

What the U.S. Needs in Metrology Education and The Role NCSL International Can Play

Speaker

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Abstract

How can anyone do a job well in our modern society without education and training?

Effective metrology education and training will provide a source of knowledgeable metrologists who can add value to the organization and to its products and services.

The Pi Group, Inc. (Pi Group) was given the opportunity by the NCSL International (NCSLI) Vice President for Education and Training, Georgia Harris, to develop a business plan for NCSLI short courses in:

- Management of a Technical Laboratory, and a
- Survey of Physical Measurement Parameters.

In researching and compiling information necessary to develop and perhaps implement these courses, the Pi Group sees a critical need to explore options for a comprehensive vision in metrology education on a U.S. National scale.

This presentation proposes a series of vital questions and provides the Pi Group's views on these questions. Major points of interest are:

- A national focal point for metrology education;
- A process or system to identify needs for metrology education on a timely and continuing basis;
- A more effective infrastructure to support, promote and enhance metrology education on a national scale; and
- Resources available, as well as needed, to get the job done.

Those attending the presentation are encouraged to respond to the views expressed and to engage in an interactive dialogue.

1. Background

One continuing, over-riding passion of the principals of the Pi Group is education and training. This includes training in leadership skills and communication for technical professionals, not just scientific and technical subjects. One area in which our interests are particularly keen is the facilitation of organizations' adoption of quality standards and processes through training those who are charged with the operation and maintenance of these processes. A principle method of our training has been hands-on learning by doing.

In 2005 the NCSL International developed a "Strategic Roadmap for Metrology Education and Training"¹ for the purposes of planning, organizing, and developing resources and activities in the U.S. Later that year, the Pi Group was asked by the NCSLI Vice President for Education and Training to develop a business plan for delivering some short courses under sponsorship by NCSLI at the Boulder Training Center.

As we began to prepare a business plan, our passions led us to go well beyond the request and to conceptualize beyond providing the short courses and consider how to meet other pressing metrology education and training needs.

This paper presents some of the issues that the Pi Group thinks challenges the future of metrology, and suggests some of the opportunities to address them in a coordinated effective manner. We are especially impressed by the efforts and actions taken by the NCSL International on behalf of metrology training and education. This organization is poised to capitalize on its unique vision, mission, and members' dedication to plan and implement elements of what are described in this paper as one approach to meeting the U.S. national needs in metrology education and training.

2. A Common Vocabulary

There are three terms that are defined below within the context of this paper – "metrology," "education," and "training."

"Metrology" – the science of measurement – encompasses the processes from characterization of a measurement unit, to calibration, to testing and comparisons, to "shop floor" measurements, to a layman's estimating the length of a ladder needed to clean out the gutters. It encompasses measurements that are physical, chemical, and biological in nature. Indeed, everyone makes measurements, so many people think of measurement as "routine" and "common place;" perhaps even "mundane."

Yes, metrology is as pervasive as computers in our lives. The Pi Group believes that, just as everyone should be minimally adept at computing, everyone also should be minimally adept at measurement. How do we accomplish this? -- Through **"education,"** and **"training!"**

Although there is a distinction between education and training, we often will use the terms interchangeably. **"Education"** is the gradual process of acquiring knowledge by imparting concepts and perspectives that will provide the student a facility for further learning, preparing

him/her for acquiring skills. Education is generally available from traditional “brick and mortar” universities and colleges, and the customer generally is the student (he/she usually pays for tuition). “**Training**” is imparting a skill, generally vocational and practical in nature, more specific and directly useful than education. Training is more task-oriented and can often be delivered in short bursts. The customer of training is generally the employer because the employer either provides in-house training or pays for cost of training. Obviously, employers favor training provided just prior to the time of use (called “just in time”). There is a relationship between the two:

- Good education has a training component.
- Good training provides some amount of education.

In the opinion of the Pi Group, metrology education and training should be lifelong pursuits, because they are required for understanding the high technology society in which we live, successfully interacting with coworkers at all levels, and providing value-added products and services in our measurement-intensive businesses. Ultimately, everyone who makes measurements should have some type of metrology education and training.

3. Vital Questions in Metrology Education and Training

A. What Are the Metrology Education and Training Needs?

From a National perspective, the Pi Group sees the most pressing needs as the following:

- Developing and delivering appropriate metrology education and training for this generation and beyond,
- Developing a process to identify needs for metrology education and training on a timely and continuing basis,
- Establishing a national focal point for metrology education and training,
- Establishing and maintaining a more effective infrastructure for metrology education and training, and
- Acquiring the necessary resources to get the job done.

