Strategies and Tips for Recruiting and Keeping Industry Members

Leonard J. Bond, Center Director & Professor
Center for Nondestructive Evaluation (CNDE)
Iowa State University
Our Center has one site: Iowa State University

Center’s vision and mission

CNDE develops the science & technology for advanced NDE.

CNDE provides materials characterization (material state awareness) using nondestructive tools to enable condition assessment and prediction of remaining safe or service life. NDE tools applied at all stages of an item’s life cycle.

Goals: perform world class research, maintain recognition as the leading Center for NDE R&D in the USA, provide thoughtful leadership in NDE and related topics, provide leadership in NDE education AND be an enduring entity that provides value to sponsors and clients.

Center established 1985 – 30th Anniversary 2015 (graduate 2016)
Historical Evolution

• DARPA/AFRL-Science base (Rockwell International) – 1970’s
• NSF I/UCRC-Generic, precompetitive research supported by industry – 1985
• Today:
  – R&D - core research /IU CRC Program
  – Federal programs-Maturation of technology in context of agency-specific needs
  – Industrial support (some proprietary & export controlled) - Application to specific corporate problems
  – IPRT – Company Assistance – NDT: Transfer of results to Iowa companies – State funded
  – NDT Resource Center (web resource)
  – Annual Review of Progress in QNDE with QNDE Programs (501c3)
Iowa State University - CNDE

- 13 professional researchers
- ~20 Affiliated faculty
- ~50 students + visitors
- More than $7.5M in equipment
- Modeling & simulation codes

Non-Invasive Measurement & Modeling Techniques
- Ultrasonics
- Radiography
- Electromagnetic Technique
- Magnetic Techniques
- Fluorescent Penetrants
- Thermal and Sonic IR
- Terahertz Radiation
- Ground Penetrating Radar
- Novel Sensors

Materials Science, degradation, fracture

Data Analysis Techniques
- Signal Processing
- Image Analysis
- Statistical Analysis
- Probability of Detection
Sponsor/Industrial Background and Competitive Landscape

Center history was focused on Aerospace – i.e., roots in the DARPA, USAF and then FAA and other Federal agencies (defense & civil aviation focus)

Now expanded into:

(i) Commercial Space

(ii) Energy/Manufacturing, (nuclear, oil/gas - pipelines, renewables)

- **Anything that is big, expensive and people don’t want it to break!**
- Aging infrastructure
- Large products – high risk/failure consequences

Profile: Larger companies/agencies

I/UCRC: Gateway To Other Programs

NSF I/UCRC (1985)
- Generic, precompetitive
- Technical foundations and early development of new techniques and simulation tools
- Established network with other companies

Government Support
- Public domain
- Often applied research with focus on transition
- Often includes partnership with companies as subcontractors to ISU

Industrial Proprietary
- Results unique to company needs
- Ability to support ITAR/EAR related projects
- Access to unique theoretical and experimental resources

Subcontractor Support
- ISU as subcontractor to company
- Ability to support ITAR/ERA requirements
- Access to unique theoretical and experimental resources
Center Value: Meeting Industry Needs

**R&D** - core research/IU CRC Program

**Federal programs** - Maturation of technology in context of agency-specific needs

**Industrial support** (some proprietary & export controlled) - Application to specific corporate problems

**IPRT – Company Assistance – NDT:** Transfer of results to Iowa companies – State funded

**NDT Resource Center (web resource)**

**Annual Review of Progress in QNDE (42nd meeting 2015)** with QNDE Programs (501c3)
Recruitment Ideas

Potential sponsors fall into two groups:
(i) Grow contacts/engagement – start from R&D contract or problem solved
   - Use NDT Resource Center Contacts
   - QNDE meeting participation
   - People who contact us to recruit students
   - People who want us to undertake projects
(ii) Industry sector e.g., Commercial Space   [NASA, Boeing, and SpaceX]

Potential sponsors invited to an IAB meeting as an observer.

Engage at QNDE [technical meeting ~ 400 participants].

Finding contacts
   - you have to know the companies & community.
   - use Center Alumni network (150+ people).
Recruitment/Retention Ideas

Recent example:

Company X recognized it had a need and had a technical problem

(i) They visited CNDE twice – brain stormed – found key inside people.

(ii) Conference calls, some white papers, came to IAB meeting.

