AC 2008-2852: NCSLI METROLOGY EDUCATION OUTREACH

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Georgia has been active in the professional metrology associations National Conference of Standards Laboratories, International (NCSLI) since 1985 and has given presentations at national and international conferences. She served as Section Coordinator for the Twin Cities Section (1988-1989) and has been a Vice President on the Board of Directors for the Eastern Division (1994), Measurement Science and Technology (1995 to 1997), Publications (2001), Operations (2002-2004) and now Learning & Development (2005-present) where she is involved in developing long term objectives in metrology Education and Training.

She has received the following awards for her work in metrology

• NCSLI Best Paper Award (co-author), Applied Category (2007)• Arthur S. Flemming Award (2004); • Algie Lance "Best Paper" Award (tied), Measurement Science Conference (2003); • MSC Andrew J. Woodington Award in (1997); and • Department of Commerce Bronze Medal (1992).

She holds a Bachelors Degree in Biology from the MN State University (Moorhead) and a Masters Degree in Technical Management from Johns Hopkins University, Whiting School of Engineering.

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Chris started his Metrology career in 1979 as a USAF PMEL technician - Chris presently is Hewlett-Packard's (formerly Compaq Computer) manager of Houston Metrology group. Prior to HP (Compaq) Chris was a principal engineer supporting IC manufacturing for DEC, an electronic engineer supporting NASA calibration laboratories, and a field engineer supporting U.S. Navy calibration laboratories. Chris spearheaded the development of ASQ's Certified Calibration Technician (CCT) program, is an editorial advisor for Cal Lab Magazine, is an officer of ASQ's Measurement Quality Division (MQD), is on the board of advisors for the National Association for Proficiency Testing (NAPT), is the author of three freeware metrology packages in use throughout the world, and is a co-author of ASQ's Metrology Handbook (Spring 2004 release). Chris's work-related interests include: Metrology Education, Uncertainty Analysis, Automation, and Proficiency Testing. Chris holds a B.S. in Technology and Management from the Univ. of Maryland, a B.S. in Electronics Engineering from the Cooks Institute of Electronics Engineering, and an MBA from Regis University. Chris has been awarded the following: Dr. Allan V. Astin Award (best conference paper) by NCSL International (1998), Max J. Unis Award by ASQ Measurement Quality Division (2002), Excellence Award by ASQ Certification Board (2003), and Test Engineer of the Year by Test & Measurement World magazine (2004).

NCSLI Metrology Education Outreach

Abstract

The National Conference of Standards Laboratories International (NCSLI), one of the world's leading Metrology professional associations, is very much in the forefront of initiating and coordinating outreach activities in order to help reverse the trend of a dwindling Metrology workforce. NCSLI, in close partnership with such other professional associations as the American Society for Quality, Measurement Quality Division (ASQ-MQD) and the Measurement Science Conference (MSC), is taking steps to increase Metrology awareness with an emphasis on Metrology education and training. These efforts are under the auspices of NCSLI's learning and development program. The goal of the next-generation outreach program, a program under the NCSLI learning and development group is to:

- Promote the Metrology profession to potential candidates;
- Publicize Metrology education and training opportunities; and
- Initiate and support activities that help enhance Metrology curricula.

The field of Metrology, like many other technical professions, is faced with an acute shortage of trained practitioners to replace retiring baby boomers. In fact, 2008 marks the first year that the baby boomer generation can start taking early social security benefits at age 62. Since many technical professions are trying to recruit potential candidates from an ever-dwindling supply of technically-minded young people, something has to be done to help ensure an adequate supply of next generation Metrology professionals. In recent years the pool of young people with technical career aspirations has become smaller and smaller: the allure of more 'glamorous' career occupations is taking its toll. Young people are often unaware of Metrology careers and of related education and training opportunities that are available to them. This situation will no doubt worsen if concerned individuals, industry sponsors and professional Metrology organizations fail to take action.

NCSLI Metrology Education Outreach

Background

In 2005, NCSLI began a strategic roadmap effort by creating a set of objectives and a framework for organizing these objectives and their related activities, followed by organizing committees and action steps to address workforce challenges in the metrology community.[1] During the technical sessions of the 2005 NCSLI Annual Workshop and Symposium, participants were given sticky dots to mark on kiosk displays the areas that they believed to be of highest priority. In addition, a survey form was distributed to gather feedback on suggested action steps that NCSLI might take. The overwhelming feedback on the kiosks, surveys, and individual discussions related to Metrology Outreach. The objectives and framework of the roadmap were slightly modified in 2007 to reflect the intervening time and are noted below.

Objectives:

1. *Metrology & Standards Outreach.* Ensure awareness of metrology, measurement sciences, and needs for calibration and standards so that they are readily recognized by organizational managers and the general public.
2. *Workplace Development.* Ensure that clear career paths are identified and communicated as widely as possible, and ensure that labor statistics are tracked and available.
3. *Professional Development.* Ensure that appropriate methods or systems are in place to provide appropriate recognition and credibility for the metrology professions.
4. *Metrology Education.* Provide multiple forums where metrology educators interact, and encourage sharing of ideas and resources, helping to ensure that stakeholder educational needs are met.
5. *Training Resources.* Ensure that information and resources on metrology education and training are widely available and ensure a high level of awareness.
6. *Training Opportunities.* Ensure development, implementation, and recognition of real-time (fast-response) metrology training.
7. *Training Assessment & Certification.* Develop and provide an infrastructure for assessment (and certification) of metrology training courses.
8. *Knowledge Management.* Ensure that critical infrastructure needs for ongoing knowledge management are in place and flexible enough to capture and widely disseminate metrology expertise.
9. *Technology Trend Analysis.* Ensure identification of potential education and training needs in support of measurements and standards needed for new technology infrastructures.
10. *Collaboration.* Ensure that the entire metrology community and stakeholders work together to gain synergy in achieving our goals.
11. *Funding.* Ensure that adequate resources are available to support metrology education and training.

