NDT Education and Training: Today and in the Future

by Michael W. Allgaier

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Nondestructive testing (NDT) education and training has evolved from a simpler time with less requirements, fewer educational providers, and an abundance of willing participants. Today, there are many formal certification requirements with many options for education and training. This era of sophisticated technology demands more education and training for NDT practitioners to succeed in the advanced NDT methods. There are fewer qualified applicants at the advanced level and the demand is growing. This paper compares the way NDT personnel training is today with how it will need to be tomorrow. Hopefully, these changes will lead to processes that are more efficient and attractive to NDT practitioners, employers and customers to assure the correct quantity and quality of NDT professionals to meet the needs of society and the industry.

Introduction
Industries are experiencing a shortage of qualified NDT personnel in the advanced NDT techniques and applications. There are many applicants for entry level positions and an adequate supply of engineers and scientists with NDT degrees. The increasing need for more education, training and advanced proficiency, however, is thinning the ranks of qualified personnel needed to advance farther into the career of an NDT practitioner. The traditional instructor-led training approach is costly for both the employer and student in terms of money and training time. The employer has a limited number of qualified instructors and a limited tolerance for candidates to become non-billable during training. Especially difficult is getting the sufficient number of
students in order to be an efficient use of a qualified instructor's time. In addition, many candidates for NDT training find it difficult to attend regularly scheduled classes at traditional institutions of higher education, and do not enjoy paying for the training upfront with a risk of not making an adequate return on investment.

While many entry level personnel may be attracted to the NDT profession, they cannot easily move up to the more advanced NDT techniques unless they are additionally educated and trained. The challenge is to determine who will pay for this additional training. This paper proposes a new training paradigm that is less expensive and more efficient, but limits the scope to addressing improving the training model of qualifying personnel. Greater depth of analysis is needed for proposing improvements in education and proficiency demonstrations.

**Demand for Practitioners**

The demand for intermediate and advanced NDT practitioners will increase as more nuclear power plants are built. Currently, over 20 companies have announced their intent (with even more making plans) to submit applications to the U.S. Nuclear Regulatory Commission for new power plant licenses to build nearly 30 nuclear power plants in the U.S. (NEI, 2010).

In looking at the future of the NDT workforce for nuclear industry, surveys indicate that by 2013, there will be 500 inspectors available, whereas 900 will be needed. This will yield a shortfall of 400 inspectors for the nuclear industry (Tumbow, 2009). Currently, there is also a need for more American Petroleum Institute inspectors and American Welding Society certified weld inspectors for the refineries, chemical processing plants and construction fields (Bertolet, 2010).

This is no small concern. With the increase in nuclear power plant construction currently proposed, there will be an increase in demand that may cause a migration from other industries into nuclear construction and thereafter to in-service inspection, thus aggravating the need for more people in NDT who need to be processed faster and have more qualifications for all industries.

**Formal Training**

Today, the entry level positions are relatively easy to break into. Entry level candidates frequently have a high school or general equivalency diploma. They cannot advance far, however, without further education and training.

The problem is how to attract new practitioners, further professionalize the occupation and fill the labor gap that is growing for ever more sophisticated NDT applications. There is a need for education and training to meet industry needs in a timely, efficient and adequate manner.

The proposed wording in the upcoming Recommended Practice No. SNT-TC-1A: Personnel Training and Certification of Nondestructive Testing (2011) states that personnel being considered for initial certification should complete sufficient organized training. The organized training may include instructor-led training, self-study, virtual instructor-led training, computer-based training or Web-based training. It further states that computer-based training and Web-based training should track hours and content of training with student evaluations.

Sufficiently organized training should be such as to ensure the student is thoroughly familiar with the principles and practices of the specified NDT method, related to the level of certification desired, and applicable to the processes to be used and the products to be tested. Historically, this has been accomplished with instructor-led training. Now is the time to think outside the box, have a paradigm shift or achieve a new normal by making Web-based training one of the standard approaches in addition to instructor-led training. The combination of these forms of training is known as the blended approach, and allows for cost saving, improved efficiency and improved awareness. Note that Web-based training is not adequate for transferring skills; improved competency qualification training with realistic flaws is needed for skill transfer.

In 1974, personnel lacking a high school education were acceptable for NDT certification if they received substantially more training than the typical high school graduate. If the public school system served candidates with at least tenth grade reading
skills and basic algebra, then a candidate could quickly be made productive and billable with short, incremental training and moderate periods of experience. If a non-graduate did not receive this minimum math and English training, that candidate’s chances of succeeding in NDT was greatly reduced for all but the most basic applications of NDT. Hence, a long and advancing career in NDT would be in jeopardy.

In the future of the NDT world, however, many NDT practitioners will require more formal training and may require higher education.

