Preparing the Wireless Workforce

Susan Sauer Sloan
Chief Executive Officer, Global Wireless Education Consortium
Arlington, VA 22209  sloan@gwec.org

Abstract – The Cellular Telephone Industry Association conducted a study on the availability of radio frequency (RF) curricula and found a severe shortage of schools offering any RF education. This study revealed that RF courses have been replaced in past years by more fashionable courses in computer science and software engineering on college campuses. However, the unprecedented success of personal and wireless communications has fueled technological advancements in virtually every aspect of electrical and computer engineering. The worldwide growth in these areas can only be supported if educational institutions commit to developing a new generation of wireless professionals, especially in RF engineering.

In 1997, a model was created in the United States that has positively affected the workforce for wireless technology companies. Through the Global Wireless Education Consortium (GWEC), a collaboration of industry and academe, colleges and universities throughout the world are preparing students in greater number who, collectively, represent a higher quality technology workforce for the future.

Index Terms – collaboration, partnership, skills, wireless education, workforce

INTRODUCTION

The wireless industry celebrated its 20th anniversary in 2003. In the period of two decades, wireless communications technology has evolved at breakneck speed. Statistics compiled by the Cellular Telecommunications and Internet Association [1] and presented in Wireless Week magazine [2] help to characterize the timeline expansion. The first commercial cellular system was launched in October 1983 in Chicago, followed by activation in December 1983 of a second system in the Baltimore/Washington, DC corridor. Three years later, in 1986, U.S. cellular subscribers topped 2 million. In 1997, U.S. wireless subscribers surpassed 50 million. By mid-year 2004, the estimated number of subscribers in the U.S. had rocketed to 170 million while the mobile industry worldwide was estimated at 1.5 billion. And the steady upward growth in the wireless industry continues. Analysts with Deloitte & Touche [3] estimate that the global wireless phone market will grow to 2 billion subscribers by the end of 2005, fueled by strong demand from developing economies in Asia and Latin America.

When we think “wireless”, we generally think of cell phones, PDAs and notebook computers. But wireless technology has expanded beyond the traditional telecommunications sector to permeate other important industrial sectors as well. Today wireless applications are an emerging and essential means of communication in the medical and healthcare sector, for example, with remote sensors, wireless monitors, and teledicine. Wireless technology is also increasingly deployed in the automotive industry, with GPS critical need and location monitoring systems (e.g., OnStar) and with satellite radio. The military has long been reliant upon wireless technology for spectrum management, satellite surveillance, and the like. Police and fire response units utilize wireless devices for rapid communications and theft curtailment, while the retail industry is embracing Radio Frequency Identification (RFID) for inventory assessment and the tracking of goods (e.g., Wal-Mart). The construction industry is eyeing RFID for similar materials tracking and communication needs. Even pet care today is “going wireless” for the tracking of household pets!

The steady adoption of wireless technology in the home, the school, local coffee shops and airports, even municipalities is exciting, no doubt, but also suggests a growing demand for knowledgeable and skilled individuals to maintain and further develop the technology. Indeed, the steady worldwide growth in these areas can only be supported if educational institutions commit to developing a new generation of wireless professionals, especially in RF engineering.

THE NEED FOR SKILLED WORKERS

Let’s begin with a look at the “big picture”. After steep increases in the late 1970s and 1980s, bachelor’s degrees in Electrical Engineering and Computer Engineering dropped through the late 1990s. Degrees conferred in the United States are on a slight rise today but, for Electrical Engineering, remain well below figures of the late 1980s (Science & Engineering Indicators 2004, NSB) [4]. Moreover, given the age distribution of science and engineering degreeed individuals currently in the workforce, it is likely that the number of retirements among such workers will increase substantially over the next 20 years. According to Mike Fucci, principal and U.S. leader of Deloitte Consulting’s Human Capital practice, “The impending talent crisis is a global, cross-industry threat that is about to become much worse as the first wave of Baby Boomers turn 62 in 2008 and skills gaps widen.” [5] These trends and others suggest that the need for skilled and
knowledgeable engineers and technologists is at a critical level in the United States.