Framework for Objectives:

<table>
<tr><td colspan="3">1. Metrology & Standards Outreach</td></tr>
<tr><td>Human Resources</td><td>Education</td><td>Training</td></tr>
<tr><td>2. Workplace Development
3. Professional Development</td><td>4. Formal Programs</td><td>5. Training Resources
6. Training Opportunities (Events)
7. Training Assessment</td></tr>
<tr><td rowspan="4">Infrastructure</td><td colspan="2">8. Knowledge Management</td></tr>
<tr><td colspan="2">9. Technology Trend Analysis</td></tr>
<tr><td colspan="2">10. Collaboration</td></tr>
<tr><td colspan="2">11. Funding</td></tr>
</table>

Based on the number of action items suggested at the 2005 conference, a Next Generation Outreach Outline was created. The outline was part of a status paper that was presented in 2007 at both the Measurement Science Conference and at the NCSL International Workshop and Syposium.[2] The outline has been updated and is included as Appendix A.

Liaison and Outreach Moving Forward

Education Liaison & Outreach Committee Established
An Outreach subcommittee was established in 2007 under the Education Liaison committee. The initial charter and objectives are as follows:

Initial Charter

Develop and support initiatives and programs enabling Metrology Education & Training globally.

Initial Objectives

1. Help advertise and promote Metrology Education & Training programs;
2. Support the expansion, enhancement, and development of Metrology Education & Training programs;
3. Develop a *clearinghouse* of Metrology & Education resources; and
4. Provide guidance and support for the donation of test equipment to University and College Metrology Education & Training programs.

As Phil Smith, the subcommittee chair, noted in an early status report:

> "The Metrology Education and Training Outreach sub-committee started from a conversation between three NCSLI and the American Society for Quality (ASQ), Measurement Quality Division (MQD) metrology veterans when they met during a break at a meeting in Houston, Texas during August of 2006. The group discussed that there needs to be more training information made available and that the number of people entering the metrology field are dwindling. The group agreed to meet again to discuss ideas to alleviate the situation. Additional people became involved and then one member who is the NCSLI 164 Education System Liaison Chair, Mark Lapinskes, suggested we form a subcommittee."[2]

Within one year, the committee grew to over 40 people, which may seem small, but is one of the fastest growing and largest committees within NCSLI. The committee and subcommittee were merged in 2008 as a stand-alone Education and Liaison Outreach committee.

In 2008, the NCSLI Education and Training function was changed to Learning and Development to reflect a wider scope of issues that were being addressed to meet workforce challenges. Some of the issues beyond education and training include workplace (human resources) and professional development (certification and qualification), scholarship sponsorships, and a formal Educational Development Fund for managing financial resources related to learning efforts. The Learning and Development committees were also updated: some subcommittees were added, some were renamed, and some were disbanded. The current charters for the Education Liaison and Outreach and its subcommittees are noted below.

Current Charters

164 Education Liaison and Outreach Committee Charter
Provide multiple forums for educators to interact on topics related to metrology learning and development; to encourage sharing of ideas and resources; and to help ensure that the educational needs of metrology stakeholder are met. Ensure that educators, students, related professional organizations, and the general public are aware of and recognize metrology, measurement sciences, and the needs for calibration and standards. Develop and support initiatives and programs enabling world-wide Metrology Learning & Development.

164.1 Marketing Subcommittee Charter
Work with the Learning & Development Committees and the Marketing team to promote Learning & Development products and services and to incorporate education and training, professional development, and workforce development topics into general NCSLI literature and resources whenever applicable.

164.2 Communications Subcommittee Charter
Work to increase world-wide awareness of metrology through ongoing and widespread communications efforts using multiple media. This primarily relates to metrology education and training, professional development, and workforce development topics (2008 changes were made to ensure that marketing efforts were more effective and focused than in the past).

The updated charters are all noted above, but the strategy for action has been to select each year a small number of manageable projects from the Next Generation Outreach Outline to enable work to be focused, to achieve short-term successes, and to enable maximum impact and momentum. Some longer-term projects have also been selected. The following section provides a list of projects that have been started and/or completed along with their current status.

Outreach Progress and Plans

Multimedia Outreach. One of the projects that the committee has been considering from the beginning is a DVD or other multimedia tool that can be used to reach counselors, teachers, students, and the general population regarding careers and opportunities in metrology. A fantastic video was created by Butler County Community College (BC3) that provides an overview of career opportunities in metrology and promotes the instructional program.[3] The BC3 video is tailored specifically to that school; hence it is not applicable for other schools or the measurement sciences community in general. In addition, the committee felt that teacher resources, salary data, aptitude exercises, and maybe even an Introduction to Metrology course could all be placed on the multimedia tool for widest applications.

Current Status and Insights: A detailed statement of work and request for proposals are being prepared and funding needs to be secured. While we believe this to be a worthy project, NCSLI has not determined if the BC3 video is having its intended effect for school enrollment. NCSLI has not invested in outreach projects of this magnitude in the past. Thus, adequate funds have not been allocated from the operating budget. NCSLI also doesn't have committee members with significant experience in writing funding requests and developing requests for proposals for a non-profit environment.

