Cost Savings through the Optimization of Automated Calibration
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Greetings! I am looking forward to beginning my term as the NCSL International President for 2015 and 2016. I have been involved extensively with NCSLI for several years and have served in many capacities, including Kansas City Section Coordinator, Southeast Division VP, Central Division VP, Treasurer, and VP of Operations. Throughout my work with NCSLI, it has been a privilege to work side by side with the many great people involved with our organization.

I am a mechanical engineer by training and have worked in the field of metrology my entire career. While still in college I interviewed for a position as a metrology engineer, although before the interview, I wasn’t even familiar with the term. During the interview I learned about a project to study the effect that temperature changes had on the accuracy of coordinate measuring machines. The prospect of working on this kind of analysis was intriguing, so when I was offered the job, I accepted and have been hooked on metrology ever since.

In order to guide the direction of NCSLI, the Board of Directors has formulated NCSLI’s Strategic Plan. The plan is designed to take us out approximately five years (to the year 2020), so I am calling the plan “2020 Vision.” This plan will serve as our road map as we continue our journey towards excellence. It builds on previous versions of the strategic plan and provides continuity in our goals and objectives. The plan includes key objectives in the following areas:

- Provide Top-Quality Products and Services
- Be in Tune with our membership to Provide Desired Products and Services
- Be a Well-Run, Financially Stable, and Viable Organization
- Strengthen and Pursue new Partnerships and Collaborations
- Encourage Education and Outreach
- Technical Standards and Publications Development
- International Focus

In our organization our members have a wide variety of abilities and interests. I challenge every person to consider these objectives and identify one or more that resonates with you. Then, determine how you can take advantage of the many avenues that NCSLI provides for you to get involved.

This is an exciting time for NCSLI, and we all have the opportunity to make a positive impact. As an example, NCSLI is now an official liaison with ISO Committee on Conformity Assessment. This group is the owner of ISO/IEC 17025. The world-wide members of ISO have voted to revise ISO/IEC 17025 and the first working group meeting will be in February. With NCSLI’s new liaison status, we can send two people to these meetings. This gives all of the NCSLI membership a seat at the table in the revision of the most important calibration quality document we use. NCSLI will be conducting special sessions at the upcoming Workshop & Symposium and regional meetings to communicate what is changing in the standard, and to gather the input and opinion of the members on this subject.

Another great opportunity is the upcoming Technical Exchange to be held in Raleigh, North Carolina, on February 11 - 12, 2015. New for this year is our partnership with AMRL, which is an organization that accredits construction material testing laboratories. AMRL will be presenting some of the tutorials, bringing an enhanced depth to the training content provided. We have a great line up of training available on topics including electrical, temperature, dimensional, pressure, vibration, proficiency testing, process calibration, calibration intervals, calibration automation, statistical analysis of metrology data, record keeping in a testing lab, and asset management. Classes are available in 2 day, 1 day and half-day sessions to fit your schedule.

The 2015 NCSLI Workshop & Symposium will be held at the Gaylord Texan Resort and Convention Center in Grapevine, Texas from July 19-23, and the conference theme is “Measurement Science and the Quality of Life.” When you consider the quality of life we have available today it is truly amazing, and the role of measurement science is essential. Without the ability to measure and control critical parameters, many of the conveniences we enjoy daily would only be science fiction.

NCSLI has much to offer for those who are involved in measurement assurance, metrology, quality, calibration and testing. Please join me as we work together to make NCSLI an even greater organization!

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2015 Workshop & Symposium

GAYLORD TEXAN RESORT AND CONVENTION CENTER • GRAPEVINE, TEXAS • JULY 19 – 23, 2015

The theme for NCSL International’s 2015 Workshop & Symposium is Measurement Science and the Quality of Life. Have you considered what impact Measurement Science has had on the quality of your life? If you take time to consider it, you can appreciate what a large impact it has.

Think, for example, how your quality of life may have improved over what your great grandparents experienced a hundred years ago. Innovations and conveniences that we enjoy today would have been hard to imagine in their day. Modern automobiles, air conditioning, appliances, commercial air travel, computers, GPS navigation systems, cell phones, TVs, radios, medical improvements including MRIs, organ transplants, and joint replacements are all examples that contribute to our quality of life. Now consider the role of Measurement Science. Without the ability to measure and control critical parameters, these kinds of advances would only be science fiction.

Measurement Science professionals are encouraged to get involved and attend the 2015 Workshop & Symposium which will be held from July 19 – 23, at the Gaylord Texan Resort and Convention Center in Grapevine, Texas.

NCSLI invites you to attend this exciting conference as we consider Measurement Science and the Quality of Life.

FULL CONFERENCE REGISTRATION

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Conference Highlights

Amazing Stories of Measurement
New this year, three plenary talks that will tell some Amazing Stories of Measurement! These talks will feature leading experts from National Metrology Institutes who will share the details of the measurement science used to solve some larger than life problems.

Energy Track
Measurement Science plays multiple roles in all aspects of the energy industry. The energy sessions will focus on topics unique to the energy industry, such as battery storage, electric and gas metering, and measurements of hydrophobicity retention.

Tutorial Program
Get registered early for the tutorial program. We are introducing 5 new tutorials this year for a total of 27 tutorials.

The Poster Sessions
Join us in the Exhibit Hall on Tuesday and Wednesday to view our poster presentations, and talk with their authors!

Keynote Speakers

Chris Greer, NIST
Dr. Chris Greer is NIST Senior Executive for Cyber Physical Systems and National Coordinator for Smart Grid Interoperability.

Steve Russell, Duke Energy
Steve Russell is the DMS Project Director for Duke Energy.

Amy Young, Screenwriter
Amy Young is a screenwriter and filmmaker. Her current documentary project is The State of the Unit: The Kilogram.
Somewhere Over the Rainbow

The Metrology Paradigm of 2050

By Chet Franklin, Franklin Training Systems
Barker, who is said to be the first person to change. A good example might be Joel has been used since by many others in or revolutionary science. “Paradigm Shift” used in reference to extraordinary science, in basic assumptions regarding scientific Scientific Revolutions Kuhn, in his book titled, “The Structure of the future? In 1962 Thomas Samuel projections based on past experiences.

changes await. Since obviously we can’t do that, we have to settle for making certain projections based on past experiences.

What will be the “Metrology Paradigm” of the future? In 1962 Thomas Samuel Kuhn, in his book titled, “The Structure of Scientific Revolutions” introduced the term “paradigm shift” to describe major changes in basic assumptions regarding scientific theory. Paradigm shift has sometimes been used in reference to extraordinary science, or revolutionary science. “Paradigm Shift” has been used since by many others in reference to more general topics than just science, such as corporate or cultural change. A good example might be Joel Barker, who is said to be the first person to popularize the concept of paradigm shifts for the corporate world. In 1986, his book and videotape, “Discovering the Future: The Business of Paradigms”, promoted the idea that the concept of paradigms could be used to explain revolutionary change in all areas of human endeavor.

Many writers have argued with this usage of “Paradigm Shift”, but I think it is well suited for this article. No one can dispute the fact that we have all been witnessing Paradigm Shift, i.e. major changes, in technology. Many of us have been expressing our thoughts on emerging revolutionary and transformational changes in the measurement world. My guess is that most of the people reading this could expound on how they think advances in technology and global measurement systems will affect the manufacture, usage, calibration and maintenance of measuring and test equipment in the years to come.

Joseph Juran in his book, “Managerial Breakthrough”, used the term “breakthrough” to mean a dynamic, decisive movement to new, higher levels of performance. He also stated that the breakthrough journey can be long and intricate; not necessarily occurring overnight. It would seem obvious that two elements, “technology breakthrough” and the “global measurement system” are marching in step down the trail. It’s always better if we look as far down the trail ahead of us as we can look. How far ahead we look is very dependent on how fast we can travel; on how fast we are traveling.

In this article I want to challenge your imagination to paint a picture of the road ahead, or to use a much worn out expression, “Think out of the box”. What do you think is over the rainbow? No crystal ball allowed!

It has been said that you can’t know where you’re going without knowing where you’ve been. So let’s take a look at where we’ve been, and ask how rapidly have we seen technology grow? For one example let’s look at the integrated circuit. In 1965, Intel founder Gordon Moore observed that the number of transistors that could be placed on an integrated circuit had increased exponentially since their invention in 1958. They doubled approximately every two years. Or to put it another way, two years from now an integrated circuit performing a particular function will be one-half of today’s size. This we know as “Moore’s Law”. This trend is not expected to stop, or even slow down for some time to come. We haven’t even talked yet about Nano scale devices.

Here is another example. For many of us, well, for some of us anyway, the “Bowmar Brain” is synonymous with the early pocket electronic calculator. Originally an LED display manufacturer, Bowmar/Ali, Inc. (USA), found they could not sell their displays to Japanese electronic calculator makers. Reviewing their business plan and examining the new trends in the marketplace, Bowmar decided to design and manufacture portable calculators which would be sold by other marketing companies. They modified their plans and began shipping their first model, a hand-held unit, under their own nameplate. This model was also produced for other companies including Craig and Commodore. Bowmar soon became one of the world’s largest producers of electronic calculators, mainly pocket models, for sale by themselves and by other companies such as Sears, Radio Shack, etc. (under their own nameplates). Early Bowmar calculators were made in the USA. In later years some were also made or assembled in Mexico [1].

In 1971 the Bowmar Brain sold for about $250; in 2014 dollars that is equivalent to about $1,250. It could add, subtract, multiply and divide, all in one hand-held unit! By 1972 production was up and the price was $100 (I paid $80 for mine in 1973); 2014 equivalent? $500! By 1975 the price had dropped to $50. However the calculator “boom” was in full swing and Bowmar could not get enough integrated circuit chips from their suppliers and could not keep pace with the marketplace in low cost and new features. By 1976 the company had gone bankrupt, leaving a legacy of technical and marketing innovations. Today you can get one small enough to fit in a shirt pocket for three or four dollars. These units, like the Bowmar Brain, will add, subtract, multiply and divide. Unlike their predecessor however they will also calculate percentages, extract square roots and have both positive and negative memory. We don’t repair these little rascals; when they stop working we just go buy a new one.

Let’s go from calculators to computers, a giant leap for mankind. What was your first computer? Mine was a Commodore 64 with 64KB Ram. Think of it, 64K of RAM! Not only that but you could buy a disk drive and copy your files onto five and a quarter inch floppy discs, introduced by
IBM in 1981! I had one of those in my office in the early eighties; shared it with three other engineers. A little later you could buy an Apple, or Atari, or the TRS 80 from Radio shack (T for Tandy, RS for Radio Shack). As one of the first home computers ever, the TRS-80 was a great success. Tandy wasn’t expecting many sales, but they sold 10,000 units in the first month on the market. The factory worked 24-7 to meet demand! It included everything you needed to have a real computer of your very own - the processor, monitor, keyboard and floppy drive for loading and saving data. You didn’t even need a card reader!

It has been stated that Tom Watson, then IBM chairman, said in 1958, “I think there is a world market for about five computers”. However, some say that it’s just urban legend, but it does represent a line of thinking at that time.

No one might have predicted the future for computers very well in 1958. The number of personal computers in use worldwide is estimated to be more than 2 billion in 2014 – and that’s just an estimate. Already laptops are giving way to tablets and iPods, as well as mobile devices! You don’t need a large hard drive, you have the cloud.

Next let’s look at a little bit of telephone history. We had the wall phone. You clicked the receiver hook to make connection to an operator. We still sometimes say, “The phone is off the hook”. Then we had the dial phone. Then we got modern and went for a Princess. Then we had a phone we could put in our brief case, or so and some stuff rubbed off. There is nothing particularly noteworthy or precise about this, it’s just intended to set the stage; to trigger your imagination.