B. What Are the Drivers for These Needs?

Driver for developing and delivering appropriate education and training for this generation and beyond: Retirements from all types of businesses, including laboratories, have been reducing the experienced work force at an increasing rate as the baby boomers age and leave their jobs. In NCSL International meetings, informal conversations, and web surveys, members report that hiring knowledgeable and skilled metrologists and metrology laboratory managers has become more difficult, and that finding appropriate metrology training for new hires both in metrology and laboratory management is harder than ever before.

Compounding this problem is the fact that business employers are reluctant to fund long-term degree programs for their employees. The type of training employers are willing to pay for must be “*just in time*” for its application, and *of short duration* (1 week or less). Ideally, employers say that on-line and web-based courses would be highly desirable to

avoid travel costs and travel time. We stress that these types of on-line courses are “ideal” because they seem to be suitable only for those students who can work independently and are self-starters, and because they take considerably longer to develop and deliver, at much higher costs than in-person short courses. In actuality, short-term just-in-time courses are not sufficient to provide the foundation for metrologists generally knowledgeable in measurement science. There is no 4-year degree in metrology available in the U.S. today and only a few scattered 2-year associates’ degree programs available.

Driver for developing a process to identify needs for metrology education and training on a timely and continuing basis: No one actually knows the full extent of the gaps in metrology education and training that exist. If we know of some gaps, we do not know the priority to give them. Even though the National Institute of Standards and Technology (NIST) has conducted a study on the U.S. Measurement System and its needs for the future, these needs do not include the education and training needs for the future metrologist.

The NCSLI Strategic Education Plan recommends that a “formal training ‘needs assessment’ should be conducted and results published.” NCSLI has not conducted a formal needs assessment, although an informal one is in process to gather input on training needs from the U.S. laboratory accreditation bodies. In addition, the Plan recommends that potential education and training needs be identified in support of measurement and standards needed for new technologies.

Driver for establishing a national focal point for metrology education and training: NCSLI members report that the Precision Metrology Equipment Laboratory (PMEL) training for the military (from 8 to 10 months long) provided large numbers of measurement specialists for hire after their military duty during the 1960’s, 70’s, and 80’s.² This was the national focal point for metrology education in those decades. With that resource nearly gone today, there are fewer knowledgeable ready workforce hires available coming from military service to civilian positions as there had been. New hires are often unfamiliar with measurement and statistics, and may not have much science or technology educational background.

Driver for establishing and maintaining a more effective infrastructure for metrology education and training: Whenever there are fewer qualified new hires than the number needed in the economy, the Pi Group would argue that, adequate pay schedules aside, the educational infrastructure (defined as the spectrum of educational and training sources from universities, government, private sources) for developing qualified candidates is ineffective.

Driver for acquiring the necessary resources to get the job done: The Pi Group suggests that metrology education and training needs are much larger than can be met by the current resources of metrology organizations and institutions. Lack of resources is no reason to live with the significant short-comings in metrology education and training in the U.S. today.

C. What Are the Envisioned Outcomes If These Needs Are Met?

- The pervasiveness of measurement will be recognized by the general public, and by implication, the importance of metrology education.
- The metrology laboratory will be perceived as a Value, not as a Cost in any organization.
- Metrology will be offered as a curriculum and major leading to a degree in the university setting.
- Students will clamor to enter the metrology profession.

D. Is the Pi Group Vision Aligned with NCSLI's?

The Pi Group vision for universal metrology education and training is consistent with NCSLI's vision and the first "key challenge" enumerated in "Serving the World of Measurement: Meeting Education and Training Needs of the Future" (Georgia Harris, NCSLI 2005)

NCSLI's Vision: Promote competitiveness and success of NCSLI members by improving quality of products and services through excellence in calibration, testing, and metrology education and training.³

NCSLI Key Challenge Number 1: *Metrology & Standards Outreach:* Ensure awareness of metrology, measurement sciences, and needs for calibration and standards in such a way that they are readily recognized by organizational managers and the general public.⁴

E. Should Metrology Training and Education Needs Assessment Be One-Time-Only or a Continuing Process?

The Pi Group suggests that a continuing process for training needs assessment, rather than a one-time-only effort, be developed and implemented. Just as NCSLI provides the national measurement institutes with a listing of its members' highest priority needs for research and development, so too is NCSLI in a unique position to define the highest priority metrology education and training needs. This assessment process (and its marketing) could be incorporated into both national and regional meetings, through survey instrument collection methods as varied as person-to-person, hard-copy, telephone, and Internet.

Whatever the means for collection, the assessment process should be planned and implemented so that

- Needs can be prioritized;
- The nature of the need identified (is the course just not available, or is it too infrequently given, not at the right level, or requiring too much travel and per diem expenses?);
- The potential employer identified (industry segment, technological specialty, type of test or measurement); and,

- The potential student identified (hard-core metrologists, laboratory management, laymen).

In addition, NCSLI must determine how it will manage the data and mine it for knowledge.