Outreach PowerPoint Presentation. One of the first projects that was selected by the committee was a PowerPoint file that would provide a standard "Introduction to Metrology" set of slides that could be used for outreach to teachers and students at NCSLI section meetings (located regionally around the world) or when Metrology Ambassadors go into schools or academic fairs to share information about the measurement sciences. The presentation was shared at the 2007 NCSLI Workshop and Symposium by Michelle Foncannon (who was a NIST engineering intern at the time who served on the 164.1 subcommittee). The target audience was primarily teens. Feedback on the presentation was solicited at the conference and the presentation was updated based on metrology community feedback.

Current Status and Insights: The current presentation has been shared among committee members and circulated to interested parties. It is posted on the NCSLI website for unlimited and unrestricted use and we will be able to track downloads. Requests for standard presentation materials on metrology topics and concepts were requested prior to the committee development so the committee knew that the project would be a valuable resource. A draft article for the April 2008 NCSLI Newsletter interviews several Metrology Ambassadors. One of the questions asked what kinds of resources would be useful for conducting outreach. One answer was: having standardized presentations available. Only one presentation is currently available. It is generic in nature and targets High School and freshmen level university students. Additional resources and standard presentations are needed for other audiences.

Internship Opportunities. The initial subcommittee considered how to help students get into metrology positions through internships. NCSLI already had a job posting and resume posting service. The subcommittee provided guidance and requested modifications to the website to allow posting and requests for internships (as well as jobs.) A press release was issued in February 2007 to encourage use of the new service.

Current Status and Insights: The website is being used to post internship opportunities. Putting an infrastructure in place was not a completely adequate solution. There have been requests to provide guidance on "how to" develop and implement a successful metrology internship program. The use of internships in the metrology community has not been widespread, successes and lessons learned have not been shared with others, and very few calibration organizations have considered internships as a way to identify promising employees or to introduce metrology concepts to other professions.

Outreach Ambassador Training. The subcommittee discussed the idea that many section meetings are located within driving distance of schools with metrology or engineering programs, or feeder schools for those with related programs. The committee put together some guidance on how to do outreach for a section meeting. Additionally, many members of the subcommittee are interested in visiting schools (from Elementary schools to University classrooms) or participating in events such as Career Days, Take your Kids to Work, Adventures in Science, or others, to share measurement science principles with teachers and students. Training was conducted for region and section coordinators at the 2007 NCSLI Region/Section Coordinator Training session. An article on how to be a metrology ambassador was published in the premier January 2008

issue of the Metrologist (NCSLI's updated newsletter) which provides more guidance on how to be an ambassador.[5]

Current Status and Insights: Resources such as the Introduction to Metrology presentation, posters, and handout materials are posted and more are being compiled for use by Ambassadors. Initial training and communications is generating interest and is identifying outreach that was already occurring but not centrally communicated. Ongoing training and promotion is needed for metrology Outreach Ambassadors. We still need more resources for use in conducting outreach. We need a way to measure how much outreach is being conducted. The metrology community is quite decentralized and NCSLI has not yet developed a way to track outreach that is being conducted or whether it is having an impact.

University/College Laboratories. One of the problems that schools with metrology programs have is the cost of the infrastructure required to develop and maintain an up-to-date working calibration laboratory. An idea to facilitate test equipment donations to metrology education & training programs was suggested. A concept was developed to have a website where schools could post wish lists, and companies could browse the list and determine if they could provide suitable equipment for use in a classroom/laboratory.

Current Status and Insights: Most contributions to schools are occurring through one-on-one interactions and networking that takes place at the section meetings. For example, at one section meeting in Puerto Rico in January 2008, university representatives mentioned an equipment need. A representative of the committee introduced him to an industry representative who was also at the meeting. It was later reported that the company would visit the university laboratory and provide equipment. Success! The committee hoped that a website interface where colleges could post "equipment needed" and standards and instrument manufacturers could review to consider where they would like to make donations would be helpful. The committee also considered that sample paperwork on how to make tax-deductible donations would be useful. However, what we have found is that making the connections between the school and potential donors is often the key challenge. Finding the best ways to facilitate the right connections is still before the committee.

Metrology Graduate Outreach. A proposal was made to provide free one-year memberships and gift packages to new metrology graduates. In addition, it was suggested that free or reduced rate conference registration would draw student attendance at the annual NCSLI conferences. In 2007 the NCSLI Board approved the membership and conference gifts. To implement this program, congratulatory letters and membership applications were sent to schools with metrology programs for distribution to graduating students. In the first year, no one accepted the offer. The committee got mixed feedback as to why there was no response. With all of the privacy limitations of personally identifying information (PII), it was found that schools are unwilling to provide names and contact information of graduating students. The committee suspects that some schools did not pass along the information. Feedback was also provided that once students graduate, if they are employed in the field, their employing organizations are likely already NCSLI members. NCSLI also provided free registration for up to three students (whom we support with scholarships) from each school with a metrology program. In addition, discounted registrations were provided to as many as 20 part-time students in the same school

programs, if they were sponsored by calibration laboratories. Four students attended the annual conference in 2007.

Current Status and Insights: the programs were again approved for 2008; we will determine whether to continue the program based on feedback we receive this year.
We have received feedback from schools that we need to target current students, not graduates. As they have noted, graduating students will likely be hired by organizations that already have NCSLI memberships and resources. We also got feedback from students employed by one of NCSLI's member companies that our literature is not as attractive as is needed for next generation students. The students felt it was "too professional" and not colorful or engaging enough. Our marketing team is considering ways to capture demographic feedback at our upcoming conference to help guide our efforts.