Today, an on-the-bench piece of test equipment is calibrated with a working standard, which is periodically sent to a calibration laboratory, and maybe even to NIST, to insure accuracy and traceability of measurements. Obviously it can’t be used until it is sent back. When I was the manager of Manufacturing Engineering and Reliability, I often fielded complaints from the factory floor about not being able to finish testing because their working standard was out for calibration. The corporate primary standards laboratory was in another building about two miles away.

My manufacturing process engineers were examining the possibility of having phone line communication with the calibration laboratory so that the working standard would remain on site. They imagined a phone cradle, similar to those used at that time to send a fax. This could be brought to the factory floor, plugged into the working standard for communicating with the lab. Diagnostics could then be performed. A signal could be sent to interrogate the standard, and the standard then send a return signal which could be read by the cal lab. Speaking of home computers here is what the Rand Corporation imagined a home computer to look like in 2004. The picture is from a 1954 popular science magazine. You only talked to it via punched cards; it could answer via the teletype, or more punched cards. I wonder, is that wheel an early version of the mouse? Is the monitor part of it?

What does all this history have to do with metrology? My intent has been to illustrate what we have seen in the past 30 years, or so. Let’s use that to speculate about 30 years or so from now.

Let’s take a simplified look at how we go about ensuring Traceability to the SI; remember, I said simplified. Let me add a caveat; I am not a metrologist, I have just hung out with them for 20 years or so and some stuff rubbed off. There is nothing particularly noteworthy or precise about this, it’s just intended to set the stage; to trigger your imagination.

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signal in response. The two could then be compared. Did the return signal agree with the transmitted one? This work was to be funded by my Manufacturing Process R&D budget. Guess what? The budget was drastically reduced just when they got started. Okay, let’s fast-forward a bit.

The following is quoted from an article by Marc Desrosiers, etc. (NIST), titled “e-Calibrations using the Internet to deliver calibration services in real time at lower cost”, published by Radiation Physics and Chemistry [2].

The National Institute of Standards and Technology (NIST) is expanding into a new frontier in the delivery of measurement services. The Internet will be employed to provide industry with electronic traceability to national standards. This is a radical departure from the traditional modes of traceability and presents many new challenges. The traditional mail-based calibration service relies on sending artifacts to the user, who then mails them back to NIST for evaluation. The new service will deliver calibration results to the industry customer on-demand, in real-time, at a lower cost. The Internet will be – in some cases is being - used to provide industry with electronic traceability to national standards. Calibration results can be delivered on-demand.

Take a close look at the title and note “in real time”. What challenges; what opportunities will come from this?

The following is quoted from an article by R. A. Dudley (MIT), and N.M. Ridler National Physical Laboratory (NPL), titled “Internet calibration direct to national measurement standards for automatic network analyzers”, presented at the IEEE Instrumentation and Measurement Technology Conference, Budapest, Hungary [3]. From a paper titled, “Generic environment for internet-enabled metrology services,” [4] Marko Jurčević, of the University of Zagreb, Croatia wrote, “Remote calibration using the Internet is offering a solution to transportation, environmental, downtime and cost issues of current methods.” For example, the client goes on line and enters pertinent data to the NMI. From this point the entire measurement process is controlled by the NMI and the need for clients to assess their own uncertainty budget is removed”.

How about going a step farther? Assume the communication is wireless, maybe using cell phone links and is full time and can be used in the field with mobile equipment?

These are given here as just examples of the work being done. Note also that this idea is not brand new; these articles are from 2001 and 2002; more than ten years ago! Research is still underway.

So; where to from here? We have smart phone apps, we have tablets, we have mobile radar, and don’t forget the cloud. How will these play into the process of calibration and measurement verification?
Time for a little fun. Let’s stretch a little and imagine the hand held multi-meter of tomorrow. The characteristics of its materials are well known. Drift is characterized such that repeatability is known and extensive testing has made reliability and life cycle accurately predictable. Let’s assume that life-cycle testing has demonstrated, repeatedly that it will perform for 2,400 hours without significant, or possibly even measurable drift. It contains a built-in run-time-recorder, and when the recorder hits 2,000 hours it shuts down, and cannot be restarted. It has a built-in accelerometer, battery monitor, and a temperature sensor. It stops functioning when it is dropped or damaged, or the battery is too low, or it’s been exposed to temperature extremes. Because of its low cost it is not sent to the laboratory for calibration, instead it goes to an electronic waste handler, just like our old cell phones. Possible? Not likely? Impossible? I think it’s not only possible, but very likely. You tell me! How about more sophisticated pieces of test equipment?

As my grandmother used to say, “What will they think of next?” Moving pictures from the radio? A non-physical artifact for mass? I feel as if I have only scratched the surface!

I have tried to present the idea that without looking into the past we can’t make many guesses about the future. Even a crystal ball won’t do it. We are only limited by our imagination, our history and our willingness to innovate!

But we need to consider the question, what’s around the corner? What is somewhere over the rainbow? We know that we cannot predict the future. But, are we planning for it? Are we ready for it?

References:
[1] Early Bowmar calculators were made in the USA. In later years some were also made or assembled in Mexico.
[2] Marc Desrosiers, etc. (NIST) “e-Calibrations using the Internet to deliver calibration services in real time at lower cost”, Radiation Physics and Chemistry 63 (2002), Elsevier Sciences Ltd

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“Still round the corner there may wait, a new road or a secret gate.”

J.R.R. Tolkien
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Students and faculty from the R. W. Creteau Regional Technology Center at the Spaulding High School in conjunction with students and faculty from the GBCC-ATAC (Great Bay Community College – Advanced Technology and Academic Center) were engaged in a very lively and in-depth education event at the GBCC-ATAC facility. Both schools are located in Rochester, New Hampshire and within a mile of each other.

The event theme was “Metrology Contribution to Manufacturing and Production.” The selection of a theme was intended to maintain focus for the students, acknowledge the education aspect of both schools and dovetail with AMPedNH, an initiative funded by a $20M TAACCCT grant provided by the U.S. DOL/ETA to create, educate, and train people for high-skilled jobs in the advanced manufacturing industry.

Students and faculty arrived at the GBCC facility at 8:00 AM for the event kickoff. While the introduction focused on the metrology aspects of the day’s activities, visitors were encouraged to acknowledge that STEM (Science – Technology – Engineering – Math) is the backbone to proper metrology and how metrology relates to successful and profitable manufacturing and production goals.

The event began with a tour of the advanced composites lab and was viewed as the keynote activity and emphasized the application of metrology principles at all stages of the manufacturing process. This was a chance for the high school students to observe education opportunities that are available to them upon graduation and included interaction with GBCC cohorts actually training in the lab. The tour was managed by GBCC-ATAC instructors Bret Blanchard, Lead Instructor – Advanced Composites Manufacturing and Sara Tower, Instructor – Advanced Composites Manufacturing.

Industry partners again joined forces with NCSL International member William Hinton who coordinated the event.
Presenting members for this event included Kyle Robbins, Technical Trainer for Turbocam International; Gary Confalone, President and CEO of ECM Global Measurement Solutions along with ECM Director of Engineering Tom Kinarre. First time team member Anthony Diiorio, District Manager for Fowler High Precision, co-presented with returning member Rob Melanson, formerly with Fowler, and now Sales Manager North America for Trimos of Switzerland.

The event focus, metrology’s contribution to manufacturing and production, is seen as a gateway to opportunities related to metrology as well as an ice breaker for additional discussion during the breakout sessions with the presenters. Implementing lessons learned and feedback from previous education events, students were provided extended breaks to speak with the presenters and to interact with the metrology products provided in support of the presentations.

Kyle Robbins of Turbocam International discussed metrology and high precision automated machining and quality control. This presentation included several items from the factory floor showing various types of machine process and stages of fabrication. The application of metrology principles was discussed including the importance when the facility is operated in complete autonomous mode on the weekends. One of the artifacts in the Turbocam collection was processed in such a way that erosion and abrasion was drastically reduced. Kyle stated “I had a lot of the students interested in the TX1 penetrant process that Turbocam does to increase wear resistance of our products. I had two parts for the students to file, one was not treated and the other was treated. They took a file to the part and were amazed that it would dig in on the untreated part and would slide across the surface of the treated part. The questions started to pour out of them when they experienced it.” While the stability of parts and the resulting resistance to wear can be measured through metrology and measurements, the realization that wear attributes can be changed spoke to the students on a level related to STEM and how manufacturing and production be influenced.
Gary Confalone presented the influence of metrology on manufacturing ranging from everyday products such as Starbucks coffee cup to advanced laser metrology used in the repair of an America’s Cup race boat and alignment of proton therapy machines all across the globe. Examples of “Bad Metrology” where measurements were not correct or outside influences were not properly considered showcased the need for knowledgeable and skilled metrology personnel.

Gary shared his thoughts after interacting with the students, the faculty members and the other presenters. He noted that “This is the exact type of curriculum that we need today. These people get out of here [GBCC] with a real vocation. GBCC really has their finger on the pulse of what the needs are for these students and the industry. It is great to be a part of something that matters and has such a positive effect on a persons’ career path. Most students do not know what they want to do in life because they are never exposed to it…..GBCC and the State of NH have figured out a winning solution for everyone involved.”

Rob Melanson and Anthony Diiorio discussed precision dimensional measurement instruments applicable not only to the setup of manufacturing processes but for the verification and validation of manufactured parts during the quality control process. Students were encouraged to examine and handle the many items provided in support of the presentation.

It was interesting to note the implementation of wireless technology in some of the newer instrument; specifically, the use of Bluetooth communication with a smart phone app to display and curate data obtained by the measurement device. The quality control aspect of manufacturing and production is currently embodied in the GBCC-ATAC curriculum and plans are being formulated to include basic quality control training into the technology training at the R.W. Creteau Regional Technology Center at Spaulding.

Rob noted that the students were technically engaged, citing “With regards to the height gage, after showing a bolt-hole circle, students asked me how it was measured. I explained that since the height gage only measures in the Z-Axis the part has to be rotated 90 degrees, and re-measured. That’s how we establish the other axis. Once that is done we can establish locations of features in either a cartesian coordinate or a polar coordinate, similar to a CMM.”

New Hampshire is both a high tech center as well as an agricultural state and William Hinton presented metrology’s contribution to agriculture, ranging from NIST advancements in time measurement that improve GPS positioning for semi-autonomous farm machinery and drones to Near Infrared (NIR) calorimetry used to determine crop health. Another New England industry that has implemented technology is the production of maple syrup. Many facilities now use collection tubing between the trees with a precision vacuum control to collect the sap for processing. Additional improvements have been seen in the digital measurement process for sugar concentration that historically relied on float type hydrometers and temperature is now
controlled through digital controllers, calibrated using traceable instruments and standards.

Students were introduced to precision and accuracy principles using a simple dart board and math. Student engagement is essential during outreach events.

Interviews with the people who participated in the half day event were very positive. Several comments from the attendees noted they enjoyed the fast pace and high tech subject matter and particularly appreciated how it related to their school studies. The peer education outreach partners and the school instructors all commented that linkage to STEM education was an excellent way to introduce the visitors to the day’s event. It is important to note that the Spaulding High School technology center, as well as the main high school campus, place high emphasis on STEM and the interaction between students and presenters demonstrated the benefits of this focus.

A query of both students and faculty demonstrated success in meeting the event’s learning objectives of being able to 1) identify several metrology influences on manufacturing and production, 2) identify how scientific improvements have real world return on investments related to manufacturing and production and 3) listing several career opportunities in metrology as they relate to manufacturing and production.