The “big picture” perspective makes clear the demand for individuals educated in the sciences, technology, engineering and mathematics (STEM) across all employment sectors and worldwide industries. The demand for STEM talent exceeds the current supply of qualified graduates. We are rapidly developing new educational technologies but we are not generating an adequate supply of “working technologists” to maintain the technology and services. This certainly holds true for the wireless industry.

Radio is the basis for all wireless technology, and yet the Cellular Telephone Industry Association [6] conducted a study on the availability of radio frequency (RF) curricula and found a shortage of schools offering any RF education. The study revealed that RF courses have largely been replaced by courses in computer science and software engineering. While these latter fields of study are relevant, the growth in wireless communications and systems can only be supported if educational institutions also commit to developing a new generation of wireless and RF engineering professionals. The predicted shortage of such specialists is so great that it has fostered a spirit of collaboration between industry and academia to develop and institute curricula and accelerate the emergence of qualified engineers and technicians. Enter the Global Wireless Education Consortium (GWEC), a non-profit 501(c)(3) membership organization established in March 1997.

GLOBAL WIRELESS EDUCATION CONSORTIUM

GWEC (pronounced “Gee-Wec”) is an industry/education partnership focused on expanding wireless technology curriculum in academic institutions worldwide in an attempt to address the workforce shortage that could potentially reach crisis proportions. Many companies and colleges and universities work together to develop a basic, vendor-neutral wireless curriculum. That material is then shared among all GWEC members for use in teaching and learning. The intent is to work more efficiently by eliminating duplication of effort and dollars spent.

Since its inception, GWEC has engaged many of the leading wireless service providers, equipment manufacturers, and others. Current industry members include the following visionary companies: Award Solutions Inc., Emona Instruments, LCC International – Wireless Institute of LCC, Motorola, Movilnet, Sprint, Texas Instruments Inc., UGS Corporation, and Verizon Wireless. The IEEE is a long-standing affiliate member. Additionally, over 75 academic institutions currently participate in GWEC as active education partners. Colleges and universities pay an annual membership fee of $600 while industry members contribute to membership according to gross annual revenues.

By working together, GWEC members have developed an extensive curriculum that includes continually updated wireless education material as well as newly developed material. As the technology evolves, so too must the curriculum. While GWEC’s emphasis has been on undergraduate instruction, the organization continues to foster relations with K-12 programs as well as with Electrical and Computer Engineering, Computer Science and Telecommunications graduate programs.

GWEC WIRELESS CURRICULUM

A major undertaking by GWEC has been the development of a basic wireless curriculum based upon numerous distinct theoretical Points of Knowledge (POK). The POKs characterize the required information and experience content for two-year and four-year undergraduate wireless-focused curricula, as determined by senior engineering and hiring managers at wireless and wireless-related companies and with considerable input from educators.

The Points of Knowledge are the basis for the Industry Resource Guide, an online document that illustrates for each POK how the various types of engineers, technicians and computer personnel use that knowledge in their work. Moreover, it outlines the depth and breadth of knowledge needed by persons occupying different positions within the wireless field (e.g., Telecommunications Engineer, Cell Site Technician, etc.). It contains overviews and job descriptions for numerous wireless-related positions.

The Points of Knowledge are divided into numerous broad knowledge categories:

- Basic Skills – Specific to Wireless
- Radio Transmission – RF Theory
- Radio Transmission – RF Propagation
- Switch/Basic Data Communications
- Switch/Basic Switching Systems
- Switch/Basic Telephony Systems
- Switch/Basic Data Networks
- Transmission & Trunking/Concepts of Traffic Engineering
- Transmission & Trunking-Basic T-1/Digital Telephony
- Transmission & Trunking/Transmission
- Transmission & Trunking/Intelligent Networking
- Frequency Reuse
- Communications
- Air Interface Technologies – Access Standards
- Digital Voice/Digital Vocoding & Techniques
- Microwave/Microwave Systems
- Power Plant
- Test Tools/Equipment/Software
- Regulatory Standards and Conventions
- Professional Affiliations
- Health and Safety
- Electromagnetic Compatibility (EMC)
- Wireless Security Issues
- Wireless Networking and Mobile Internet Protocols
IEEE Wireless Standards (IEEE 802.xx)

Corresponding to each POK is a curriculum module or set of modules.