Strategic Liaisons. As a part of the NCSLI strategic roadmap process, partnerships were developed to support the education and training framework with the American Society of Quality, Measurement Quality Division (ASQ-MQD) and the Measurement Science Conference (MSC). Both of these organizations were already active in the metrology community and the strategic road mapping effort. Many members of one organization are likely to be involved in the other. Each group has unique objectives with respect to the roadmap, and more specifically regarding outreach efforts. MSC has been active for many years with outreach to schools, though primarily in southern California. MSC has also administered scholarship programs and created a new youth achievement award in 2007. ASQ-MQD has been involved with developing a certified calibration technician (CCT) program which helps meet career and workplace objectives once someone selects a career in metrology. Relationships with ASQ-MQD and MSC formed the foundation of NCSLI liaisons in outreach efforts. NCSLI began pursuing the idea of other strategic liaisons after noting education outreach efforts by standards organizations, such as the American Society of Testing and Materials (ASTM), and by the American National Standards Institute (ANSI). NCSLI already has numerous passive liaisons with specific committees of professional organizations (for example, ASTM), and with the Instrument Society of America and the Institute of Electrical and Electronic Engineering (IEEE), all of whom are already active in education and training and outreach. The committee thought, "Why reinvent the wheel?" The members began making initial contacts and are looking to pursue active liaisons with organizations that already have effective and/or growing outreach programs to learn what they are doing, gain synergy, share ideas, and become more effective. An article published in the premiere issue of our updated newsletter, the Metrologist[5] in January 2008 references a number of our proposed liaisons and champions, including the American Society for Engineering Education (ASEE). The NCSLI VP of Learning and Development attended the 2007 ASEE conference and began investigating opportunities to link metrology to the engineering outreach efforts.

Current Status and Insights: The metrology session at the 2008 ASEE conference is the result of our efforts to pursue active liaisons with other professional organizations that are pursuing outreach in the science, technology, engineering, and mathematics (STEM) fields. The third annual International Committee for Education on Standardization (ICES) conference was held in February 2008. Members of the NCSLI committee prepared outreach resources for use in the Poster Session and made contacts with universities and organizations coordinating outreach to

many of the same audiences. A number of ideas for improving NCSLI efforts were identified. Yet, ICES is struggling with many of the same issues as NCSLI. For example, how we get the academic community to the table and how we get adequate funding for the efforts we want to pursue are issues not unique to NCSLI. Another common issue is how we get content and courses integrated into curricula that are already full. Attendance at the ICES conference reinforced the need for us to work with other organizations to gain synergy of our efforts.

Educational Measurement Kits. Hands-on experiments are a key activity that can be used in the classroom to generate interest among students about measurements (and other STEM topics). The Outreach committee has been researching and reviewing possible measurement kits for NCSLI to purchase and share on a regional basis with our Outreach Ambassadors. An effective program of providing measurement-related activities and kits is already in place in the United Kingdom, sponsored by the National Physical Laboratory.

Current Status and Insights: A review of possible kits is expected in an upcoming issue of the Metrologist. Metrology Ambassadors have identified resources that would be useful in classrooms. At this time, they are sharing ideas and taking equipment that they each think will be interesting to students. Experience in the United Kingdom has been successful. However, NCSLI has not had enough experience with providing resources to know what measuring standards and instruments would be best to include in kits.

Virtual Physical Laboratory. In the absence of a laboratory or hands-on kits and resources, teachers are at a disadvantage in teaching such subjects as physics, engineering, and other measurement-related disciplines. One of our colleagues in the United Kingdom spent time teaching Physics in India and developing computer tools using National Instruments LabView™ (no endorsement is implied: the product could be developed using other software tools). The resulting software package is called the Virtual Physical Laboratory (VPL).

Current Status and Insights: NCSLI is pursuing funding to license and distribute this software throughout the United States, free to teachers once they attend a short training session on how to integrate the VPL in the classroom. Again, the United Kingdom has distributed thousands of copies of this software to teachers and students. Yet, having not implemented this idea, NCSLI has no idea of its potential effectiveness in communicating metrology concepts.

Communications and Marketing are two subcommittees of the Education and Liaison Outreach committee. Their work often overlaps, with Marketing and Communications working on the same materials. For organizational purposes, the marketing function is to provide a liaison to the NCSLI Marketing committee to present an Educational face to ideas about Marketing for NCSLI as a whole (marketing has historically focused on memberships and membership related products and services).

Communications. NCSLI began publicizing its Outreach efforts through conference presentations, conference attendance, publications in media that reach the metrology community, press releases, and a blog site (see http://www.metrologytraining.org). Articles have been published in: ASQ's Quality Press, ASQ MQD's The Standard, NCSLI's Metrologist, and Cal Lab International Journal of Metrology. *Current status:* Numerous articles and a few press

releases have been developed and are in process. Our goal is to gradually move the communications outside the metrology community to reach a wider audience.

Careers in Metrology. One of the products NCSLI has created is a communications resource and hand-out for Metrology Ambassadors. It was created within the Communications subcommittee and branded for NCSLI use by the Marketing team. It is a one-page summary of careers in metrology. It was originally suggested as a resource to fill a gap on career information websites. However, it has now been published in the Metrologist and will also be used as a poster/flyer with metrology scholarship information.