This event will be followed by a spring capstone event consisting of a visit to the Seabrook Station Nuclear Power Plant. Six students and two instructors will learn how metrology contributes to the production of electricity and the safe operation of a nuclear power station through actual hands-on demonstration in a working metrology laboratory.

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During an outreach event, I always ask “what does a Metrologist do at work” and every student always answers “they forecast weather.”

I immediately switch to my metrology education techniques which engage the students by means of hands-on training. The students enjoy operating different types of measurement and test equipment (M&TE), and afterwards every middle school, high school and college student finally understands the importance of accurate measurements in the quality products we manufacture.

My reward after each metrology outreach event is that every student now comprehends why measurement science is such a major part of our daily lives.
Future Metrologists

As a Metrology Ambassador, I encourage all students to fully participate in the hands-on application of different types of (M&TE) in our lab here at Fairchild Controls. We are located in Fredrick, Maryland not far from NIST.

All metrology outreach sessions influence students in a positive way; I have noticed the absolute fire in their eyes via their enthusiastic academic responses (Q&A), and education gained from a science that has been around since the building of the Pyramids in Giza which were measured precisely by use of a Royal Cubit (ancient measurement standard).

Metrology Ambassadors exist to challenge, inspire, develop, and mentor future Metrologists. We must pay forward via our metrology knowledge, experience and desire to enlighten students and citizens that metrology is not the study of weather (that’s half the battle).

The profession of metrology embodies S.T.E.M initiatives that safeguards present and future prosperity for the USA, therefore become a Metrology Ambassador to pass-on the exciting fields of Science, Technology, Engineering, and Measurement (MATH).

Metrology engagement in schools will start a new pioneering breed of measurement scientists; it’s essential for the education board throughout the United States to integrate a metrology core curriculum within the elementary, middle, and high school level students. Once the metrology syllabus takes root it will only encourage technological advancements within our culture.

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The Universidad Politecnica de Santa Rosa Jauregui (UPSRJ), is a public university located in the state of Queretaro in Mexico, and the first educational institution to develop an undergraduate program in Industrial Metrology Engineering. In October 2014, ETALONS, a private calibration laboratory, signed a collaboration agreement with the Polytechnic University of Santa Rosa Jauregui which will strengthen the scientific and technical cooperation in the field of metrology, initially benefiting more than 90 students of engineering in industrial metrology, also this agreement will allow work in the development of new measurement methods and to create educational, employment and entrepreneurship opportunities for the benefit of engineering students and the national industry in Mexico.

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PROMOTING ACADEMIC EXCELLENCE IN METROLOGY
Welcome back, readers, to your MII column and another New Year. This installment discusses MII news and opportunities and, as promised, sketches a data model for accreditation scopes.

Resolutions
By way of review, we previously highlighted three main MII communication vehicles: instrument specifications, accreditation scopes, and calibration & testing certificates. These documents convey critical information between organizations whose businesses depend on measurements—calibration laboratories, accreditation bodies, instrument manufacturers, and customers of all the above.

Figure 1 shows some of these relationships.
Currently, we transmit that information via paper or “electronic” (e.g., pdf) documents, requiring human processing to handle the documents, interpret them, and take appropriate action. Smart (machine-readable) MII documents and MII-aware software would automate and streamline measurement data processing, assuming that we establish the appropriate machine-to-machine communication protocols. We will address communication protocols in future installments, and previous articles already covered instrument specifications.

Today’s topic, an accreditation scope data model, would enable MII software to locate and validate acceptable calibration vendors for our instruments and relieve us from manual and sometimes tedious searches and comparisons. Ideally, the model would also encompass the information from BIPM’s KCDB for those interested in NMI-level measurements. As a further design goal, we would like the model to extend to accreditation scopes for other measuring entities such as testing laboratories, IBs, and PTPs.

**Recommended Practices**

In a fortuitous development, Pam Wright of A2LA, NCSLI Accreditation Committee Working Group Chair, announced in the last Metrologist issue that NCSLI recently updated its Recommended Practice RP-9, Measurement Capability Description. NCSLI RP-9 bears heavily on our accreditation scope data model, as it, to paraphrase Pam, provides guidance for publishing such information and includes specific descriptors such as measuring entity, activity type, function, category, subcategory, object of interest, quantity of interest, range, quality indicator and measurement method.

We will therefore let RP-9, and thus indirectly ILAC G18:04/2010, Guideline for the Formulation of Scopes of Accreditation for Laboratories, inform our data structure.

Language usage, however, varies among ABs on published accreditation scopes so let’s once again turn to the VIM for more precise terminology to strictly standardize the internal model for our computing systems. When the VIM has no analogue, we will fall back to RP-9. Just as with the smart spec sheets discussed previously, the MII accreditation scope will include the flexibility for an organization to imbue a document template to render a human readable version in its customary visual appearance and terminology.

Speaking of recommended practices, they may offer perfect venues to define their respective MII smart document data models until we arrive at appropriate international standards. For example, an RP-9 appendix might standardize our accreditation scope data model.

Let’s not forget other RPs. NCSLI RP-5, Measuring and Testing Equipment Specifications, has languished for some time but a new draft greatly expands and elaborates on the former version. The draft does not speak to data models or electronic specification formats but such material might well fit in this or a future version. Though documentary standards such as ISO/IEC 17025 and ANSI/NCSL Z540.3 have preempted it, NCSLI RP-11, Reports and Certificates of Calibration (currently withdrawn), might likewise provide a home for an MII calibration certificate’s data model, which we hope to soon lay out in this column.

**Fashioning A Model**

Okay, back to today’s business—what should our model include? Let’s look at what happens in practice: A measuring entity declares its services by publishing a “scope of capability,” which describes its various CMCs. Typically, the entity seeks third-party accreditation to confer trust in its CMCs with existing and potential customers. The resulting accreditation scope or certificate then includes the entity’s capability scope or at least the specifically accredited CMCs. Not all organizations require accreditation of all measuring entities, however, so to allow MII software to seek out and find measurement capabilities suitable for any organization’s application, our data model should both recognize stand-alone capability scopes, and those embedded in accreditation scopes.

So, let’s begin by modeling the Capability Scope. It should obviously identify the Measuring Entity, which specifies the organization’s name, address, contact, and contact info. Some ABs issue separate accreditations for each site location; others may include several locations in one scope. Following that, RP-9 recommends dividing the CMCs into a Activity Type hierarchy denoted General Function, Category, and Subcategory. So, the Capability Scope simply comprises the Measuring Entity, its Locations and Activities. Scope Notes allow for any interpretation or explanation, including references to recommended practices or consensus standards, that the measuring entity would like to include. A Locale-Language element allows customization for a world region’s language and character set:

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1. Bureau International des Poids et Mesures (International Bureau of Weights and Measures)
2. Key comparison database
3. National metrology institute
4. Inspection bodies
5. Proficiency testing providers
6. International Laboratory Accreditation Cooperation
7. Accreditation bodies
8. International Vocabulary of Metrology
9. Calibration and measurement capabilities
Capability Scope
• Measuring Entity
  – Organization ID
  – Organization Name
• Locations
  – Location 1
    • Organization Address
    • Contact Name
    • Contact Info
  – Location 2
  ⋮
  – Location \( N_t \)
• Activity
  – Activity 1
  – Activity 2
  ⋮
  – Activity \( N_a \)
• Scope Notes
• Locale-Language
• Human-Readable Document
• Visual Aids Script

Activity
• Activity Type
  – General Function
  – Category
  – Subcategory
• Location List
• CMC

The Location List specifies which of multiple locations, if any, offer the associated CMC. General functions include test, calibration, inspection and measurement, whereas the category describes the broad measurement discipline, e.g., dimensional (calibration), and subcategory the specific field, e.g., length.

RP-9 supplies tables of recommended category descriptors for each general function; for example, for calibration it lists the categories accelerometry, acoustics, density and viscosity, dimensional, electrical, flow, force and torque, hardness, humidity, magnetism, mass, optical, pressure and vacuum, radiological, temperature, time and frequency, volume and vibration. Ultimately, the data format would define extensible lists for these and similar descriptors, perhaps in authorized Web registries hosted by ILAC, BIPM, or another appropriate organization. The Activity Type structure just organizes a human-readable capability scope and not all ABs use it, so we leave it optional for any given scope, except for the general function, which qualifies both the AB’s and measuring entity’s scope.

Next up, we have the CMC itself, the interesting part. At this point, RP-9 delineates descriptors for the object of interest (test subject, such as an instrument or measured quantity), quantity of interest (including the range and measurement quality), methodology, and other important details. As applicable, this structure should parallel our previously discussed VIM-based instrument spec sheet model, so that machines may understand the data and compare information in separate documents. Therefore, we reuse and abbreviate the relevant spec sheet building blocks for our CMC as follows:

CMC
• Measuring System Identifier
• Measuring Instrument Identifier
• Function Nomenclature
• Function Accuracy Class
• Measuring Range
  – Measuring Interval
  – Influence Quantity 1
  – Influence Quantity 2
  ⋮
  – Influence Quantity \( N_{IQ} \)
  – Quality Function
  – Calculation Script
  – Traceability
• Applied Methodology

System or Instrument Identifier
• Unique ID
• Nomenclature
• Manufacturer
• Model

We’ve flattened the spec sheet’s measuring systems-instruments-functions-ranges hierarchy to stand internally for RP-9’s object and quantity of interest and provide all the desired detail. A given CMC may omit any inapplicable level; for example, if “DC Voltage, 1 mV to 1 kV” gives all the required information, the hierarchy collapses simply to a Measuring Range with no influence quantities. The scope may also omit specifics such as Manufacturer and Model when indicating only the general instrument type. The Influence Quantity elements supply the ancillary ranges where applicable, such as the frequency limitations for an RF power CMC.

As in the MII spec sheet, the Quality Function or Calculation Script provides the equation, whether trivial or complex, representing RP-9’s Quality Indicator or MQM\(^{10}\)–uncertainty, measurement decision risk, TUR\(^{11}\), etc.). If you didn’t see that installment, we would implement those features via a special purpose equation interpreter or a general purpose scripting language, both already commonly available. Some general functions may simply require basic Traceability information instead. Finally, Applied Methodology lists or references any consensus standard, regulatory requirement, or controlled procedure that governs the measurement method and potentially affects the results.

Wrappings and Trappings
Now let’s clothe the capability scope in an optional accreditation. A brief survey of accreditation scopes leads us to the following general structure:

Accreditation Scope
• AB ID
• MRA Identifier
• AB Logo-Signature

\(^{10}\) Measurement quality metric
\(^{11}\) Test uncertainty ratio
Published scopes identify the AB of course, so the AB ID element specifies its name and address. The MRA Identifier data element might contain an ILAC-issued UUID\(^\text{12}\), where applicable, or, alternatively, a URL\(^\text{14}\) pointing to the AB’s MRA signatory list entry and scope of recognition. The AB would “sign” a smart accreditation scope with a security certificate that both validates the document electronically and adorns the human-readable version with the AB’s logo and appropriate signatures. The Scope ID Number stores the AB’s unique ID assigned to this particular scope.

Other elements include the Criteria, or documentary standard(s), to which the AB accredits the measuring entity, the Effective Date (issue date) and Expiration Date, where applicable, and any textual Statement the scope includes to clarify the accreditation, its terminology, etc. Finally, the accreditation scope specifies the accredited Capability Scope, whose model we already defined, and embeds the same Human-Readable Document and Visual Aids Script technology we included with our MII spec sheet model; without that, the model has only an invisible outfit.

