The Way We Were

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Nondestructive evaluation of aging infrastructures and new designs manufactured from lighter more efficient materials are pushing the capabilities of both technology and human performance. In an effort to address the human element, a process to accurately determine practical limits for the finite and precise detection and sizing of flaws is needed. A growing trend in many industries that challenge such human skills is moving toward a performance demonstration process.

This paper will discuss the features and elements of the process and how they may apply to the qualification and certification of NDT personnel. The objective is to evaluate available information and experience that may lead to a revolutionary approach for the qualification and certification of NDT personnel resulting in more accurately defined human performance expectations. While human performance excellence is the ultimate goal, an effective and cost efficient delivery system of such a new initiative will be extremely important in determining feasibility and industry acceptance.

NDT has continued to evolve as both an engineering tool and as a viable method for ensuring product quality. The methods utilized today continue to improve with advances in research, product development and technology. The increasing expectation of the technician's level of competency has continued to rise with demands being focused on quality initiatives driven by the end customer. With this evolution, the NDT technicians of tomorrow must be a cut above the competency of yesterdays. To address this demand, technicians are being more specialized. The importance of specialization within an industry sector is rapidly increasing as the complexity of technology evolves and the expectations of industry and consumers continue to rise.

To address these increasing demands, we must first understand the past and present performance level of NDT. A number of studies, round robins and industry experiences since the 1970s show that on average some NDE methods only detect reliably about 50% of the known discontinuities. These studies include:

- Pressure Vessel Research Committee (US) Welding Research Supplement 1971
- U.S. Air force "Have Cracks Will Travel" 1974-78
- U.S. Industry Implementation of "Intergranular Stress Corrosion Cracking" Performance Demonstration Examination 1982
- Pacific Northwest Laboratory "Piping Inspection Round-Robin" 1981-82
- Pacific Northwest Laboratory "Mini Round Robin" 1986
- European Base Program for Inspection of Steel Components 1985-94
- Nuclear Industry Implementation of ASME Section XI, Appendix VIII 1989-99

- Program for the Assessment of NDT in Industry (PANI), Organized by the UK Health & Safety Executive (HSE), and the Inspection Validation Center and AEA Technology 1999
- Nuclear Industry Implements Steam Generator Eddy Current Performance Base "Qualified Data Analyst" as a requirement (NEI 9706) 2000
- American Petroleum Institute "API Personnel Proficiency Program-UT" (30% first attempt pass rate)

The above data was mostly gathered by providing candidates a series of test samples containing flaws. Some of the earlier studies included artificial flaws while the latter were sophisticated samples with actual implanted flaws in components representing real world geometric configurations. The results of these experiments reflect the reality of NDT performance in the field.

Performance-based qualification requires personnel to demonstrate that they can do a job that meets certain standards consistently under real working conditions. It puts certification candidates in situations where they must use their knowledge and demonstrate their skills in a manner that can quantitatively measure the elements that employers and certification organizations care about most, i.e., job tasks, especially those requiring specialized knowledge and skills to reliably detect relevant discontinuities.

A job task analysis is a formal process for determining or verifying what people do, under what working condition they do it, what they must know to do it, and the skills they must have to do it. The analysis can be applied to a set of duties, a group tasks, a job, or an occupation, but most people just refer to the process as a job task analysis. The purpose of the analysis is to get data to support the development of performance standards, tests, training, and criteria to judge experience, practical examinations and so on.

There are a number of proven processes for conducting a job task analysis, but any analysis should include the following phases:

- Phase one involves generating a list of tasks or behaviors that describe what people do, the conditions under which they do it, and the skills and knowledge required to do it. Some of the methods used to generate the initial list of tasks are to
    * Convene a panel of experts - representatives from the target audience to describe the job or task
    * Convene the stakeholders to describe their expectations of people in the job
    * Interview experts and stakeholders to elicit what is done, why it is done, and what is important
    * Observe one to three experts performing the task being studied to identify what is done and under what conditions
    * Survey experts and stakeholder to identify trends affecting the job and future skills
    * Conduct literature reviews and document searches to identify the results of other studies about the job
- Phase Two involves (a) verifying the degree to which a larger group agrees with the initial description and (b) rating or ranking the specific tasks or behaviors according to

their importance, frequency, and difficulty. The typical methods used to do this are to survey the target audience, survey the stakeholders, and interview the target audience and stakeholders.

- Phase three involves converting the list of tasks into performance standards that include
  * The conditions and constraints under which people are expected to demonstrate knowledge, skills, or performances
  * What they have to work with (tools, equipment, information)
  * What triggers the task
  * The tasks or behaviors encompassed in the performance
  * the criteria used to judge adequacy or proficiency

The goal of the first two phases is to build as complete a picture as possible of the task, the environment in which it is performed, and the stakeholder's expectations. The goal of the third phase is to describe the organization's expectations in sufficient detail to support assessing candidates' ability to satisfy the standards.

Performance-based qualification provides other opportunities, e.g., the administrative burden with no value added of detailed tracking of education documentation, classroom training and on-the-job experience hours can now be more practically addressed. Training and experience are obviously still essential; however, how long it takes to complete these tasks becomes irrelevant since they are measured by performance testing. We are aware that each individual learns at a different rate, thus the traditional training classroom is not always the best way to transfer knowledge. Interactive, computer-based training programs and simulators can provide more effective learning geared to the individual.

To prepare candidates to perform at the level expected, the training and experience process must be reengineered. The new process must incorporate the lessons learned, i.e., emphasis on accessibility, component configuration, geometry, human factors (weather, working conditions, stress, health, family, etc.), must be integrated. However, the major focus must be on hands-on application and detection of flaws. Here is where industry sector specific applications will become essential. While the NDT industry has hung on to the hope that "one shoe fits all" we now have the experience and data that says this philosophy must change. While NDT generalist may suffice in some markets, demonstration of competence in specific industry sectors will likely be the way of the future.

Performance based certification can improve our personnel qualification systems by recognizing individual capacities, limitations and needs. These qualities can be measured or otherwise defined with more accuracy today than 40 years ago. If this approach results in a system that is portable, employer to employer, industry sector to industry sector, and applies to more than the nuclear industry, it will represent a significant move forward.

Providing training at the rate and level which is appropriate for the individual, using learning technologies which are available today, with structured practical experience, and delivery at reasonable cost are the key considerations as we develop a "revolutionary" approach to personnel qualification and certification.