Current Status and Insights: See Appendix C for text which may be used, with acknowledgment to NCSLI, to promote careers in the measurement sciences. NCSLI has just begun providing this resource in outreach efforts and has received limited feedback to measure whether it is an effective resource.

Marketing. The Education Liaison and Outreach committee has a liaison with the NCSLI Marketing committee to ensure that products and services that are developed include education and training outreach materials and concepts whenever possible. The Marketing team promotes Outreach activities and products that are developed (in addition to all of the Learning and Development resources). Some examples are: 1. Measurement posters and calendars developed by the Marketing team for NCSLI members are also useful as Metrology Ambassador handouts. The Marketing team also reviewed the Careers in Metrology flyer and is working to convert it to a two-sided poster, with career information on one side and the Joe D. Simmons Memorial Scholarship poster on the other side (also developed by the committee). These items are useful as handouts for Metrology Ambassadors and also as bag stuffers at conferences. 2. The Introduction to Metrology presentation was reviewed and formatted to fit the NCSLI branding theme. 3. The Marketing team developed colorful 3D rulers for use as outreach handouts.

Current Status and Insights: The Marketing team has a liaison member from the Outreach committee and is pursuing sponsorship of copies of American Society of Engineering Education's (ASEE) "Engineering – Go for It" to distribute as another outreach resource. The liaison between NCSLI Learning and Development and Marketing is still new. Current volunteers are in agreement about the need to have a common plan and to work together. But, we have limited insight on whether the marketing tools and resources are helping to attract new students to careers in metrology or to NCSLI as a professional organization based on these preliminary efforts.

Summary and Conclusions

NCSLI has made progress in the past three-and-a-half years on its mission to alleviate the gaps in the metrology workforce, education, training, and professional and workforce development through developing a strategic framework, identifying objectives, and selecting specific outreach activities. The current outreach projects, status, and insights were presented in this paper. A critical component in NCSLI's progress was the 2007 addition of the Outreach subcommittee/committee. Whether or not NCSLI formative efforts are producing measurable

results – as demonstrated by an influx of new students into metrology careers – remains to be determined in the coming years.

Much work remains to be done in our organization's outreach efforts and the support and volunteer staffing infrastructure needs to be embedded in the organization so that success will be reaped in the long-term independent of the individuals making the changes. We still need to develop intermediate and long-term measures to determine if our efforts are moving us in the right direction. Having effective measures will also provide us a way to determine if/when we need to modify our approaches. We also need to keep in mind that conducting outreach to teachers and students does not pay off overnight. Long-term success in our education liaison and outreach efforts requires that we have adequate numbers of well-educated and well-trained staff in the measurement sciences in our calibration and testing laboratories, and that we have engineers and scientists with a solid foundation in and understanding of the measurement sciences.

Bibliography

1. NCSLI Strategic Roadmap for Metrology Education and Training, "Serving the World of Measurement: Meeting Education and Training Needs of the Future", 2005 Workshop and Symposium, G. Harris, http://www.ncsli.org/current_events/ncsli-strategic-roadmap-metrology-training-education.pdf
2. NCSLI Education Liaison Outreach, 2007 Measurement Science Conference, 2007 NCSLI Workshop and Symposium, P. Smith, See excerpt: Next Generation Outreach Outline, Appendix A
3. Metrology: The Science of Weights and Measures, 2005. Butler County Community College, P.O. Box 1203 • Butler, PA, 16003-1203.
4. Metrology Education and Training – NCSLI Taking the Initiative, *Cal Lab*, The International Journal of Metrology, Oct-Nov-Dec 2007, C. Grachanen pp. 31-33. Article also included in *The Standard*, Vol. 21, No. 4, The Newsletter of the Measurement Quality Division, American Society for Quality, December 2007, C. Grachanen pp. 9-10.
5. You Can Be a Metrology Ambassador! *Metrologist*, January 2008, C. Grachanen, pp. 22-24. Appendix B.

Appendix A: Next Generation Education Outreach
Measurements, Metric, Standards, and Quality (updated 2008)

A. Outreach to Career Counselors
    a. Career Awareness Campaign- career vignettes, aptitude and interest survey for students (Would I Like Metrology?), student profiles (college age), expert profiles, job profiles, links to schools with metrology programs, web forums and chats with selected experts; distributed printed media to schools, libraries, counselors
    b. Define/Describe Career Paths (build on SOC/OOH); add career profile into career publications and journals (e.g., NSTA "All in a Days Work")
    c. Create career fair resources and other multimedia tools to encourage study in these areas: posters, interactive CDs (video game element), video updates (work with Marketing team)
    d. Dovetail with other career pathway outreach efforts where there is overlap with measurement science (e.g., medical, nursing, pharmaceutical)
B. Outreach to Elementary, Middle, and High School Students (different materials for each level)
    a. In areas of math/science
    b. Provide "teacher tools"; focus on real world applications
    c. Talk to schools – have sample lesson plans for modules, presentations, hands-on experiments, props, and stories to share; create an on-line pool of presentations that measurement people can share with each other and use; have a speaker's bureau of willing metrology professionals that can be contacted; Measurement theme kits that can be donated to schools libraries or science/math departments that contain all supplies and lesson plans needed for "hands-on" classroom activity [could also be for individual study]
    d. Help with science fairs – mentor students interested in measurements; create examples and models and topic lists
    e. Offer open houses and tours in laboratories
    f. Provide instructional opportunities and industry/government internships for teachers
    g. Create table-top displays that can be used for career days
    h. Have school partnership programs (adopt a school); after school science projects and family science nights
    i. Develop a NCSLI National Science Fair "Best Measurement" Award
    j. Outreach to alternative education venues frequented by target groups such as regional science centers, libraries, and museums
    k. Target science and math magnet schools or other career academy programs
    l. Measurement Bus- traveling interactive laboratory; learn by doing
    m. Focus efforts by region; follow cohort of students through consecutive school years to reinforce exposure
C. Outreach to Vo-tech, Community Colleges & Universities
    a. Promotion of metrology programs
    b. Sharing of curriculum content, texts, and resources among metrology programs; identify best practices and text books; benchmark program content (assessment and feedback); create a list-server for dialog among schools, scholarship providers, industry liaisons