**Backstage**

Beneath a human-readable accreditation’s skin-deep appeal lies the machine-readable substance that allows software to handle routine tasks without human intervention, namely

- Find measuring entities whose accredited function, quality standard, and approval period meet our requirement.
- Locate scopes whose CMCs overlap the measuring functions and ranges specified in an MII instrument spec sheet.
- Calculate, compare, or filter the entities’ MQMs.
- Identify the issuing AB.
- Verify the scope’s AB security signature.
- Look up and validate the AB’s MRA status.
- Compare the AB’s scope with the accredited activity scope.
- Archive the accreditation document for the (electronic) record.
- Compare CMCs against future service certificates from that entity.

That does it for a high-level view. Our model may not look ready to walk the runway, and probably requires some tweaks for wardrobes like inspection scopes and the KCDB, but perhaps it illustrates a potential future. We welcome feedback from anyone, whether involved in capability scopes or otherwise.

**Trends**

A few words about MII-related topics before we close: The IEEE Standards Association issued a call for participation on its IEEE P1871.2™ Working Group, which develops the recommended practice for IEEE 1671 Test Equipment Templates and Extension Classes for Describing Intrinsic Signal Path Information for Cables, Interface Adapters and Test Equipment. This new recommended practice will augment the IEEE’s standards for ATML\(^\text{15}\), previously discussed in this column. The invitation remains open until February 15, so contact Mike Seavey at mike.seavey@gmail.com if it interests you.

We would also like to recognize some past work by the French metrologist Jean-Claude Krynicki. Jean-Claude has given a number of presentations and papers now related to such MII topics as universal metrology data exchange, instrument specifications, test point selection, metrology economics, instrument models, accreditation, and calibration intervals. Visit http://www.krieger-krynicki.org/jean-claude_krynicki.htm for more information.

Finally, we’ve created a forum at www.ncsli.org to discuss and plan the MII. Sign up to follow this project, take a look at the tasks or to let us know if you want to help tackle any. We should have it populated with information from these articles by the time you read this. You should find it under the COMMITTEES, Communities menu item. If you don’t already have an NCSLI account, you may create one from any of their web pages (top right corner), membership not required.

Happy New Year!

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\(^{12}\) Universally unique identifier

\(^{13}\) Mutual Recognition Arrangement

\(^{14}\) Universal resource locator

\(^{15}\) Automatic test markup language
Cost Savings through the Optimization of Automated Calibration

By Robert Hamner, Staff Calibration Engineer and Tim Coonan, Calibration Engineer
National Instruments Corporation

Calibration is a necessary and often expensive aspect of maintaining any measurement device. As devices become more complex and sales increase in volume, the calibration time per device becomes increasingly important to analyze for inefficiencies. Like many companies, National Instruments (NI) has encountered issues with calibration cost and efficiency for several years. Below, we walk through a short description of our automated calibration software, a number of ways in which design inefficiencies ended up costing us time and money as requirements changed, why efficiency was not our highest priority during the design phase, and how we optimized our framework when efficiency became important.

Our group at NI develops an automated calibration suite called Calibration Executive (CalExec). CalExec consists of a framework to support automated calibration, along with calibration procedures that use the framework. These
procedures verify that NI’s products meet their specifications and adjust their onboard calibration values if needed.

Historically, our service labs calibrated a small number of devices. The calibration procedures required relatively few measurements; therefore run time was not necessarily a top priority when initially developing the framework. This was no longer the case as NI began developing more complicated products that were sold in higher volumes and required more measurements during calibration. While monitoring the run times of our calibration procedures in detail, we discovered a number of minor inefficiencies in our framework that resulted in major time sinks in longer procedures. After gathering data, we implemented many simple fixes that resulted in massive savings for the company, and we learned some valuable lessons for future framework design.

During testing, we experienced recurring issues with instrument settling time. We discovered that using the manufacturer’s recommended settling times (20 ms in this case) on one of our signal generators was not always ideal. During longer calibration procedures, we commonly measure the power coming out of a signal generator using a power meter configured with automatic settling. The power meter will not return a value until the readings settle within a specified percentage, so anything that interferes with the settling algorithm results in an unnecessary slowdown. After monitoring the settling time in various procedures, we noticed that some test points appeared to take longer than others and decided to investigate.

We investigated this settling time issue by connecting the power sensor to the signal generator and sweeping through frequencies and power levels we typically calibrate, while simultaneously recording detailed run times. The results showed that certain settings caused extremely long settling times on the power meter (on the order of 50 times expected). We determined that for specific situations, the power meter would settle significantly faster if, before taking a measurement, we allowed the signal generator to settle for 50 ms versus the manufacturer recommended 20 ms (see figure 1). In this case, adding more settling time for the signal generator resulted in a faster total measurement. The simple solution was to add a check in our signal generator driver to programmatically determine the ideal settling time. This fix alone resulted in a 50% run time reduction for one of our calibration procedures, while generally improving run times for all procedures using this signal generator and power meter configuration.

We also found issues with inflexible driver design. An example of this is that the signal generator driver configured both power level and frequency simultaneously even if only one of these settings changed. At best, this required sending additional commands to the signal generator each time you changed only one setting, and, at worst, the driver would wait until the output settled for both frequency and power. Since we have used this driver for years in a large number of procedures, simply updating the code at a high level to set one parameter was not an option, which forced us to look for another solution.

Our solution was to implement low-level state caching for each signal generator supported in CalExec. The run time improvement depends on many parameters, such as which instrument we use and whether we change frequency or power. However, at a minimum, if only one parameter changes it is always faster to configure it alone. This single improvement resulted in a 10% run-time reduction for one of our most popular products.

A third issue that we uncovered was that redundant calls can be costly. One example is that each time we sent a command to an instrument, we checked to make sure that the instrument method was supported. This took on the order of 1 ms per call; since a typical procedure made
less than 1000 calls, the time overhead was negligible. This changed when we began developing procedures that made hundreds of thousands of calls to the instruments. For one of our devices, this single 1 ms check resulted in over four minutes of wasted time per calibration.

Another issue that we uncovered was that fixing the required accuracy for a measurement can waste time. For example, it is common for instruments to have auto-settling capabilities. These obviously can affect the uncertainties of measurements, so we tend to use very tight settling to ensure measurement accuracy. However, longer settling leads to longer test times. If the uncertainty due to the settling is extremely low compared to the other components in the system, we could justify looser settling. Thus, we developed algorithms to update the level of settling based on the test point and desired test uncertainty ratio.

During our research, we discovered many other issues that we were able to fix. As evidence of how valuable this is, we reduced the verification time for one of NI’s most popular products from three hours to one hour. NI’s services team plans to run verification on at least 5,000 of these units per year using our procedure, so this single product’s run time reduction will potentially save 10,000 man hours per year. At an estimated cost of $50 per hour for a technician and test station, this amounts to an estimated $500,000 in savings per year for a single product with no negative impact. Since our optimizations improved calibration times for many calibration procedures within our framework (several months of developer time in our case). Thus, when increasing the volume of calibrations or the complexity of calibration procedures, investing in developer time for optimizations can definitely be worth the cost. Even more importantly, developers should plan for efficiency and scalability when designing a framework that will be used long term in order to avoid wasting money.

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Figure 2: These two products were used as benchmarks for our performance across multiple releases due to their long run times and high sales volumes. The cost reductions here are the result of many improvements, including the ones discussed in this article and many others (most notably, updates to our user-interface, updates to measurement algorithms, and a reduction in the number of test points measured for certain steps).
Improving Measurement Capabilities for Canadian Industries

By National Research Council of Canada

Accurate measurement underpins industrial success across all sectors of the economy and enables our industries to be more innovative and competitive in domestic and export markets. Broadly speaking, a national measurement system stimulates good measurement practice, which results in a better quality of life through improved trade and consumer protection, a cleaner, healthier environment, and more effective health and safety measures.

Advancements in technology have required the science of metrology to keep pace. The National Research Council of Canada (NRC) meets this demand with world-class facilities, technologies, and staff tackling challenges in innovation and providing first-rate metrology capabilities. Measurement Science and Standards at NRC are divided into three research and development programs: Measurement Science for Emerging Technologies; Scientific Support for the National Measurement System; and Metrology for Industry and Society.
Measurement Science for Emerging Technologies

The Measurement Science for Emerging Technologies program addresses critical issues facing Canada and the global economy where new technology solutions are required, where conventional measurement approaches don’t apply, or where existing capabilities are limited. This program works to address key measurement challenges so Canada is well-positioned to realize the social and economic benefits expected from emerging technologies.

The program also ensures the responsible introduction of new technologies to the marketplace. It enables companies to create and develop market share using game-changing technologies that are likely to transform existing sectors and create new global market opportunities for Canadian products and know-how.

The program has advanced services and development in black carbon metrology for the environment and in nanoscale measurement, and also has early phase projects designed to put a measurement science perspective on existing expertise in biometry.

Scientific Support for the National Measurement System

As part of a global system where each national measurement institute serves their own interest, the Scientific Support for the National Measurement System program ensures that Canada’s interests are well-represented internationally. It also serves as a bridge between the Standards Council of Canada and third-party measurement laboratories seeking accreditation to International Organization for Standardization (ISO) standards.

The program aims to foster a more coherent national measurement system for Canada by linking metrology (measurement science), quality management, accreditation, and normative standards development as a single conceptual entity that enables fair and safe competition, and provides support for innovation—improving the competitiveness of businesses both domestically and in export markets.

This program focuses on national and international engagement (including consultative committees and key comparison committees), quality systems, and Calibration Laboratory Assessment Service, which is parallel to the National Voluntary Laboratory Accreditation Program but not an accredited body by our own rights.

Metrology for Industry and Society

The Metrology for Industry and Society program develops, improves, and delivers metrology services to support industrial competitiveness and regulatory compliance in existing and evolving market sectors. The effort aims to improve the productivity (and in particular, efficiency,
quality and safety) of clients in the target sectors of energy, health, and industrial processing. It also responds to evolving national measurement needs, delivering technical services to clients in targeted sectors.

The program has a conventional discipline-based approach to research and services delivery: biotoxin metrology, chemical metrology, electrical power measurements, electrical standards, frequency and time, ionizing radiation standards, mechanical metrology, and photometry, radiometry, and thermometry.

75th anniversary of Canada’s official time signal
Canada’s official time signal was first broadcast on CBC Radio 75 years ago. It was November 5, 1939, as war was being waged in Europe. Since then, listeners all across Canada have used “the beginning of the long dash” to set their clocks to the exact time. However, the story of the national time signal actually began quite a few years before that.

Back in the 1900s, the Dominion Observatory provided time for Canada prior to the National Research Council receiving this federal mandate (back when astronomical observations were used for time keeping instead of atomic clocks). The Dominion Observatory had direct links to provide time to several businesses, including the Bank of Canada, Ottawa Electric for the streetcars, Birk’s Jewelers, and the Department of Transport.

In 1905, the Dominion Observatory started supplying a time signal by telephone line to the Canadian National Railway telegraph office. But it was not until February 1924 that the railway radio network station CKCH started broadcasting this time in Ottawa. To do so, a line was extended to the radio station so that every day at 9:00 PM, the Dominion Observatory time signal could be broadcast via CKCH. At that time, the pulses were produced by a buzzer and later by an audio oscillator.

In 1933, the station was purchased by the Canadian Radio Broadcasting Commission (the predecessor of the CBC) and became CRCO at AM 880. Over the years, the name of the radio station changed and so did the time signal. The 10-seconds of silence before the “long dash” no longer existed, and the signal was changed from 3:00 PM to its current time, 1:00 PM on CBC and 12:00 PM, the Dominion Observatory time signal could be broadcast via CKCH. At that time, the pulses were produced by a buzzer and later by an audio oscillator.