The GWEC Wireless Curriculum is currently composed of 53 separate modules designed for maximum flexibility and to be readily incorporated into current engineering and engineering technology curricula. The materials are meant to be a starting point for faculty members to develop their own material but substantially cut down on the development time as well as the duplication of effort by re-creating materials at multiple academic institutions across the globe.

The curriculum is a dynamic entity. Three modules were added in 2004 that address the IEEE Wireless Standards, notably IEEE 802.11, IEEE 802.15 and IEEE 802.16. Two additional modules on emerging topics of interest and importance are currently in development for expected release later this year (2005). Material updates are made regularly. Online simulations are being added. A companion text is being written. eLearning and lifecycle management tools are being explored. And, to date, one-third of the modules have been translated into Spanish in addition to the English version.

Modules are currently posted on the GWEC Web sites as zip files and consist of a STUDENT NOTES document made up of PowerPoint slides with corresponding notes pages, and generally an INSTRUCTOR GUIDE, detailing the learning objectives for the module, time estimate for delivery, resources and references, review questions, and laboratory exercises. GWEC is committed to preparing students with viable workplace skills; thus, efforts are made to incorporate practical application exercises and case studies wherever possible that illustrate the different theoretical Points of Knowledge. Infused throughout the curriculum are problem solving, communications and teamwork concepts and exercises.

Visitors to the GWEC Web site may view a sample module online. The module TCP/IP, loaded as a WinZip file, may be viewed at http://www.gwec.org/modules.cfm.

The flexible curriculum can readily be applied in the following learning environments:

<table>
<thead>
<tr>
<th>AUDIENCE</th>
<th>ENVIRONMENT</th>
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</thead>
<tbody>
<tr>
<td>Students in college/university undergraduate and graduate programs</td>
<td>Academic programs</td>
</tr>
<tr>
<td>New employees</td>
<td>Orientation programs</td>
</tr>
<tr>
<td>Experienced employees</td>
<td>Career development</td>
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<tr>
<td>Displaced workers</td>
<td>Retraining opportunities</td>
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</tbody>
</table>

GWEC Education Partners and Industry Members alike make use of the curriculum for teaching and learning purposes. It makes sense, certainly, as all have contributed to its development.

The beauty of such an approach is twofold: (1) it allows GWEC members to work more efficiently by eliminating duplication of effort and dollars spent while providing a comprehensive teaching/learning resource, and (2) its applications in the various environments as noted above help to generate a larger pool of qualified workers for today’s increasingly wireless job market. Moreover, by incorporating input (subject matter expertise) from many wireless companies, the GWEC curriculum maintains currency in an area of rapid technological change and serves as the consolidated voice of industry about topics of relevance that should ideally and appropriately be taught at the undergraduate level and beyond.

OTHER ACTIVITIES MADE POSSIBLE THROUGH COLLABORATION

GWEC’s unique collaboration between industry and education includes efforts to provide faculty members and their affiliate institutions with:

- access to wireless experts
- an understanding of and material for teaching current wireless technology
- opportunities to participate in industry wireless training courses
- relationship with industry for populating advisory boards and pursuing research interests
- opportunities for industry internships, job shadowing
- curriculum materials developed by industry and education together for use in college/university classes; timely technical guidance for curriculum development
- lab exercises for students to emphasis the practical application of theory
- student exercises that integrate written/oral communication, teamwork, critical thinking and problem solving skills
- thesis and capstone project topics and ideas to share with students
- industry internship and co-op opportunities to publicize to their students
- recognition through the annual GWEC Wireless Educators of the Year Award
- means to collaborate with faculty at other academic institutions on research projects and/or grant proposals
- opportunities to attend Faculty Workshops and Regional Seminars on cutting-edge wireless topics
- marketing support for student recruitment