c. Embed metrology concepts into Engineering, Physics, and Technical Management courses and programs; assess gaps; (look to Mexico's Centro Nationale de Metrologia (CENAM) for a model); link with other organizations such as "teachengineering.org"
d. Provide talks to engineering students about measurements and standards
e. Offer internship programs; create a model internal mentoring program that corporations and government can adopt; internship projects should feed into NCSLI annual conference (e.g., poster session)
f. Create "Professional Development" opportunities for teachers; Two components: Year round enrichment and summer residential/externship (secondment)
g. Outreach to Institutions with Teacher Education Programs (easier to integrate new curriculum material to novice teachers)

D. Liaison Program.
   a. Link with standards organizations (e.g., ANSI, ASTM, ICES) to provide free standards to students and schools; include link on websites; StandardsLearn.org (free, interactive, on-line training about standards); Indicate to ANSI the areas of expertise where we would be willing to serve as a metrology "standards" resource to university programs
   b. Link with Federal agencies that have education outreach programs to focus on our needs and collaborate on efforts (e.g., NASA, NOAA, NSA, EPA, USDA, NSF)
   c. Link with teacher and educational associations to focus needs and collaborate on outreach efforts (NSTA, PLTW, SACNAS, ASEE, AAPT, IEEE, ISA, STEP, ASME, U.S. Science Olympiad)

E. Scholarships
   a. Jointly promote scholarship availability
   b. Provide scholarship resources to schools
   c. Link with MSC and ASQ/MQD to sponsor the Simmons Scholarship
   d. Provide scholarships for donated funds; use those we have already
   e. Promote scholarship winners widely

F. Conferences
   a. Offer student paper sessions with sponsored registration; provide an opportunity to publish
   b. Offer poster sessions
   c. Offer a discounted or free attendance for students
   d. Have a mentoring program for student attendees
   e. Offer exhibit space to highlight programs

G. Section Meetings
   a. Identify instructors/professors of courses/programs and invite them and their students to region/section meetings; sponsor registration if there are fees
   b. Invite students to talk at local meetings

H. Memberships
   a. Offer a "free" individual membership to students graduating from a supported program (graduation gifts/packages)
   b. Promote the student memberships through marketing – encourage posting of resumes from graduates

I. Grants

a. Create models of partnership for developing courses/coursework or doing collaborative research studies and obtaining funding
b. Get Federal support for outreach efforts in math/science/engineering that can be directed to measurements
c. Find ways to contribute equipment to schools (shipping costs are issues)

J. E-Learning Opportunities
a. Develop basic age-appropriate materials in metrology that can be accessed on line for students and for instructors; link to other teacher-tool portals
b. Web forums and chats with selected experts

K. Corporate Sponsorship Activities
a. Internships
b. Teacher Sabbaticals (summer development opportunities)
c. Research Opportunities for students

You Can Be a Metrology Ambassador!

by Christopher L. Grachanen

A question often posed in Metrology circles concerning the dwindling number of young adults entering engineering / science disciplines is 'What can you do to help reverse this trend'? The answer is typically along the lines of 'get involved', but how does one do that? We, as Metrology practitioners, have a responsibility to help advance the Metrology profession as well as promote the profession to those not familiar with what we do. Congruent with promoting the profession is encouraging prospective candidates to consider Metrology as an occupation. Some of the avenues that can play an important role in becoming a good Metrology ambassador are described here.

When we speak of encounters we are talking about chance as well as planned opportunities to talk with individuals and groups about the Metrology profession. I am reminded of a business exercise often referred to as the 'elevator speech' where given the chance encounter of riding an elevator with an executive from your company you have all of 20 to 30 seconds to give a brief synopsis of your department and how your department's contributions enable your company to reach its goals and objectives. Not the easiest of tasks given the time restraint but one can easily see the value of promoting one's department to upper management at a moments notice. Chance encounters with individuals and groups allows one to plant 'gold nuggets' even if only to enlighten folks that Metrology practitioners do not predict the weather (name recognition is an important first step in helping folks become better aware of the profession). A planned encounter on the other hand allows one to prepare for their intended audience. An example of this would be career day at a local school where you may be speaking to 4th graders on up to seniors. On a planned encounter you have prior knowledge of the intended audience so you can tailor your presentation to coincide with the audience's interests, education level, etc. The NCSLI Outreach committee has developed a template PowerPoint presentation that you can download and use (or modify as needed for the audience). See: www.ncsli.org/training/index.cfm

Mentoring

All calibration practitioners have an implicit obligation to pass on knowledge and skills to other practitioners. This is especially true for those more senior in the Metrology profession. Mentoring helps reinforce ones own knowledge and skills and encourages others to also pass on their knowledge and experience. Mentoring involves not only those already in the Metrology profession but also prospective candidates contemplating entry into the profession. Individuals that show an interest and an aptitude should be encouraged and provided guidance / direction on becoming a calibration practitioner. Supervisors and managers ought to consider creating internship positions so that perspective candidates can gain experience and insight as to the real workings of a Metrology laboratory. Internships, while helping reduce a laboratory's workload, allows employers to directly evaluate a candidate for possible permanent hire. Note: The NCSLI Job board website provides the means to post internship opportunities.