(iii) Center Director attended VP level retreat (about 30 people) at one of their sites – provided a briefing (intended to be about 60 minutes – became 3 hours dialogue).

(iv) Eight potential projects identified. Business cases prioritized five. Four were undertaken as “feasibility studies.” Provided data and insights for company gate point meetings (December 2015).

(v) Next phase, probably three projects with Divisions in 2015.

ENGAGE, UNDERSTAND CLIENT NEEDS, IDENTIFY OPPORTUNITIES, PERFORM PROJECTS and DELIVER (on time and within budget)
Keeping Sponsors

Listen to sponsor needs (this includes site visits).

Spend time interacting with sponsors.

Be willing to adjust what we want to do to fit their needs.

DON’T simply tell them this is what we do! We know best!

Sponsors have access to:
(i) SIM computer codes
(ii) Preferential R&D overhead rates
(iii) Access to students
(iv) Networking
(v) Access to CNDE expertise (researchers and faculty)

Retention --- relationships, communication and visits.

Engage sponsors in proprietary projects (IU/CRC probably only 15% of what we do)
Closing Words of Wisdom

Know your “market”
Have needed technical expertise and capabilities
Be recognized as a (or the) leader in your field
Be the preferred provider in your field
Be open to evolving interests
Be flexible
Listen to your clients (and partners) and be willing to
VISIT sites and facilities
The #1 item is your relationship with your center sponsors and clients
CNDE : Center Major Participants

- Energy/manufacturing
  - KAPL
  - AREVA
  - John Deere
  - Toyota
  - Schlumberger
  - BP
  - United Technologies Research Center
  - PHMSA
  - APLUS
  - Kiefer & Associates, Inc.

- Aerospace
  - Pratt & Whitney
  - SpaceX
  - Rolls-Royce
  - Boeing
  - Honeywell
  - NASA
  - IHI
  - Alcoa
  - GE Energy
  - NSF
  - U.S. Army
  - FAA
  - RTD
Selection of appropriate conventional technique

Development of new inspection techniques

Implementation of techniques in factory and field

Quantification of technique performance

Transfer Mechanisms:
- Expert advice
- Technique development
- Applications studies
- Inspection tools
- Training materials

Students

Understanding inspection physics

New inspection concepts

Prototype instrumentation and software

Inspection simulators (including POD)

Educational programs
- Distance Ed
- Undergrad/grad
- Community College

Well-trained workforce at multiple levels

Industry Needs
CNDE Experimental Capabilities
Supporting Detection, Characterization, and Validation

CNDE is located in ~52,000 sq feet in Applied Sciences Complex

**Ultrasonics:**
- Six immersion scanning systems including turntables, billet rotator, dual axis bridge
- Air-coupled UT
- Phased array UT including three lab based systems, a medical UT system, and portable instrument
- Portable instrumentation for contact inspection

**Terahertz radiation:**
- Time-domain pulsed system from 50GHz up to 4THz at 5GHz resolution
- Frequency-domain continuous-wave system ranges from 50GHz to 1.5 THz at 100MHz resolution
- 4D gantry system for static spectroscopy and high-speed imaging in various geometric configurations

**Radiography:**
- Five x-ray inspection facilities including three microfocus tubes and two standard x-ray tubes, with voltages up to 320 kV
- Film and digital radiography
- Computed tomography with <5 micron resolution
- Energy-sensitive characterization including high-energy x-ray diffraction

**Magnetic Particle, Fluorescent Penetrant Inspection, and Supporting Instrumentation:**
- Three magnetic particle systems with coil diameters from 12” to 24”
- Penetrant inspection and quantitative assessment for characterization of indications
- Surface characterization tools including optical microscopy, laser profilometry, and x-ray fluorescence
- Two mechanical testing systems for mechanical property measurement and sample fabrication

**Eddy current and microwave inspection:**
- Motion-controlled scanning for careful laboratory studies using impedance analyzers and eddy current instruments, including swept frequency approaches up to 60 MHz
- Commercial instrumentation up to 15 MHz
- Anritsu 37347C vector network analyzer for microwave testing up to 20GHz

**Thermal Inspection:**
- Infrared camera, high resolution, high sensitivity, 640 x 512 array
- Flash lamps for traditional thermography
- Broadband, vibration source and laser vibrometers, and associated data acquisition and analysis for vibrothermography
**CNDE Modeling**

- **Goal:** Increase use and modeling capabilities

- **CNDE Codes**
  - UT Sim
  - X-Ray Sim
  - EC SIM
  - EC (Bowler)
  - Grain Scattering etc

- **Chalmers SUNDT**
  - Weld inspection

- **ZETEC - Ultravision 3-D**
  - 3-D Phased array + data review
  - FE - COMSOL
Center for Nondestructive Evaluation (CNDE)

CNDE develops the science and technology for advanced NDE.

