AC 2009-1833: EXPERIENCES OF ENGINEERING TECHNOLOGY FACULTY IN PROFESSIONAL CERTIFICATION PROGRAMS

John Denton, Purdue University
John Denton is an Associate Professor in Electrical and Computer Engineering Technology in the Purdue University, College of Technology in West Lafayette, Indiana. He received his Ph.D. in Electrical Engineering from Purdue University in 1995. His areas of interest and expertise are analog electronics, RF electronics and electronic materials. He is the author or co-author of over 50 journal articles and conference proceedings.

Nancy Denton, Purdue University
Nancy Denton, PE, CVA III, is a professor of mechanical engineering technology at Purdue University. She is involved in machinery monitoring, mechanical testing, curriculum and assessment. Her professional affiliations include ASEE, ASME, and the Vibration Institute.
Abstract

Professional certification is a widely accepted method for establishing credentials in one’s field. Certification is an industry driven process to establish a level of competency for employers and employees. Becoming certified generally consists of a minimum length of practice in the field of a technical discipline and earning a passing score on a written examination. These examinations are generated through a committee-based process comprised of experts in the area of certification, where the experts include a wide base of representatives from different aspects of the certified area. Typically, the committee contains industry professionals and very few, if any academics. While the absence of education-based members may be due to many factors, one contributor may be the lack of current industrial practice in most educational venues. Industry-based education programs, such as in engineering technology, are an often overlooked resource for professional certification. As academic contributors, the authors share their experiences serving on certification examination committees for two professional societies and how this is impacting their programs and students.

Introduction

Professional certification is becoming more prevalent in the technical sector as a means to show competence and experience in an area of expertise. Certification has many advantages for both the employer and employee, but there are also benefits for participants in the certification development process. This paper will present the overall scope of professional technical certification and benefits for the employer and employee. This paper seeks to highlight the advantages for those who participate in the generation and maintenance of certification programs.

There is a multitude of professional certification programs available that are government based, corporate based and industry based. There are many opinions regarding the applicability, need and efficacy of the various types of certifications that are beyond the scope of this paper. Government-based certifications are typically for public safety, understanding of governmental regulations and compliance. For many professionals, this type of certification is a prerequisite for beginning or continuing employment, such as nurses, accountants, teachers, and doctors. Professional engineer licensure is a typical technical example of a governmental certification, and is mandatory for engineering requiring signature authority, where the resulting product will directly affect the general public. There are also standards that industry has employed to certify the certification process.

Corporate-based certification consists of certifying competency in a specific company’s systems or products. Cisco, Motorola, National Instruments, and Rockwell Automation are all examples of the many companies that offer certification programs for individuals. For example, Cisco offers individuals a three-level general networking certification program, with the option for
additional evolving specialist certifications. The general program offers six parallel certification tracks, requiring a laboratory practice exam and a written examination to attain certification for 24 months. Recertification requires passing another laboratory exam every 24 months\textsuperscript{8}. The National Instruments individual certification program consists of three levels of proficiency for three of their software packages. At each level, a written examination is hand-graded to determine proficiency. The initial associate developer exam is a one-hour multiple-choice exam, while developer and architect exam-takers must demonstrate program development proficiency in paper form within a four-hour time block. Certification is maintained by passing a recertification exam every 24 months\textsuperscript{9}. Many companies that provide certification of their products and systems have similar types of exams and requirements. These certifications are excellent tools for individuals or companies that use the specific products, but are limited in scope and are not useful to those that use different corporate products. A skill set from one corporate certification is usually not translatable across the industry.

To provide more universal equivalent credentials, professional societies have defined bodies of knowledge for aspects of their respective disciplines, and offer certification in said bodies of knowledge. Industry-based professional certification is designed to establish the credentials of individuals in a manner that validates their knowledge and experience in a technically defined body of knowledge, beyond specific vendors or products. The cross-corporate nature of industry-based certification affords employers the opportunity to obtain employees with a wider base of knowledge and experience and subsequently work across a wider base of the industry. The work discussed here is industry-based certification performed by the professional and industrial societies representing the both the employers and employees.