Participating

One of the most potent ways of promoting the Metrology profession is by getting involved on a committee and/or working group. For those with an interest in Metrology education and training, the first step in getting involved is as simple as sending an e-mail to one of the following committee chairs requesting to be put on their emailing list:

Training Resources (161)
Chair: Helga Alexander
halexander@keithley.com

Education and Training Financial Resources (162)
Chair: Mark Lapinskes
mark.lap**inskes@sypris.com**

Personnel Training and Qualifications (163)
Chair: Gloria Neely
gloria.neely@navy.mil

Education System Liaison and Outreach (164)
Chair: Philip Smith
psmith@a2la.org
Co-Chair: Chris Grachanen
chris.grachanen@hp.com

Marketing (164.1)
Chair: Dilip Shah
Emc3solu@aol.com

Communications (164.2)
Chair: Chris Grachanen
chris.grachanen@hp.com

The NCSLI website has a wealth of information on education and training as well as information about other Metrology committees. In addition, items from the NCSLI business office can be used / distributed to increase Metrology awareness: Metrology posters, calendars, Joe Simmons Scholarship posters….

Ways you can be a Metrology Ambassador:

Inviting science teachers and students in Metrology curriculums to attend NCSLI region and section meetings (with sponsored attendance when registration fees are charged)

Disseminating NCSLI's 'Careers in Metrology' flyer (see flyer in this publication) to educators, councilors and applicable student groups

Volunteering to present at 'Career Days' at a local school. The Metrology Education and Training Outreach committee is in the process of evaluating education kits[1] which can be checked out from NCSLI headquarters and used in classrooms to demonstrate measurements / Metrology principles (look for a review of the kits in the next Metrologist.)

Coordinating student tours of your laboratory (schedule around special events like World Metrology Day, new or updated services on display with a subsequent press release highlighting the new service and the participation of teachers and students)

Hosting a laboratory 'open house' for other groups in your company / organization

Identifying idle test equipment in your laboratory which can be donated to colleges and universities with Metrology curriculums; establish an ongoing relationship with the colleges and universities by providing speakers, tours, internships

Increasing Metrology awareness by writing articles for trade journals and other applicable publications

Passing on information about professional organizations education and training outreach activities to one of the aforementioned committee chairs so that 'best in practice' initiatives may be identified and adapted as makes sense

Taking advantage of 'liaison' opportunities for disseminating information about Metrology and Metrology careers at professional organization conferences and meetings[2]

Contacting educators to learn about opportunities for promoting and enhancing their Metrology programs; expand on partnership opportunities

Selectively attending meetings and assisting with quality audits to help facilitate a better understanding and appreciation for Metrology throughout your company/organization

Organizing something special on May 20th for World Metrology Day such as open houses, region/section meetings, press releases

Opportunities abound for Metrology Ambassadors to really make a difference. Please consider how you can help promote the Metrology field and encourage prospective candidates in becoming calibration practitioners.

American Society for Engineering Education (ASEE)
Champions: Christopher Grachanen, Georgia Harris, Herb O'Neil
Founded in 1893, the American Society for Engineering Education is a nonprofit organization of individuals and institutions committed to furthering education in engineering and engineering technology. We have submitted abstracts to present a metrology session at the 2008 conference in Pittsburgh, June 22 to 25. www.asee.org/conferences/annual/2008/index.cfm

Project Lead the Way (PLTW)
Champions: Christopher Grachanen, Georgia Harris, Herb O'Neil
PLTS is about building strategic partnerships among middle schools, high schools, colleges and universities, and business and industry to provide students with the rigorous, relevant, reality – based knowledge necessary to pursue engineering or engineering technology programs in college. www.pltw.org/index.cfm

National Science Foundation (NSF)
Champions: Christopher Grachanen, Georgia Harris, Herb O'Neil
The National Science Foundation (NSF) is an independent federal agency created by Congress in 1950 "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense. www.nsf.gov

American Association of Physics Teachers (AAPT)
Champion: Ed Morse
AAPT was established in 1930 with the fundamental goal of ensuring the "dissemination of knowledge of physics, particularly by way of teaching." www.aapt.org

National Science Teachers Association (NSTA)
Champion: Tom Weidmyer
The National Science Teachers Association (NSTA), founded in 1944 and headquartered in Arlington, Virginia, is the largest organization in the world committed to promoting excellence and innovation in science teaching and learning for all. www.nsta.org

American Society for Testing and Materials (ASTM)
Champion: TBD
ASTM International is one of the largest voluntary standards development organizations in the world-a trusted source for technical standards for materials, products, systems, and services. www.astm.org

American National Standards Institute (ANSI)
Champion: TBD
As the voice of the U.S. standards and conformity assessment system, the American National Standards Institute (ANSI) empowers its members and constituents to strengthen the U.S. marketplace position in the global economy while helping to assure the safety and health of consumers and the protection of the environment. www.ansi.org

Continued on page 24

[1] Dilip Shah will be evaluating a middle school science kit that uses a Texas Instrument (TI) calculator as the controller / data acquisition unit for various measurement transducers such as motion detectors, temperature probes, gas pressure sensors, magnetic field sensors, etc. A lab book provides for 'Complete student experiments with materials list, step-by-step instructions, data tables, and questions … specifically for students in grades 6-8. It contains 37 experiments in earth science, life science, and physical science, making use of the middle school sensors.' Dilip will be reporting his evaluation results in a future issue of The Metrologist.