For wireless companies, the benefits of GWEC membership include:

- Increased pool of trained wireless talent
- Reduction of recruitment costs
Reduction of training time
Better leveraging of investment with universities
Influence and input regarding wireless curriculum content within colleges and universities
Building relationships for continuing education for employees
Linkages with other wireless companies; benchmarking
Community outreach

GWEC is a tried and true model for successful relations between industry and education and a win-win situation for all involved. Grow the pool; gain the talent. Students graduate in increasing number with basic wireless knowledge – ready to be productive in the workplace from day one.

SUMMARY

The ubiquity of wireless devices and new wireless applications is the result of unprecedented growth in the wireless industry. To meet current and future product and service demands, it is imperative that we grow the wireless workforce so that companies have a pool of highly qualified individuals to employ and students graduate with a skill set and knowledge base that is current and fully recognized by the wireless industry. Herein lies the mission of the Global Wireless Education Consortium (GWEC).

GWEC has helped in the establishment of a growing number of undergraduate wireless programs; indeed, “wireless” is becoming a recognized topic in engineering and engineering technology education. One GWEC education partner, Auburn University [7], is the first institution in the United States to offer a Bachelor of Wireless Engineering degree program. The program had its first graduates this year.

Schools are not only newly incorporating RF and wireless courses into their curriculum, but many campuses are “going wireless.” The Campus Computing Project’s 2004 National Survey of Information Technology in American Higher Education [8] revealed that, for all institutions (public and private universities, public and private four-year colleges, and public two-year colleges), 55.3 percent have a strategic plan in place for use of wireless on campus while 31.0 percent have classrooms with wireless service. By sector, percentages are higher for all accept public two-year colleges.

GWEC members are cognizant of the trends and are fully committed to the long-term need for skilled and knowledgeable employees in this burgeoning technological field. Moreover, GWEC members are realizing mutual gain through innovative collaboration.

While GWEC is focused on the mobile and wireless industry and on wireless education, this tried and true collaborative model is one that can easily be adapted to other industries as well. It will be successful only with the willingness to change, to adapt, and to go outside the bounds of traditional education and industry relationships, however, and with the acceptance of new and innovative approaches to creating and delivering educational programs.

GWEC Web Site: http://www.gwec.org

Current GWEC Industry Members:

Award Solutions Inc.
Emona Instruments
LCC International – Wireless Institute of LCC
Motorola
Movilnet
Sprint
Texas Instruments Inc.
UGS Corporation
Verizon Wireless

IEEE (affiliate)

Current GWEC Education Partners:

Four-year (+) Division
Ajou University (South Korea)
Auburn University
British Columbia Institute of Technology (Canada)
College of DuPage
DePaul University
DeVry University - Addison IL
DeVry University - Alpharetta GA
DeVry University - Arlington VA
DeVry University - Calgary CAN (Canada)
DeVry University - Chicago IL
DeVry University - Colorado Springs CO
DeVry University - Columbus OH
DeVry University - Crystal City VA
DeVry University - Decatur GA
DeVry University - Federal Way WA
DeVry University - Fremont CA
DeVry University - Ft. Washington PA
DeVry University - Houston TX
DeVry University - Irving TX
DeVry University - Kansas City MO
DeVry University - Long Beach CA
DeVry University - Long Island City NY
DeVry University - Miramar FL
DeVry University - North Brunswick NJ
DeVry University - Ontario CAN (Canada)
DeVry University - Orlando FL
DeVry University - Phoenix AZ
DeVry University - Pomona CA
DeVry University - Tinley Park IL
DeVry University - West Hills CA
DeVry University - Westminster CO
Florida Institute of Technology
Florida International University
George Washington University
Malaviya Regional Engineering College (India)
Marathwada Institute of Technology (India)
REFERENCES