Professional certification has numerous advantages for the employer and employee. For the employer, benefits include:

- A pre-defined assessment tool to identify individuals with a required competency,
- Guidance for setting up employee professional development plans,
- The ability to verify applications and practice-based knowledge and skills of individuals using objective criteria,
- Potential business advantages such as client preference in contract decisions and insurance discounts for meeting safety and reliability requirements.

For the employee, certification can:

- Provide a method to indicate competence in a technical area,
- Show a needed level of skill, experience, and understanding of a specific body of knowledge,
- Indicate currency with industrial practices and continuing education effort,
- Suggest a strong commitment to continued professional development,
- Demonstrate potential for more responsibility, promotions and higher salaries, or otherwise offer career advancement opportunities.

Background

The impetus for establishing a certification examination often begins with recognition that a new body of knowledge has emerged or is emerging. Initially, instructional content and training
options will vary across a broad spectrum, and practitioners in the new field possess disparate knowledge and skills. This may lead to frustration or concern among employers and employees as well as contractors and clients. If the disparity becomes sufficiently widespread, the related industrial organization or professional society will begin the process of defining the body of knowledge so a certification program can be generated.

This paper presents the experiences of the authors’ involvement with the professional technical certification programs of two engineering societies. One of the programs is mechanically based from the Vibration Institute (VI). The other program is electronically based from the Institute of Electrical and Electronic Engineers (IEEE). The certification programs are at differing stages in their development and delivery.

Nancy: My certification program is through the Vibration Institute (VI), which offers certifications for vibration analysis and balancing of rotating equipment and is developing shaft alignment certification. Comments in this paper will be limited to vibration analyst certification. This is a four-stage vibration analyst certification program that spans levels of expertise from the data collection technician through the top-level consultant, conforming to the requirements for training and certification of personnel specified in ISO 18436.2. Certification examinations are offered in over 20 countries through the Vibration Institute and cooperating societies in Canada, Japan, Korea, and Great Britain. This certification program began in the 1980s as a three-level five-year specialty certification program meeting the needs of VI members and their employers. The Vibration Institute has attempted to include at least one academic member on its certification examination committees to provide expertise on question writing and a more general perspective on the discipline.

I joined the fifteen-member Vibration Institute certification examination committee as they transitioned from a single society basis to an ISO-approved certification program. This transition process started with a review of the body of knowledge encompassed by the existing vibration specialist examinations. Content was regrouped and modified to move to the ISO’s four tier certification system. Existing questions were classified by topic and level of difficulty, allowing identification of question distribution concerns. Some questions were rewritten to change their level of difficulty, while new questions were developed to fill topical gaps in the exam database. Rotating machinery knowledge, signal processing, vibration fundamentals and vibration analysis are representative topic classifications.

Multiple-choice examination questions are randomly generated from the database by classification whenever an exam is given. Responses to each question are tracked to help identify questions with wording, interpretation, deviations from common practice or other issues. The certification exam committee periodically reviews all questions, rewriting any question deemed to be subject to multiple correct interpretations, tied too closely to a specific industry sector, or simply not conforming to good multiple-choice exam question practices.

John: The program that I am involved with is electrically based from the Communication Society of IEEE; Wireless Communication Engineering Technologies (WCET). WCET is an international five year certification in wireless communication knowledge demonstrating industry practice and problem solving skills for current applications. The general idea of
this certification is to target a practitioner in wireless communication that has 3-5 years of experience and the body of knowledge that should be acquired and used during that period of time. My involvement for the IEEE WCET certification started at the beginning of certification process. The initial phase of this certification was the industry practice analysis task force, which drafted a delineation of practice domains. The practice domains consisted of seven areas;

- RF engineering, Propagation, and Antennas
- Wireless Access Technologies
- Network and Service Architecture
- Network Management and Security
- Facilities Infrastructure
- Agreements, Standards, Policies, and Regulations
- Fundamental Knowledge

Three of the sixteen individuals on this task force were from academic institutions with the remaining task force members as industrial practitioners. These practice domains were reviewed by industrial focus groups and independent reviewers throughout the world. The practice task force used this input to finalize the scope and content of the practice domains.