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**Measurement and dissemination of time has a huge impact on our lives. Cellphones, computers, GPS systems, and stock exchange markets are but a few examples of applications relying on accurate time. Having the exact time is also essential for the coordination of communications, transportation and power distribution networks. A few seconds can sometimes make a big difference. But more than that, the NRC time signal on CBC is now part of Canada’s national heritage. For many Canadians, it is a tradition to set their clocks to the time signal. By housing and operating the precision clocks that disseminate the signal, NRC has been providing a trusted source of exact time that people have been relying on for years and will continue to do so in the years to come.**

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The Conference on Precision Electromagnetic Measurements, more popularly referred to as CPEM, is devoted to topics related to electromagnetic measurements at the highest accuracy levels. These cover the frequency spectrum from dc through the optical region. A major focus of this conference is quantum devices that relate electrical standards to fundamental constants and the international system of units. Since its first edition in 1958, this event has been recognized by the quality of the papers presented.

The Instituto Nacional de Metrologia, Qualidade e Tecnologia (INMETRO) from Brazil, and the Instituto Nacional de Tecnología Industrial (INTI) from Argentina, jointly organized CPEM 2014. This was the first time the conference was hosted in South America. The initiative was a result of the long-standing collaboration between the two countries. The conference was held from 24 to 29 August 2014 in Windsor Barra Hotel in Rio de Janeiro, Brazil (see http://www.inmetro.gov.br/cpem2014).
A total of 353 scientists and researchers from exactly 40 countries attended CPEM 2014, continuing the long-standing tradition of CPEM being the venue for technical exchange among international researchers and metrologists who are responsible for electromagnetic measurements at the highest levels of accuracy. There were 172 oral presentations and 224 posters.

CPEM permanent sponsors are the Bureau International des Poids et Mesures (BIPM), the National Institute of Standards and Technology (NIST), the National Research Council of Canada (NRC), NCSL International (NCSLI) and the Institute of Electrical and Electronics Engineers - Instrumentation and Measurement Society (IEEE-IMS). The 2014 edition was mainly sponsored by INMETRO. Additional sponsors were Fluke Calibration, Measurements International (MI) and International Union of Pure and Applied Physics (IUPAP). The Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) also supported the event. There was a parallel exhibition of instrumentation and measurement products and services from National Physical Laboratory (NPL), Ohm-Labs, Andeen-Hagerling, Guildline Instruments, Agilent Technologies, Fluke Calibration, Radian Research, Rhode-Schwarz, Bohnen-Messtek, Measurements International, and Institute of Physics Publishing (IOP).

CPEM attracts a highly specialized international participation. The principal types of organizations that participate at CPEM are the national standards laboratories; industrial organizations that manufacture the highest accuracy electrical standards and measurement instruments; industrial and government standards laboratories that interact extensively with national laboratories; and universities that conduct research on precision measurements, standards and related fundamental constants. Attendance at CPEM is considered a must for the researchers and metrologists who are responsible for electrical standards.
The technical program for CPEM 2014 featured plenary speakers presenting talks on the topics of Quantum Optics, Quantum Information, Quantum Metrology: Exploring the Subtleties of the Quantum World by Prof. Luiz Davidovich - Universidade Federal do Rio de Janeiro (UFRJ) - Brazil, Precision Penning-trap Mass Measurements and Fundamental Constants by Prof. Dr. Klaus Blaum - Max-Planck-Institut für Kernphysik - Germany, and The Femtosecond Laser as a Microwave Experiment by Dr. Mark Bieler - Physikalisch-Technische Bundesanstalt (PTB) - Germany. The technical program also included three Special Sessions (SS) featuring the topics of Characterization of the Electrical Properties of Nanocircuits, Metrology for Smartgrids, and The New Kg - Progress on Watt Balances and Silicon Spheres.

The technical program committee comprised 72 experts from 17 countries. The committee had selected 396 summary papers to be presented in oral and poster sessions on quantum metrology, fundamental constants, redefinition of SI, electrical metrology (specifically on voltage, resistance, impedance, power and energy, high voltage and current, radio frequency, magnetics, energy sources, and data analysis), optical metrology, time and frequency, and thermometry. The summary papers have been published at the CPEM 2014 digest (both book and CD). They are now available at IEEE Explorer database and may be consulted at http://ieeexplore.ieee.org/Xplore/home.jsp. Extended papers have been submitted during the conference to be considered for publication in the Special Issue of the IEEE Transactions on Instrumentation and Measurement dedicated to CPEM 2014 to be available in 2015.

Several satellite meetings occurred before, during and after the conference: International Avogadro Constant Meeting, Consultative Committee on Electricity and Magnetism (CCEM WG) working group meeting on Monitoring the Kilogram, CCEM WG meeting on Radio Frequency (GT-RF), CCEM WG meeting on Regional Metrology Organizations (WGRMO), CCEM WG meeting on Low Frequency Quantities (WG-LF), Power and Energy Experts Meeting, EURAMET SCLF, ADC DC Difference and Impedance Experts Meeting, Meeting of the participants EURAMET comparison EM-S31, Project meeting of JRP SIB07 “Qu-Ampere,” Project Meeting of JRP SIB59 “Q-WAVE,” EURAMET EM, DC & Quantum Metrology Experts Meeting, Project meeting of JRP SIB51 “GraphOhm,” CPEM Executive Committee Meeting, CODATA Task Group Meeting on Fundamental Constants, and the SIM Electricity and Magnetism Metrology Working Group (SIM MWG-1) meeting. There was also a training workshop on the “Calibration of Power Quality Reference Standards” with instructors from Centro Nacional de Metrología of Mexico (CENAM) and Fluke Calibration.

This year two awards of the IUPAP Commission on Symbols, Units, Nomenclature, Atomic Masses and Fundamental Constants (C2-SUNAMCO) Young Scientist (Early Career) Prize in Fundamental Metrology were made. The prize-winners were: Samuel Lara-Avila from Chalmers University of Technology, for his contribution to the understanding of quantum electrical transport in epitaxial graphene, leading to the development of a novel quantum resistance standard, and Stefan Ulmer from the Institute of Physical and Chemical Research (RIKEN) / European Organization for Nuclear Research (CERN), for his measurement of the magnetic moment of the proton and the antiproton.

A tour of the INMETRO Laboratories in Xerêm, Duque de Caxias, Brazil, was provided on the afternoon of the last conference day. INMETRO laboratories are located about 50 km from Rio de Janeiro. A welcome reception (on Sunday, Aug 24) and a conference dinner (on Thursday, Aug 28) were served to the attendees at the conference venue.

The next CPEM will be held in Ottawa, Canada from 10 to 15 July 2016 hosted by the National Research Council of Canada (see www.cpeem2016.com). We look forward to seeing you in 2016.

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This biennial conference is the premier international forum for the exchange of information on precision electromagnetic measurements.

www.c pem2016.com

Hosted by the National Research Council Canada
In an effort to better serve the measurement science community and involve more members of the testing community, NCSL International (NCSLI) reached out to ASTM International (ASTM) to put together a joint workshop. ASTM Committee D04 on Paving and Road Materials agreed to host the workshop at their biannual meeting with the focus on some measurement science topics that are important to their committee. The workshop focused on terminology in measurement science and its application within the ASTM standards, measurement uncertainty concepts, interactions between calibration and testing laboratories, as well as some technical topics related to temperature measurement.

For those of you not familiar with ASTM International, they are a globally recognized leader in the development and delivery of international voluntary consensus standards. Today, some 12,000 ASTM standards are used around the world to improve product quality, enhance safety, facilitate market access and trade, and build consumer confidence. ASTM members deliver the test methods, specifications, guides and practices that support industries and governments worldwide.

The committee that hosted the joint workshop, ASTM Committee D04 on Road and Paving Materials, was formed in 1903. The Committee, with a membership of approximately 580, currently has 27 technical subcommittees that have jurisdiction of over 200 standards, published in the Annual Book of ASTM Standards, Volume 04.03. These standards

**Summary:**
ASTM International Committee D04 and NCSL International (NCSLI) have teamed up to bring the ASTM D04 Testing Community a unique workshop that will focus on measurement science and thermometry.

One of the goals of the workshop was to foster greater communication and perspective between calibration laboratories, the testing community, and developers of testing standards.
have and continue to play a preeminent role in all aspects of construction and maintenance of highways, and other transportation construction. You can find out more information about ASTM at www.astm.org.

The workshop was held on Tuesday, December 9, in New Orleans, Louisiana and included presentations and a panel discussion that involved both members of NCSLI and ASTM. It was very interesting to listen to the different perspectives that were being brought to the discussions from the members of the two organizations. It appeared that all in attendance agreed that there is room to improve the interactions between the metrology community and the testing community.

The panel discussion regarding the use of terms such as “calibration,” “verification,” “standardization,” and “check” really brought up some interesting discussion and highlighted some areas of potential improvement in how the two communities interact. The four terms are often used incorrectly and interchangeably and it has been a challenge to come to consensus as to the definitions and applications of these terms especially in this area of measurement. What really came across is that there is a lot of confusion caused by the use or misuse of terminology and that there is more work to be done in this area.

Another area of focus for the workshop was temperature measurement, largely due to the replacement of mercury liquid in glass thermometers with electrical temperature measuring devices. Concerns around the negative environmental impacts of mercury has led many states to ban the use of mercury liquid in glass thermometers and this has required ASTM to revisit many of their test standards and update them with electrical equivalents.

However, there is no perfect electrical temperature measurement device that can be universally applied as a replacement in all applications so there has been much effort put into revisiting the test standards and identifying equivalent devices to meet the test standard. It was also stressed that it is critical to correctly define in the test standards what constitutes an acceptable electrical equivalent, that is, what are the specifications of the device, accuracy, resolution, etc. This is critical as the users of the test standards may not be very knowledgeable in the area of temperature measurement and there are so many options of electrical temperature measuring devices that it can be overwhelming to try and find an equivalent device to replace the mercury liquid in glass that has been used for years.

In summary, the joint workshop with ASTM was a great success and is hopefully the start of a mutually beneficial relationship between the two organizations. Also, it demonstrates NCSLI’s initiative to further engage the testing community and achieve our mission of investing in the advancement of measurement science. NCSLI members, made up of mostly the metrology community, have a vast amount of knowledge to share in regards to good measurement practice but the testing community is making the majority of measurements in practice and has the knowledge as to how the measurements are made in industry. Sharing knowledge and experiences will allow us all to improve.

NCSLI would like to thank ASTM for hosting the workshop and we look forward to working together again in the future. Special thanks to NCSLI members, Tim Osborne, Dilip Shah, and Rob Knake who were all part of the workshop. Also, a very special thanks to ASTM staff member Dan Smith and ASTM members Maria Knake, Roger Pyle, Jack Cowsert, John Yzenas, Mary Stroup-Gardiner, Robert Kluttz, and Robert Lutz for organizing and participating in the workshop.

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Dilip Shah
Jack Cowsert, John Yzenas, Roger Pyle, and Tim Osborne
The NCSL International Canadian meeting was held on October 1st and 2nd in Montreal, Quebec and was another resounding success. For the second time in the past six years, Hydro-Quebec hosted the event, providing us with a first rate auditorium for the presentations and plenaries, a break out space for the exhibitors and a most convenient in-house cafeteria.