[2] NCSLI's Metrology Education and Training Outreach committee has identified the following professional organizations for establishing liaison contacts (the list included champions who have volunteered to act as liaisons on behalf of the committee). If you are interest in becoming a liaison or working with the liaisons please contact Phil Smith at psmith@a2la.org or Christopher Grachanen at chris.grachanen@hp.com

Institute of Electrical and Electronics Engineers (IEEE)
Champions: Ed Morse, David Braudaway
A non-profit organization, IEEE is the world's leading professional association for the advancement of technology. Through its global membership, IEEE is a leading authority on areas ranging from aerospace systems, computers and telecommunications to biomedical engineering, electric power and consumer electronics among others. www.ieee.org

Instrumentation Society of America (ISA)
Champions: Herb O'Neil, Mike Suraci
Founded in 1945, ISA is a leading, global, nonprofit organization that is setting the standard for automation by helping over 30,000 worldwide members and other professionals solve difficult technical problems, while enhancing their leadership and personal career capabilities. www.isa.org/

Science and Technology Education Partnership (STEP)
Champion: Doug Sugg
The Science and Technology Education Partnership (STEP) helps students, teachers, and professional scientists work together to make science and math fun and exciting. www.mysciencеeducation.com

American Society of Mechanical Engineers (ASME)
Champion: Michelle Foncannon
Founded in 1880 as the American Society of Mechanical Engineers, today's ASME promotes the art, science and practice of mechanical and multidisciplinary engineering and allied sciences around the globe. www.asme.org

Society of Women Engineers (SWE)
Champion: Michelle Foncannon
The Society of Women Engineers (SWE), founded in 1950, is a not-for-profit educational and service organization. SWE is the driving force that establishes engineering as a highly desirable career aspiration for women. Empowers women to succeed and advance in those aspirations and be recognized for their life-changing contributions and achievements as engineers and leaders. www.swe.org

Society for Advancement of Chicanos and Native Americans in Science (SACNAS)
Champion: TBD
The mission of SACNAS is to encourage Chicano/Latino and Native American students to pursue graduate education and obtain the advanced degrees necessary for science research, leadership, and teaching careers at all levels. www.sacnas.org

U.S. Science Olympiad Champion: TBD
Science Olympiad is a primarily American elementary, middle school, or high school team competition that requires knowledge of various science topics and engineering ability. Over 14,000 teams from 45 U.S. states and Canada compete each year. www.soinc.org n

Careers in Metrology

The field of metrology, the science of measurement, offers many rewarding career opportunities for those with an interest in science and technology. Cutting edge, state of the art, technologies used in engineering, applied research, material analysis, telecommunications, avionics, biomedical, etc., have their foundations built upon metrological principles and practices. These technologies depend on the work of professional metrology practitioners to ensure accuracy of measurements. Persons working in the field of metrology field support functions such as manufacturing and new product development, the mission of governmental agencies (U.S. Armed Services, NASA, U.S. Dept. of Energy, U.S. Dept. of Commerce, FCC etc.) as well as the service sector such as health care. If something can be measured, it's a good bet that metrology practitioners are measuring it right now, or they are creating the technology to measure it in the future.

Metrology practitioners routinely use mathematics, physics, science principles and engineering techniques in performing their jobs. Depending on personal interests and work requirements, metrology practitioners have taken courses in engineering, computer science, biology, chemistry, physics and mathematics. Topics of study may include sound, light and lasers, temperature, vibration, mass and force, acceleration and electronics, just to name a few. Education credentials for metrology positions range from technical trade and military school certificates to associates through doctoral degrees. Some common metrology job titles are: calibration technician, instrumentation specialist, measurement technologist, calibration engineer, metrology engineer and metrologist. Metrology practitioners obtain their skill sets by performing physical measurements as part of a technical curriculum, participating in hands-on instructional courses, and via on the job training sessions.

What kind of tasks do metrology practitioners perform? Many are involved in calibrating and maintaining inspection, measurement and test equipment (IM&TE) in calibration laboratories and at customer locations. Troubleshooting, repairing and inspection may also be part of their duties. Whether it is a device for measuring infrared radiation, sound pressure, relative humidity, or a thousandth of a millimeter, metrology practitioners use sophisticated calibration standards and diagnostic tools to ensure IM&TE is operating correctly. Other tasks for metrology practitioners may include software programming, technical writing, analyzing measurement data, developing measurement systems and calibration procedures, designing test fixtures and new instrumentation, measurement consulting and training, quality administration, process evaluations and maintaining calibration standards, just to name a few.

Metrology practitioners may choose to specialize in one particular support area such as environmental parameters or precision electrical, or they may want to become versed in multiple areas. The opportunity to learn new technologies and master new skill sets is always present for those working in the metrology field.

Job openings for qualified metrology practitioners can be found all over the world. Chances are good that there are employment opportunities in a location near you, or a place where you would like to move to. Wages for metrology practitioners are very competitive when compared with technical positions for other vocations having similar job responsibilities. The metrology field offers individuals challenging career opportunities that are in demand by industry and government agencies. **If you like science and have a knack for technology, metrology may be just the vocation for you.**