My involvement in the WCET certification program continued as a member of the inaugural certification question writing and exam review team. I wrote 25 questions for the exam. I then joined a question review team, where my team reviewed, edited and verified nearly a two hundred certification questions and answers for consistency, grammar, geographical/cultural bias, pertinence, accuracy, and industrial use.

The WCET certification examination was first offered in Fall 2008, with its second examination for Spring 2009. The WCET certification is intended to be ISO certified as it passes the requirements for this standard.

Motivation

Engineering technology graduates cannot be assured of access to professional engineering licensure but are eligible to sit for various certifications. Engineering technology faculty members have many reasons to participate in the industrial certification exam development process.

Nancy: My involvement in the Vibration Institute’s industry-based certification program began when I took a couple of their certification examinations. I did so to establish more credibility in a highly practice-oriented field, while gaining a better understanding of what MET students should study to be competent in vibration-based machinery monitoring. The reliability field has been growing and evolving. Project opportunities regularly arise that require full understanding of rotating equipment, its vibration signatures, and related data acquisition concerns. Maintaining technical currency and ensuring my students are prepared for work in this field are some of my motivators for participating in the certification exam process.
John: I am an engineering technology faculty member. I need to instruct students in the practice of engineering and I need to know the area I teach both in theory and practice. I got involved with the WCET certification because I want to understand more about wireless communication practices. My specialty is electronic circuits and their design for RF communications and teaching this material to the future work force. This is only about ~20% of the wireless communications area. I wanted to know how the material I teach fit into the big picture of the present and of the future.

I find that students will learn better, pay closer attention and gain confidence when you can relate the small piece of information you are teaching into a larger scenario of a system or industry. It gives me more confidence in my instruction and lends credibility to the students that the material has importance.

Outcomes

Participation in the certification programs yielded a number of valuable outcomes and skills. Some of the benefits to date are improved exam question writing skills, better understanding of the scope and extent of the core body of knowledge for the discipline and wide array of professional and industrial contacts.

The authors were experienced in writing exam questions from their years of college instruction, but developing exam questions for the certification program greatly enhanced and honed those skills. Certification exams generally consist of multiple choice questions (MCQ) to some level. Both of the programs discussed contain 100% MCQ. There are many excellent resources on creating MCQ exam questions. Generation of questions for the exam is the most central element for the certification program.

The certification exams are designed for international use so they must be understood by all. The VI examinations are offered in English and Spanish, while the WCET exam is in English only. It is essential to write each MCQ with no cultural bias in the problem statement and answer choices. The use of standardized international units is an obvious requirement, but these units are not always in SI. For example, satellite communication dishes have an international standard diameter measurement in feet and not meters. Similarly, line frequencies vary by country, impacting vibration analysis. Question review and editing required a team with a wide range of capabilities and knowledge. For both authors, the MCQ editing and review process produced the most powerful outcomes.

Nancy: Serving on the VI certification exam committee has resulted in a number of direct and indirect benefits for me and my students. The involvement has increased my understanding of what is considered common knowledge by vibration/reliability practitioners, as opposed to vibration test engineers and product developers. Understanding this part of the practice aids my own professional development while guiding course content to better prepare my students. One concrete course improvement has been the infusion of more realistic vibration analysis examples and assignments.
Another professional benefit has been improved skill in overall examination design. I am now much more methodical about beginning with a listing of concepts to be tested, mapping questions to concepts, and ensuring I have an appropriate balance between topic importance and point distribution on the exam.