This annual region meeting is the flagship event for NCSLI in Canada and in many ways is a mini version of the NCSLI annual conference. The majority of attendees do not attend the conference so participation at the Canadian meeting is their only opportunity to meet their metrology peers, other Canadians in the business and in fact just others with similar interests and passions. Canada is, geographically a large country. It’s a long way from one coast to the other and there are few opportunities for measurement science folks to get together. The region meeting is the meeting reinforces, each year, the value to Canadians of belonging to and taking part in NCSL International.
only such event available to most and pulls participants from all corners (and the middle) of the country. The meeting reinforces, each year, the value to Canadians of belonging to and taking part in NCSL International.

This year we had 80 attendees, 13 exhibitors, 11 papers presented, two plenary sessions and of course a banquet the evening of the 1st. Papers covered pressure, precision electrical, ISO standardization, traceability to the SI within the Canadian Calibration Network, a presentation from Canada’s specialist testing laboratory accrediting body and two papers on reference materials. The first plenary session was a follow up from similar sessions at the Orlando Workshop & Symposium – talking about matters pertaining to the upcoming revision process for ISO/IEC 17025. The second session discussed issues around limited calibration – what it is, when and how it is used and so on.

Presentations were given by Fluke Calibration, Martel, NRC, Measurements International, and CALA. In what has to be a different gender balance from any NCSL International meeting I’ve attended 45% of the paper presentations were from the distaff side. A (Canadian) first?! The limited calibration panel session was organized and chaired by Pylon.

This year too, courtesy of Fluke Calibration and Jeff Gust, their Chief Metrologist, we held a special, well attended half day tutorial in Measurement Uncertainty.

Special thanks to I.R.E.Q. (Hydro-Quebec), Sylvain Bérubé, André Langlois, both of I.R.E.Q., Carlo Rea of Technel Engineering, Ingrid Ulrich of Ulrich Metrology, Pat Stuart and Jeff Gust of Fluke Calibration for their generosity and time in organizing and enabling the 2014 Canadian Region meeting.

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Hendrick Motorsports in Concord, North Carolina hosted the September 11, NCSLI Carolina region meeting. Robert Ray, region coordinator opened the meeting and thanked the meeting sponsors including: Hendrick Motorsports, A2LA, Southern Marketing Associates and Fluke Calibration.

Mark Lapinskes, from Tektronix and the NCSLI Southeastern VP discussed the 2015 NCSLI Technical Exchange in Raleigh, North Carolina and the NCSLI board highlights.

Tim Weather, Southern Marketing Associates (a manufacturer’s representative organization providing solutions for world class manufacturers in nearly every aspect of test and measurement, presented on new products from Fluke Calibration).

Chris Gunning, from A2LA gave an in-depth full day “Root Cause Analysis” training class with tips and tools that can be used to identify the true root cause for identified problems and non-conformities. Many standards such as ISO/IEC 17025 and ISO 9001 require that your quality management systems have a procedure for investigating and eliminating the root cause of a non-conformance during the corrective action process. At the end of the presentation we were able to identify potential root causes and use the tips and tools discussed. With a good root cause analysis you should be able to implement an appropriate corrective action to avoid recurrence of non-conformities.

During lunch most attendees toured the campus visiting the Hendrick Racing Museum and Team Store. At the end of the day Jon Plyler from Hendrick Motorsports provided an in-depth guided tour of the entire campus including the race shops of Jeff Gordon, Jimmy Johnson and Dale Earnhardt Jr.

About Hendrick Motorsports:
Founded by Rick Hendrick in 1984, Hendrick Motorsports has earned more than 200 race victories and a record 11 car owner championships in NASCAR’s premier division, the Sprint Cup Series. Celebrating its 30th anniversary in 2014, the organization fields four full-time Chevrolet teams on the Sprint Cup circuit with drivers Kasey Kahne, Jeff Gordon, Jimmie Johnson and Dale Earnhardt Jr. Headquartered in Concord, North Carolina, Hendrick Motorsports employs more than 500 people. For more information, visit HendrickMotorsports.com or interact on Twitter, Facebook, Instagram and Pinterest.

More:
In 1984, Rick Hendrick founded All-Star Racing. That year, the fledgling outfit fielded a single NASCAR Winston Cup Series (now Sprint Cup) team with five full-time employees and 5,000 square feet of leased workspace. With Geoff Bodine driving an entire 30-race campaign in the No. 5 Chevrolets, All-Star Racing finished ninth in championship points after earning three victories and three pole positions in its inaugural season.

Known as Hendrick Motorsports since 1985, the organization today is headquartered in Concord, North Carolina, with 430,000 square feet of workspace on 140 acres that span Cabarrus and Mecklenburg counties. Hendrick’s original race shop overlooks a state-of-the-art facility housing more than 500 employees and featuring complete engine- and chassis-building areas to support four full-time Chevrolet teams in NASCAR’s elite Sprint Cup Series.

Now one of the sport’s premier operations, Hendrick Motorsports has garnered a NASCAR record 14 national series owner’s championships and 15 overall: 11 in the Sprint Cup Series, three in the Camping World Truck Series and one in the Nationwide Series (driver’s title only). Its roster of stock-car drivers includes Kasey Kahne, Jeff Gordon, Jimmie Johnson and Dale Earnhardt Jr.

In May 2012, Hendrick became just the second owner to reach the 200-win milestone in the Sprint Cup Series. He currently is second on NASCAR’s all-time Cup victories list (1949-present) and leads all owners in modern-era wins (1972-present). His teams have won at least one Cup-level race each season since 1986 – the longest active streak – and averaged more than 10 points-paying wins annually over the last decade (2004-13).
The Central Indiana Section 1133 fall meeting was held on November 13, 2014 at Purdue University regional campus in Columbus Indiana. The facility we met in is called the Advanced Manufacturing Center of Excellence (AMCE) and is connected to the Purdue campus. A total of 34 participants were in attendance. The weather outside was very cold with an early taste of winter including snow flurries.

The meeting started with a welcome from our host Joe Fuehne with Indiana University - Purdue University Columbus (IUPUC) School of Engineering Technology. Joe gave an overview of the AMCE, Purdue University and its relationship with Indiana University - Purdue University Columbus (IUPUC). He also introduced the AMCE metrology laboratory and display case of historical measurement artifacts.

The first speaker was Joe Fuehne PhD, Director and Maha Associate Professor, Mechanical Engineering Technology, Purdue College of Technology, Advanced Manufacturing Center of Excellence (AMCE). His topic was “Introduction to Geometric Dimensioning and Tolerances (GD&T).” His presentation was based on ASME Y14.55-2009 and included “Why do we need GD&T? And What Types of GD&T are There?”

GD&T is a symbolic language used on engineering drawing and CAD drawings. GD&T is used to reduce manufacturing costs, protect functional relationship on a part, ensure part can be assembled, reduce drawing revisions, verify with functional gage, improve repeatability, outsource part, and analyze designs. GD&T overcomes many problems of Coordinate Tolerancing such as the need for more notes and language dependencies.

Joe discussed the major components of GD&T including symbols and provided real world examples. GD&T is a global language that is being adopted by more and more large companies. Obviously dimensional calibration laboratories need to understand this language and be prepared to apply it accordingly.

Special thanks to Tangent Labs of Indianapolis for providing lunch for the group.

Our second speaker was Anthony Hamilton, Senior Engineer, Eli Lilly and Company. His topic was “Uncertainty Analysis Tips for Instrumentation Calibration.” Tony presented several tips about uncertainty that he has learned while performing uncertainty analysis for pressure and flow calibration systems.

Tony discussed experimental standard deviation of the mean to include requirements, math, uses (measurement system stability and instrument output sensitivity) and alternatives (repeatability/reproducibility R&R, ANOVA and resolution).

ILAC P14 (International Laboratory Accredited Cooperative) requires accredited labs to be able to show measurement uncertainty of the unit under test (UUT).

For the best analysis follow the GUM (Guide to the Expression of Uncertainty in Measurement).

Do not put in aspect of uncertainty as normal if you have not analyzed it personally. GUM requires that data be analyzed (or from an accredited lab which requires that data be analyzed) to be used as normal in measurement uncertainty.
Tony covered standard uncertainty of the resolution, normal vs. rectangular distributions, measurement uncertainty of the reference and TUR (test uncertainty ratio). Tony concluded his discussion with audience participation. One fact brought out was an area of top nonconformance, ISO/IEC 17025 sections 5.4.6.3 and 5.4.6.1, written procedures are required.

The third speaker was Ryan Fischer, Calibration Program Manager, Laboratory Accreditation Bureau (LAB). His topic was “How to Apply ILAC P14 to Laboratory Measurements.”

Ryan told us accreditation bodies seem to have different interpretations of ILAC P14. It is important to note that customer requirements allow labs to deviate with process as long as communication is (at minimum) documented via contract review. How to make inconsistencies consistent with accreditation assessments?

The least favorite and perhaps the least understood requirement of ISO/IEC 17025 is found in section 5.10.4.2 where it states, “When statements of compliance are made, the uncertainty of measurement shall be taken into account.” Least favorite because: Labs do not understand uncertainty very well, Laboratories lack tools to automate this activity, and Laboratories’ customers do not understand uncertainty.

Accrediting bodies are trying to come together to provide a unified front. Understanding ILAC P14 and ISO/IEC 17025, discerning differences between a test uncertainties, CMC scope uncertainties, and measurement uncertainties, and the ability to determine customer needs and apply an agreeable method for taking uncertainty into account. Ryan concluded his presentation with real life examples and practical solutions.

Our final session was a discussion panel with a topic of “Real Life Examples of GD&T.” Many questions were asked and the discussion was lively.

The NCSLI Central Indiana Section steering committee members are John Bush, Eli Lilly and Company, Elizabeth Robinette, Eli Lilly and Company, Kevin Pata of Roche Diagnostics and Kevin Broderick of Tangent Labs.
Blue skies and a sparkling Lake Guntersville served as the backdrop for the Huntsville Section Fall meeting held at the Lake Guntersville State Park Lodge Goldenrod Room on November 20, 2014.

After a continental breakfast and welcome by section coordinator Bev Garcia we started the meeting presentations with: “Rugged DC Josephson Voltage System,” by John Ball, ARMY; “The North American 1 Ohm Inter-Laboratory Comparison,” by Kai Wendler, NRC Measurement Science and Standards; “Fluke Calibration Software Overview and Update,” by Patrick Butler, Fluke Calibration; “Leveraging Automation to Assure the Quality of Calibration Results and why it matters,” by Bob Stern, Keysight Technologies.

In addition Bob Stern lead an open discussion titled: “If you were King, which paragraphs of ISO/IEC 17025, would you revise?” Which paragraphs in ISO/IEC 17025 should be prioritized for revision, now that the international community has voted to revise ISO/IEC 17025:2005?

The meeting was sponsored by Additel Corporation, Chris Christofferson; ITE Labs, Inc., John Hunter; Keysight Technologies, Nancy Richardson; JM Test Systems, Inc., Beverly Garcia; Pinnacle Test Solutions, Clint Plant; Southern Marketing Associates, Randy Fowler; and Tegam, Kevin Kaufman.

I would like to thank Norman Casto, USATA (ARMY) our meeting photographer for doing a wonderful job!

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The 23rd Annual NCSLI-Japan Technical Forum was held at the Tokyo Metropolitan Ohta-ku Industrial Plaza on November 5, 2014 under auspices of the Japan Measurement Standards Forum and NMIJ. There were 174 participants, and 15 organizations who exhibited their products and services.

The forum began at 10 a.m. with opening message by Kazumi Hayakawa, Chairman of NCSLI Japan addressing the necessity of calibration on new measuring devices that may be attached to iPhone/iPad-like communication devices and web browsing tools, the educational needs of metrology and calibration including the basics for new comers to the industry, and a general overview of the NCSL International 2014 Workshop & Symposium held in Orlando, Florida.