4. The Vital Question of Finding Sufficient Resources

- How can we develop and deliver the metrology courses that are identified as needed?
- How can we prepare for future courses that will be needed?
- How can we educate the layman?
- How can we entice other stakeholders to collaborate?
- How can we integrate various stakeholders to maximize metrology education and training efforts?

In short, how can we identify and produce useful metrology education and training products or services requiring investments in time and money greater than what collaborators and partners presently give?

It is the opinion of The Pi Group, Inc. that resources for metrology education and training needed to achieve success are much larger than NCSLI or any other current metrology organization possess. We recommend that NCSLI establish a Metrology Education and Training Advisory Group composed of stakeholder representatives to flesh out the NCSLI, MSC, and ASQ Metrology Education and Training Strategic Plan. The Advisory Group would be charged with generating ideas for funding ongoing training development and needs assessment. This Group should include:

- A champion from the NCSLI Board of Directors,
- Metrology education and training experts,
- Training providers,
- Customer organizations and potential trainees, and
- Other partners such as MSC and ASQ Measurement Division.

F. Should NCSLI Establish a Metrology Education Foundation?

One suggestion for acquiring funding is to establish a Metrology Education Foundation under the NCSLI. Although NCSLI is already a non-profit organization that can accept gifts and grants, its mission is much broader than metrology education and training, and a separate foundation would act as a magnet for attracting gifts and grants specifically for metrology education and training. It could gather resources to expand and operate, and provide continuity and stability for metrology education.

The Foundation's mission would be to act as a national focal point for metrology education and training.

The Foundation's objectives would be to convey the importance of metrology education in our modern society, and to advocate and speak for metrology in our daily lives. The Foundation could fund:

- Continuing, ongoing needs assessment process;
- Data repository and knowledge resource for education and training availability;
- Underwriting of training and education development and delivery;
- Partnering with organizations for professional certification, credit for training, CEUs;
- Enhanced provision of scholarships;
- Establishment of quality training standards; and
- Promotion of a more effective infrastructure for metrology education.

This infrastructure would include:

- Existing brick and mortar schools and universities;
- Federal agencies such as NIST, Defense Department, National Aeronautical and Space Administration, National Institutes of Health, and the Department of Energy National Laboratories;
- Private laboratories such as Lockheed Martin, Boeing, Northrop Grumman, etc.; and
- Professional organizations, professional trainers, and volunteer trainers.

A primary objective would be the establishment of an ideal educational and training milieu for metrologists pursuing a given career path that would include

- Formal education,
- Short and long-term training and on-the-job learning requirements,
- Just-in-time training opportunities via
 - In-house,
 - One-on-one,
 - Group in-person, as well as
 - Internet,
 - Broadband, and
 - Other computer-based metrology education opportunities.

The Pi Group, Inc. sees all of the infrastructures listed above as potential sources for metrology education partnerships and sources for grants and gifts for metrology education. If NCSLI is successful in establishing a funding source for metrology education, these same organizations might be the recipients for funding for metrology education or training.

G. What's in It for NCSLI Members?

Effective metrology education and training will produce a number of beneficial outcomes for metrologists, public and private organizations, and the economy in general.

Among the desired outcomes is a pool of skilled and knowledgeable metrologists who can add value to their organizations and their products and services. Their training and

education would include leadership and communications skills for technical professionals, not just scientific and technical subjects. It would also include training and education in basic metrology for those who are pulled from a variety of disciplines to meet the merging metrology needs in our technologically-driven future.

Although NIST will publish an assessment of the U.S. Measurement System (USMS) and supplement initial findings with regular updates, these assessments focus on technological and scientific needs, not the needs in metrology education and training resulting from gaps in the current state of the USMS, or gaps from emerging technologies of the future. Without doubt the existing gaps, and those on or over the horizon, will give rise to formidable challenges and opportunities in metrology. The NCSLI is uniquely positioned to take a leading role in meeting these challenges and leading the way to excellence in metrology education and training.

We all have an opportunity to join together and leave a legacy for this generation and those to come.

To paraphrase Dr. Phil⁵,

The joy in a job is not *having a job*, but the joy of *a job well done*.

How can anyone do a job well in our modern society without appropriate education and training?

¹ See <http://www.ncsli.org/training/index.cfm> for the roadmap and update.

²For an informal history of PMEL, see <http://www.pmel.org/PMELHistory.htm> and <http://www.afmetcal.af.mil/PublicHome/history/publichistory.htm>

³ <http://www.ncsli.org/welcome/index.cfm>

⁴ <http://www.ncsli.org/training/index.cfm>

⁵ “Dr. Phil” is Dr. Phil McGraw, a television personality, who has a nationally syndicated daily one-hour series. An advertisement for one of his shows used the concept of work and job and job satisfaction as “a job well done.”