Participation in certification exam development has resulted in many indirect benefits. Professional relationships fostered by working closely with industry representatives as peers have been fruitful. I am able to proctor certification exams on campus so my students can begin establishing machinery monitoring credentials before graduation and at reduced cost. One consultant donates his corporate copies of the practitioner journal, *Vibrations*, allowing me to supply every student with their own journal copy and to require each student to summarize a current article from their journal. He also volunteers to review student machinery monitoring projects, giving them a much-needed external perspective. Another exam committee member regularly checks on our transducer requirements and arranges donations when needed. Employment opportunities for our graduates in the reliability field may be enhanced through certification exam involvement. Finally, having this experience on my vita has helped obtain sponsorship for several industrial projects.

*John:* The major outcomes that I am getting from participation are improved exam question writing skills and credibility of the material instructed and a world view of the body of knowledge and the industry, industrial contacts and interaction.

I always felt that my question writing skills for academic exams were good, but writing and reviewing the WCET questions improved my question writing ability greatly. In an academic setting, you present the material to learn, write the questions and score the results. If there is an exam question error through poor wording, incorrect data, or excessive level of difficulty or ease, then as the exam grader, you have control over the question results and score. For the professional exam, the questions are required to be accurate and correct both in result and problem statement. Add the global nature of the exam and the difficulty increases. Instruction material was provided for question writing format and style. As a question writer, I spent about 45 minutes on each of the 25 questions that I wrote. For my courses, I used to spend about ten minutes designing new questions, now it takes about twenty minutes, and the questions are more clear, to the point, contain proper stems and distracters, directly relate to the lecture material and the concepts. Anecdotal evidence from students is that these questions are more challenging, yet I get fewer complaints regarding ambiguity or topic relationship.

The review of certification questions was an interesting and challenging experience. Many questions were submitted by industrial practitioners from around the globe. These questions ranged from excellent with few if any changes to those where it difficult to even to determine what the question was. The question review team that I worked with consisted of experts in two or three of the practice domains, so that we did review questions on material in which we had little personal experience. This turned out to be quite beneficial, because the non-experts were used as a knowledgeable sounding board on which they reviewed the question context and content and left the solution details of accuracy and rigor to the experts in the team. The non-specialists provide a viewpoint similar to the individuals for whom the exam was
designed; knowledgeable practitioners. This process exposed the entire question review team to the body of knowledge, enhancing understanding, showing the interrelationships of content areas and the breadth of topics spanned in each exam.

The volunteers working on this certification were an excellent group. Everyone was took their responsibility seriously. It was refreshing to interact at this professional level with an engineering group again. I know that if I have questions in the various communications areas, I can contact members to help me out.

An anticipated long-term benefit is that I can tailor and adapt the curricular content of my courses to the body of knowledge for ET graduates. This effort has created more awareness of current and upcoming challenges in the discipline, which allows me to change related lecture and laboratory course material in a timely manner.

**Conclusions**

The idea of this paper evolved out of discussions between the authors in which the certification programs of two totally different technical professions were found to be more similar than different, except for their technical content. The global nature of the certifications and material only reinforces the similarities that exist across the world.

Each author has grown in their understanding of exam question writing. Each has broadened perspective on their discipline, developed positive professional relationships with industrial representatives, and used these experiences to improve their course content and delivery. Participating in this process allows the interaction of like-minded individuals that are interested the current and future outcomes of their industry. For educators, this interaction encourages the mechanisms that strengthen technical education and our students’ preparation for professional practice.

Engineering technology faculty span the academic and industrial fields and create a link between practice based professionals and theory based scholars. Involvement in the examination question development process can afford engineering technology faculty many benefits, such as a better understanding of core body of knowledge in the discipline. This understanding creates more awareness of current and upcoming challenges in the discipline. It also affords exposure to national and international aspects of the discipline and related industry.

**References**


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