Thank you Exhibitors!
- Additel Corporation
- Alpha Electronics Corporation
- Fluke Japan
- Japan Electric Meters Inspection Corporation (JEMIC)
- Japan Electronics and Information Technology Industries Association
- Japan Quality Assurance Organization (JQA)
- Key Techno Co., Ltd
- Keysight Technologies International
- Ohte Giken, Inc.
- SANKYO INTERNATIONAL CORPORATION
- Shinyei Technology Co., Ltd.
- Spectris Co., Ltd.
- SunJEM Co., Ltd.
- Yamari Industries, Ltd.
- Yokogawa Meters & Instruments Corporation

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The Los Angeles/Orange County Section meeting was held on December 10, 2014 at NSWC Corona in Norco, California. A total of 66 participants were in attendance. The meeting was held at the Narconian Club on the Navy base which allowed for good participation from the US Navy and also local NCSLI members.

The theme of the meeting was “Measurement Uncertainty” presented by Tom Wiandt, Jack Somppi and Dilip Shah with a special lunch discussion on the revision of ISO/IEC 17025 conducted by Bob Stern, Keysight Technologies.

After a brief welcome by Jon Sanders, the NCSLI Los Angeles/Orange County Section Coordinator, Jack Somppi, the NCSLI Western US Division VP, provided an overview and introduction to NCSLI. Jack’s presentation covered an update on board meetings, the 2014 NCSLI Workshop & Symposium and divisional highlights. Of particular interest were the upcoming events, namely the NCSLI Technical Exchange offering measurement training on February 11-12, 2015 in Raleigh, North Carolina and the 2015 NCSLI Workshop & Symposium from July 19-23, 2015 in Grapevine, Texas.

Tom Wiandt started the technical portion of the meeting covering general uncertainty evaluation. Tom is the president of TrueCal Metrology and has over 30 years of metrology experience with 18 years in metrology management. Tom is active in the ASTM, NCSLI, MSC, APS, A2LA and ASQ and has published in both national and international journals, metrology conferences and general articles. Tom’s presentation covered practices and publications prior to the Guide to the Expression of Uncertainty in Measurement (GUM) in 1993. Although not without controversy, publication of the GUM standardized uncertainty evaluation and became the...
main impetus for working laboratories to begin to evaluate uncertainties for the first time. Tom’s presentation reviewed the difficulties experienced prior to the acceptance of the GUM and the implementation of uncertainty budgeting following GUM principles. Tom explained the general history of the GUM and much of the controversy surrounding the GUM’s implementation and general acceptance. Tom also discussed the markets need for the GUM, specifically in terms of standardization in uncertainty evaluation techniques.

As a continuation of our theme, Tom Wiandt provided a review of a temperature uncertainty budget illustrating how various issues are addressed in constructing a robust uncertainty budget. Tom explained how thermometer calibration combines thermodynamics, DC/low frequency measurement and mathematical artifacts that each affect the uncertainty in unique ways. This was demonstrated by constructing a temperature uncertainty budget and discussing each uncertainty associated with the budget.

Jack Somppi, finished the morning session with a presentation on the uncertainty of electrical measurements. Jack Somppi manages the electrical dc and low frequency ac metrology instrument product line within the Fluke Corporation’s Calibration Business Unit. Jack is also the NCSLI Western US Division VP and active in the NCSLI 120 Marketing Committee. Jack’s presentation introduced the study of measurement uncertainty and its application to digital multimeter calibration. He discussed measurement uncertainty from the perspective of the GUM and provided general and detailed examples.

During lunch Bob Stern presented on and led a discussion on the need for specific sections that need revision in the ISO/IEC 17025. This is of particular relevance as ISO CASCO has voted to revise ISO/IEC 17025 and the NCSLI Board of Directors will be active in providing suggestions to the CASCO working group. Bob started the discussion with some of the changes he sees necessary and then opened it up to the group to get additional feedback.
Since 2003 Bob has been active on NCSLI committees concerning calibration standards, including the subgroup that wrote the ZS40.3 Handbook. He is chair of the NCSLI 174 Standards Writing Group and is currently employed by Keysight Technologies.

The afternoon presentation was given by Dilip Shah on the topic of Proficiency Testing. Dilip has over 35 years of industry experience in metrology, electronics, instrumentation, measurement and computer applications of statistics in the Quality Assurance areas. He is currently a Principal of E = mc3 Solutions and is certified by American Society for Quality (ASQ) as a Certified Quality Auditor, Certified Quality Engineer and Certified Calibration Technician.

In his presentation on proficiency testing, Dilip discusses how to properly conduct a proficiency test. Dilip states that most laboratories that participate in a proficiency test do not understand how to report the results asked of them. They make the correct measurements but fail in the measurement uncertainty estimation process by incorrectly reporting the uncertainty. Dilip explained estimating the uncertainty of a proficiency test artifact and how to report and analyze the results correctly.

To wrap up the meeting door prizes were provided complements of NCSLI, Additel Corporation and Fluke Calibration. Exhibitors included Additel Corporation, American Technical Services, Fluke Calibration, Guildline Instruments, King Nutronics, Mensor Corporation, Michell Instruments, Sartorius, Wilmington Instruments, and WorkPlace Training. The Los Angeles/Orange County section would like to thank all the exhibitors for supporting this event. Also the many of those involved with making ready the facilities at NSWC Corona were a tremendous support. Of special thanks the section would like to recognize Gloria Neely, NCSLI groups 143, 163, and 164-1, who is currently retired from the US Navy but put many hours into arranging the venue and organizing logistics and security clearance for the many non-base attendees.

We are very excited for our next section meeting which is scheduled for May 12, 2015 in Fullerton, California at the new Transcat laboratory.

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The NCSLI Michigan Section met at the Robert Bosch LLC facility in Farmington Hills, Michigan on Wednesday, November 5, 2014.

Sam Davis, NCSLI Section Coordinator started the meeting off with breakfast and networking. Lloyd Baker, NCSLI Mid-Western Region Coordinator gave updates on the NCSLI Board of Directors and the benefits of being a member of NCSLI.

First up was Jerry Bambach, with JRB Consulting. Jerry discussed “Internal Audit Requirements of ISO/IEC 17025 for Testing & Calibration.”

Next up Drew Bulbuk, Hexagon Metrology with his presentation on “The Theory of Metrology” using CMM, CMM probes and articulating arms measurement devices. Drew brought the Romer Absolute Arm with integrated laser scanner system. This metrology tool is portable and used for creating 3D digitizing images using the scanner. The images can be used for reverse engineering, rapid prototyping or copy milling.

Henry Alexander, Perry Johnson Laboratory Accreditation (PJLA) gave his presentation on dissecting statements of compliance with specification on certificates which made for an interesting topic on how statement are written on certificates in regards to the measurement we are making and if they truly have an uncertainty coverage probability that corresponds to approximately k=2 @95%.

We would also like to thank Patrick Butler, Fluke Calibration who gave a Met/Team Software presentation.

The turnout for the Michigan section was good and at the end we had a round table discussion on a potential host for the 2015 spring meeting and topics members would like to see at the next meeting.

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The NCSLI Northern Ohio/Western Pennsylvania section held its fall meeting on November 18th, 2014. The meeting was hosted by the NASA Glenn Research Center, Cleveland Ohio. A total of 20 participants were in attendance. NASA provided great accommodations in the new “Mission Integration Center.”

A special thanks to the NASA team and our contacts Betsy DeLaCruz and Perry LaRosa. Perry LaRosa, the metrology technical representative, welcomed all attendees, and included a presentation on NASA Glenn’s history and mission. The Glenn metrology department supports a number of NASA missions, including Glenn’s core competencies, which include: air-breathing propulsion, communications technology and development, in-space propulsion and cryogenic fluids management, power, energy storage and conversion, materials and structures for extreme environments, and physical sciences and biomedical technologies in space. Facilities include wind tunnels, drop towers, vacuum chambers and an aircraft hangar (aeronautics, microgravity, solar cell, and icing research).

The first presentation, “Practical Considerations for Vibration Calibration” was presented by Patrick J. Timmons, a calibration systems engineer at The Modal Shop, a PCB Group Company.

Patrick gave an extensive overview of accelerometers including; structure, operation, and their failure modes. He also covered gravimetric and comparison calibration methods with emphasis on the mounting of accelerometers in comparison calibration frequency response testing accompanied by a live demo with a portable accelerometer calibration system. As part of the demo, Patrick induced typical failures modes (e.g. mounting cleanliness,
lack of coupling grease, insufficient torque, etc.) and resulting graphic plots were analyzed. He also touched on transverse sensitivity determination methods and the effect of transverse motion on accelerometer frequency response.

Mihaela Fulop, of SGT, Inc., presented “The Problem with Classical Repeatability” which covered the economical estimation uncertainty for repeatability, as performed for a project for NASA. Mihaela first reviewed the various repeatability definitions, techniques and calculations for repeatability. She then explained the economics part of the equation for repeatability for a system with over 2000 pressure sensors that included various calibration methods (e.g. deadweights and automation systems). Using automated systems, pressure devices were evaluated and repeatability methods were chosen. Further studies identified the estimated repeatability for the pressure devices that the customer would be able to use for measurement uncertainty analysis.

Upon return from lunch, we broke into groups and toured Glenn’s calibration labs. Glenn performs a vast array of physical and electrical calibrations.

Patrick Timmons was first up after lunch and presented on “Dynamic Pressure Calibration Methods” i.e., acoustic microphones to high pressure blast sensors. Patrick covered the differences of static and dynamic measurement types, with relation to response characteristics. He also covered microphone and pressure sensor construction and principles of operation. Calibration methodology of microphones using a dynamic piston phone pressure sensitivity calibration and electrostatic actuated diaphragm frequency response was described. The art of calibration of dynamic pressure sensors was explained for several different actuator types including review of calibration system construction. He also reviewed the state of calibration standards and the challenges in dynamic pressure calibration.

Andy Brush, CEO of Tegam, Inc., presented “Automating the Calibration of Microwave Power Sensors using MET/CAL” which reviewed an issue of repeatability, including for waveguides used for mounting during calibration. His presentation not only included a review of uncertainty calibration, but proposed an automated method to included waveguide mounting uncertainty, including a format which would allow customers to adjust constants for a more applicable uncertainty.

Lloyd Baker, of GM and our NCSLI Regional Coordinator, held an open discussion covering NCSLI updates, vision and mission, recruited volunteers.

Attendees were surveyed on topics of interest for future meetings. Most notable comments: interest in basics and desire for occasional evening meetings.

Several door-prizes were provided by Technical Maintenance Inc. and NCSL International. Planning is underway for our next meeting in April 2015.

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The NCSLI Southern Ohio/Kentucky Section held a fall meeting on 20 October 2014. The Bionetics Corporation, Newark Metrology Operations, sponsored breakfast for the meeting. The meeting took place at the Dayton Regional STEM School in Kettering Ohio. Mr. Dave Nebel, DEN Technical Services and Ms. Christine Yeary, Program Manager, Dayton Regional STEM School coordinated the meeting location. Door-prizes were provided by meeting attendee, Ms. Jill Hammond, Technical Maintenance Inc. and the NCSLI Business Office.

Following breakfast, Mr. Matthew Denslow, Bionetics Training Manager and Section Coordinator, welcomed all attendees and reviewed the day’s agenda. Matthew encouraged the group to provide feedback and suggest ideas for future meeting topics. The group discussed ways to better market the meetings in order to improve attendance.

Mr. Lloyd Baker, 1130 NCSLI Mid-Western Regional Coordinator, General Motors, presented the May NCSLI Board of Directors’ meeting activities.

