obtained funding to work on that particular problem. "I would never have been exposed to these issues if I hadn't been involved in the business."

Perhaps the greatest advantage has been the opportunities made available to his graduate students. "We have been able to provide the opportunities of a large academic research group that would otherwise not have been available with me," he said. "For example, our work at EDD has exposed us to many different design calculations that are used and needed by utilities. These design calculations are applied to the same system and thus interact with one another. For instance, if you work design "a" first and then design "b", the results for the overall design will be different than if you had worked design "b" first and then design "a." What is needed is a way for calculations written by different people to work together for the best solution. Our students have developed that capability, and have been able to solve problems that they would never have had the opportunity to solve without the EDD exposure and support," he explained.

"Would I do it again? Given the advantages to the students and the industry, yes, I would do it again. I would do it differently, though: I would do it better."

Not bad for a reluctant businessperson.

Left: The Electrical Distribution Design team. Seated in front: left - Jeff Thompson, EDD director of development; right - Rich Sequin, Detroit Edison. Standing from left: Fangxing Li (G); Murat Kilek (G); Lauraine Broadwater, EDD office manager, Irislav Drezga (back row), EDD lead development engineer; Robert Broadwater; Robert Torgersen, EDD lead quality engineer, and Darrell Loyd, lead Windows developer.