Provides:
• Materials characterization
• Advanced diagnostics and prognostics
• Prediction of remaining safe or service life

All applied to a diverse range of structures, systems and components (SSC).
New NDE drivers

Prognostics – prediction of remaining/safe life

Design for testability


Shearon Harris nuclear plant crack in head – discovered May 2013

Need NDE in advanced manufacturing
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Research at CNDE

• **IU CRC Core Program**
  – 12 projects
  – 4 new 3 year projects ($60k per year)

• **Sponsor Projects** 35 current projects (majority industry sponsored)

• **Other funded research**
  – E.g. DOE NEUP
Engine Titanium Consortium

- To provide reliable and cost-effective tools for detecting cracks, inclusions, and imperfections in critical rotating materials and hardware
- ISU-led consortia with GE Aviation, Pratt & Whitney, Rolls Royce and Honeywell
- ISU provides fundamental understanding in support of engineering applications expertise at the OEMs
- Resulted in numerous changes to inspection practice throughout the life-cycle of jet engines
- Established CNDE as a trusted partner and respected coordinator of large, joint projects

- Led to a factor of five reduction in catastrophic engine events

Cu Nguyen, Technical Monitor
From NDE to Total Quality Management

• QA/QC on finished products is too late in process

• Need to reject defective parts as early as possible – to save energy to enable material reuse

• Need NDE to identify process parameters that must be controlled and part parameter

Example of types of defects
2013 Hagen Symposium

Shear crack (left) and brittle crack in green PM compacts (GKN Sinter Metals Engineering)
42\textsuperscript{nd} Annual QNDE 2015
Incorporating the 6\textsuperscript{th} European-American Workshop on Reliability of NDE & proceeded by World Federation NDE Workshop
Hyatt Regency Minneapolis, Minneapolis, Minnesota
July 26\textsuperscript{th} – 31\textsuperscript{st}

Iowa State University Digital Repository
3000 NDE articles downloaded a month

NDT Resource Center
NDT Resource Center  www.ndt-ed.org

• International resource
  – 2013 – 62 M hits
  – 13+M page views
  – Over 5 million visits
  – 3.5M unique visitors
  – 2014
  – 400,000+ visitors per month

Get 10 + technical enquiries &/or requests to use content per month
Education – (goal – increase output!)

• BS Level
  – Interns
  – 490 (project students)
  – NDE Minor

• NDE Graduate Education
  – on-line certificate

• Graduate students – engaged in research
  – Required course options under review
    • Engineering mechanics (Aero), ME/MSE etc.
CNDE Researcher: Leonard J. Bond

Position(s)
Director CNDE & Professor

Qualifications:
Ph.D. Physics (1978) - The City University, London

Selected publications
• Bond, L.J. (2012) Moving beyond nondestructive examination to proactive management of materials degradation. J. Pressure Vessel Technology (ASME) 134 (1) 014501

Expertise:
• Ultrasonics (high & low power)
• Advanced Sensors
• Diagnostics & prognostics

Personal & professional GOALS
• Develop R&D in NDE for powder metals and advanced manufacturing
• Grow industry interactions and non-federal funded research at CNDE
Greater CNDE – more than an IUCRC

- Annual QNDE Conference
- IPRT – company assistance
- NDT Resource Center
- World Federation NDE Centers
- Employable graduates
- ISU, professional researchers & faculty Teaming partners
• Listen to sponsor needs
• Visit sponsors
• Be willing to adjust what you plan to do!
• Don’t tell sponsors you know best
• Need to understand business drivers/needs
• Deliver something of value

• Communicate – communicate – communicate
• Engage-engage-engage
• Not just core projects
• Make your activities part of their activities
New sponsors

- Have something to offer
- Market & deliver on time, within budget
- Spend time engaging sponsors
- Understand sponsor needs
• Local

• National

• international