Mr. Patrick Butler, Regional Product Manager for Fluke Calibration provided the group an overview of Fluke’s current calibration software. The presentation included a brief history of Fluke’s calibration software. Mr. Butler explained how customer needs have driven the integration of calibration and documentation software with asset management systems. Additional functionality has been incorporated in the software systems through the use of a cloud-based information management system. All attendees left with a better understanding of the improvements in automated calibrations.

Mr. Patrick Timmons, Calibration Systems Engineer, The Modal Shop Inc. continued the meeting with a presentation titled “Dynamic Pressure – Sensor Basics and Calibration Theory.” Patrick explained the basics of dynamic pressure sensor theory and construction as well as calibration methods. Several challenges to the calibration of these sensors include the lack of an industry standard and accurately capturing the rapid pressure change. Patrick also explained several industry applications for these sensors.
Lunch with the Experts – Dave Nebel, Lloyd Baker and Matthew Denslow met with over 20 students during the lunch period. The outreach activity explained the importance of calibration to the student’s everyday lives. The group discussed the many job titles found within the metrology career field and the all-important pay scale (as published by NCSL International in the 2010 Metrology Human Resources Handbook).

Following lunch, meeting attendees were given a tour of the facility by four members of the school’s senior class. The tour guides described the school’s history, classroom activities, and span of classes (6th through 12th grades). The schools STEM focused curriculum is taught in a non-traditional, collaborative format that the guides stated they enjoyed.

Mr. Lloyd Baker, discussed the implementation of a Structured On-the-Job Training (SOJT) program. Lloyd based this presentation on the 2007 NCSLI presentation “Developing Employee Expertise through Structured On-the-Job Training” given to this section by Dr. Ronald Jacobs from the Center of Education and Training for Employment, College of Education and Human Ecology, The Ohio State University. Lloyd had established a program and developed an SOJT model template. The SOJT template involves a Microsoft Excel workbook with nine separate tabs. The tabs include several useful items, for example: an overview, training guide (used by the trainer), trainee checklist, OJT Scorecard (record trainee performance) and a record of revision. Attendees participated in the development of a training guide with Lloyd leading the group in the creation of a simple guide describing the use of a camera.

Readers: As demonstrated with only four attendees to this meeting, Our section meetings have experienced declining attendance. How can we reverse this trend? Your assistance is needed; what topics do you want to attend; more or less subject; what location will help improve participation? Please send me your thoughts, suggestions and ideas.

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The N.C.S.L.I.
Rio Grande Valley
Section met in McAllen,
Texas at South Texas College. The Technology campus had the honor of hosting this event and the day’s agenda was filled with a great schedule and distinguished presenters. We are grateful for our meeting sponsors; National Instruments Corporation, Dyna Cal, American Association for Laboratory Accreditation, and CL Scales. Breakfast, lunch and refreshments were great, a big thank you to our sponsors!

Our meeting started with a welcome from Esmeralda Adame, Assistant Professor at South Texas College and NCSLI Rio Grande Valley Section Coordinator followed by Mario Reyna, Dean of Business and Technology at South Texas College.

Both greeted the attendees and thanked everyone for their appearance and mentioned that our College's doors were always open for future events. Dr. Hy Tran, NCSLI Central Division VP gave an NCSLI update and mentioned future events for the organization. Dr. Tran serves as the Project Lead Engineer at Sandia National Laboratories.

Our first presentation provided by Scott Mimbs, U.S. Marine veteran and NASA retiree was on “Metrology and the Consequences of Bad Measurement Decisions.” His presentation contained great information and interesting points. Our next speaker was Logan Kunitz, from National Instruments. Logan presented on “Avoiding Measurement Errors from Manipulating Data in Software.” This was also a very interesting presentation.

Dr. Hy Tran was the third guest presenter who brought forth, a tutorial on “Estimating Measurement Uncertainty.” Participants had the opportunity to do some hands on measurements which everyone enjoyed.

A group photo was taken followed by a lunch break. During the breaks attendees enjoyed ample time with the exhibitors and the opportunity to network. Exhibits included; Perry Johnson Laboratory Accreditation, Inc. (PJLA); The University of Texas Pan American; CL Scales and E.M.A. Instruments, Inc.

Scott Mimbs shared our fourth topic, “Influence Variables for Conformance-Test Calibrations.” A good discussion soon followed at the conclusion of his presentation.
The meeting brought together presenters, manufacturing company managers, students and professionals from the local area and Mexico.

The meeting brought together an estimate of about 100 individuals ranging from presenters, manufacturing company managers and professionals from the local area and Mexico as well as students. The audience was engaged, very interested and asked questions after each of the four relevant presentations. The floor was then opened for questions and comments from the crowd.

At the end of our event we handed out door prizes donated by NCSLI, CL Scales, and South Texas College and our attendees enjoyed some ice cream and a chance to network once again. Sponsors and presenters were given thank you certificates along with a small token of appreciation and both Esmeralda Adame and Daniel Morales thanked everyone for their attendance and gave closing remarks.

A tour of the Precision Manufacturing Technology, PMT Department at the College followed given by Mr. Morales. He explained the PMT program and gave insight on our local manufacturing employers and the need for more skilled machinists and had CNC project demonstrations as well.

Everyone was excited, eager and enthusiastic about our region meeting and look forward to the next.

Thanks to everyone that made this event possible. Special thanks to our sponsors, exhibitors and last but not least… a big thank you to our speakers who brought forth such well informed presentations.

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On October 23, 2014 Ed Philips, Metrology Supervisor and Eva Pellow, Metrology Manager from Laboratory Testing Inc., graciously volunteered to host the NCSLI Philadelphia meeting at their facility. This is the first meeting for the Philadelphia section in a long time.

Laboratory Testing Inc., (LTI) is a long-time NCSLI member and an independent, accredited testing and metrology laboratory in business since 1984 near Philadelphia, Pennsylvania. LTI provides materials testing (mechanical testing, chemical analysis, and metallography), nondestructive testing, and dimensional inspection and calibration services.

The meeting focused on risk assessment, measurement uncertainty for pressure and an update on metrology from NIST.

Scott Mimbs, NASA Metrology Program Mgr. (Retired) was first up and presented on “Metrology and the Consequences of Bad Measurement Decisions.” Scott discussed how bad measurement data can lead to bad decisions and the consequences of these decisions can flow from one phase of product development to the next. The consequences of bad measurement-based decisions can range from monetary losses in the billions of dollars, such as the 1990 Hubble Space Telescope mirror, to the loss of life, such as the 2005 British Petroleum Texas City refinery disaster.

Greg Strouse, Physical Measurement Laboratory, Sensor Science Division, Leader, NIST. Greg is a world-class expert in contact thermometry. He has led the activities of the NIST Platinum Resistance Thermometer Laboratory since 1989. Using these facilities, he has extensively investigated and improved the performance of platinum resistance thermometers and the fixed-points used to calibrate them. Mr. Strouse has led the automation and refurbishment of both the NIST Platinum Resistance Thermometer Laboratory and the Industrial Thermometer Calibration Laboratory. He presented “Who needs calibrations anyway.” This talk explored examples of how NIST measurement services are evolving to meet the needs of the ever-changing manufacturing landscape to ensure that the impact of a calibration continues to go unnoticed.

Joshua Biggar, a metrologist for Fluke Calibration specializing in pressure instrumentation has been with Fluke Calibration/DH Instruments for 10 years after serving seven years in the U.S. Air Force as a PMEL Craftsman. Joshua presented “An Uncertainty Analysis of Fluke Calibration Fused-Quartz Bourdon Tube Pressure Products.”

The scheduled topics for the presentation appeared to resonate and drew over 30 attendees from around the country.

A big thank you to our sponsors! A2LA, Ametek Test & Calibration Instruments and Mensor Corporation.

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Accreditation in Europe
In today’s global market and trade there is an increased need for conformity assessment – calibration, testing, and inspection, certification ensuring that products and equipment meet specifications. Along with that goes the request for assurance of the competence of the conformity assessment bodies by accreditation. The term originates from ac/credit <Latin> to give trust to, to believe. In connection with a new legislative framework for the marketing of products, a legal framework for the provision of harmonized accreditation services across Europe was established in 2010. On occasion of its fifth anniversary, the development of harmonized accreditation in Europe is briefly reviewed.

Trade, Conformity Assessment, and Accreditation
The interrelations between trade, conformity assessment, and accreditation are illustrated in the following figure. The primary goal of conformity assessment is to provide the user, purchaser or regulator with the necessary confidence that a product, service, process, system or person meets relevant requirements. The international standards for conformity assessment services are provided by ISO’s Committee on Conformity Assessment (CASCO). Accreditation is a third-party attestation related to a conformity assessment body conveying formal demonstration of its competence to carry out specific conformity assessment tasks (ISO 17000).

The New Approach to harmonization and standardization in Europe
The establishment of a common European market depends upon an adequate level of technical harmonization. To this aim, EU legislation was revolutionized in 1985 with the so-called “New Approach to harmonization and standardization.” This “New Approach” is based on a few key principles:
• legislative harmonization (e.g. directives for product groups: toys, construction products, machinery etc.) ensures the free movement of products throughout the Community,
• corresponding technical specifications are described in harmonized standards,
• products manufactured in conformity with harmonized standards are presumed to be conformant to the essential requirements,
• CE marking allowing the manufacturer to declare that the product is in conformity with the legislative requirements and may be placed on the market,
• safety clauses require the Member States to take all appropriate measures to withdraw unsafe products from the market.

New measures for Accreditation
Modernizing the “New Approach,” in 2008 a new legislative framework for marketing of products was adopted, which applies from January 1, 2010. Regulation (EC) No 765/2008 (full text at www.europa.eu) sets out the requirements for accreditation and market surveillance relating to the marketing of products. The Regulation states:

A system of accreditation which functions by reference to binding rules helps to strengthen mutual confidence between Member States as regards the competence of conformity assessment bodies and consequently the certificates and test reports issued by them. It thereby enhances the principle of mutual recognition. The issue at stake is the quality of certificates and test reports irrespective of whether they fall within the regulated or the non-regulated area, and no distinction should therefore be made between those areas. Accreditation should in principle be operated as a self-supporting activity. Member States should ensure that financial support exists for the fulfilment of special tasks.

The harmonized European Accreditation System
With the New EU Internal Market Package for Goods, for the first time a legal framework for the provision of harmonized accreditation services across Europe has been established. It covers the operation of accreditation in support of both voluntary conformity assessment as well as conformity assessment required by legislation. Important aspects are:

• accreditation as public authority activity
• responsibility of the member state
• only one national accreditation body per country permitted
• conformity assessment body must use its national accreditation body
• cross frontier accreditation is generally not possible and restricted to exceptional cases
• the European co-operation for Accreditation (EA) to coordinate the European accreditation infrastructure.

In essence, the European Regulation requires National Accreditation Bodies:

to operate on a not for profit basis
to be objective and impartial
to employ competent personnel for the tasks to be carried out
to be independent from the conformity assessment bodies they accredit
not to offer services offered by conformity assessment bodies
not to compete with other accreditation bodies
to be member of EA (European Co-operation for accreditation) and participate in the peer evaluation organized by EA.
To facilitate consistency of accreditation across Europe, National Accreditation Bodies have been established in the EU Member States on the basis of the EU Regulation No 765/2008 on accreditation and market surveillance.

As an example of accreditation at the national level, the status, the activities and the work results of the German National Accreditation Body DAkkS (Deutsche Akkreditierungstelle, www.dakks.de) are briefly outlined in the following graphics.

The information about DAkkS by Norbert Barz (Managing Director) and Christian Schrade is gratefully acknowledged.

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