Higher Education
If the NDT workforce anticipates higher compensation and a professional work environment, candidates may be willing to pay for advanced instruction in NDT training from qualified institutions and colleges. An associate of applied science degree in nondestructive testing, giving specialized and advanced NDT training, can lead to enhanced employment opportunities. This is no different than many other technology based occupations, but the number of practitioners seeking out this education on their own has not yet been sufficient. Many employees still rely on their employers to pay for training.

There is currently a debate about reducing experience based on additional intensive training. Some people are promoting one year of specialized intensive skills training after two years of intense college courses that are industry specific. This is seen as a way of reducing the need for experience lasting at least a year, but again, who is going to pay for the extra schooling and training?

Even with approximately 23 junior colleges and 61 senior colleges offering courses in NDT, there still seems to be very few people working in the field with an associate of applied science degree or bachelor of science degree in NDT technology. Many NDT Level III practitioners frequently have bachelor of science degrees in other disciplines. More frequently, many colleges only offer NDT elective courses in other engineering or science curriculums. These junior and senior colleges do not turn out nearly enough graduates each year to meet the demands of the industry. The bulk of the NDT workforce still comes from two sources: trade/technical schools and internal training programs (Algaier and Serabian, 2010).

If a candidate is willing to pursue higher education, the question becomes: Is this candidate willing to personally pay to obtain a two- or four-year degree, only to work in the harsh environments of heat, cold, hazardous materials, radiation exposure, chemical contamination and general industrial safety dangers? Even though regulated and controlled, these dangers are still present in refineries, chemical processing plants, nuclear reactor power plants, fossil power plants, construction sites and factories.

Some of the avant-garde companies and training institutes are offering an alternative to traditional education and training. More and more are offering NDT courses online. Some new enterprises specialize heavily in online training and education. The classic brick and mortar school, with a professor or instructor and a classroom full of students having access to laboratories, is now beginning to give way to a combination with e-learning.

Some colleges are offering masters programs that mix online instruction with limited on-campus time. This is a popular option for prospective students who want to attend brand-name schools without giving up their jobs, relocating or trekking to campus for classes several nights a week.

These hybrid programs (as many colleges refer to them) are less expensive for schools to run, partly because students in the programs use fewer services and resources. Professors and schools do the bulk of the work or preparation up front, but contribute less time face-to-face (Middleton, 2010). Today, this is true for instructor-led NDT training courses as well as Web-based NDT training.

Web-based Training
The initial investment in a hybrid college curriculum can cost up to $1 million or more in a campus setting, but are relatively inexpensive to maintain (Middleton, 2010). Needless to say, industrial employers would also have to make a significant investment upfront to provide Web-based training. When a company makes that investment, however, they need to attract the employee to stay with the company, so that they will get a return on the investment. Another advantage for the employer providing online training for employees is that the employee can see the employer's investment. This makes the employee more likely to stay with that company.

More reliance on Web-based training to augment the classical instructor-led training approach can result in a lower cost approach in the long run. In the past, a Level I technician who showed promise might be enrolled in an outside certification course at the company’s expense or be given classroom instruction by a senior member of the employer's staff. Not all of the candidates worked out, however, and those that either dropped the program or failed were a costly disappointment. Alternatively, the candidate that passed the training course, but then left the company, was also a costly disappointment. Today, early online
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*Figure 1. Typical instructor-led training class schedule.*

Low cost training and low commitment classes help to weed out those who are not capable of advanced work, or not motivated enough to successfully pursue certification. This makes it more likely that the employer will invest in the employee and see results with less risk.

Online instruction or Web-based training is not a total solution to the training problem. Only knowledge transfer can be achieved by Web-based training. Candidates still need sufficient hours of supervised, hands-on instruction and field experience in order to achieve skilled competency. However, Web-based training classes provide an excellent head start (Serabian and Allgaier, 2010).

For comparison reasons, consider the typical instructor-led training paradigm for a five-day, 40-hour class (Figure 1) (Allgaier, 2009). This table adds up to approximately two days in the classroom, two days in the laboratory, one half day of review and one half day of exams (written/practical).

There is motivation to change this paradigm and think outside the box because:
- Level III resources are scarce and need to be billable.
- Scheduling conflicts make larger classes difficult to conduct efficiently.
- There is reduced cost effectiveness when small classes are given repeatedly.

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<td>Web-based training</td>
<td>Competency qualifications with Level II or III on-the-job trainers</td>
<td>Review with NDT instructor</td>
<td>Written exam</td>
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*Figure 2. Proposed approach utilizing blended training.*
Logistical costs exist if the test specimens and the candidate are at different locations.

An alternative to this standard practice is to utilize the Web-based training approach for knowledge transfer. With Web-based training, there is no waiting for initial training in theory and principles, while it also provides flexibility in conducting hands-on, structured competency qualifications (formal, on-the-job training).

There is still a need to assure transfer of skills and knowledge with a Level II or III at the end of the Web-based training. Hands-on competency qualification could be equal in hours to Web-based training. In the classical instructor-led training course, lab exercises are mixed with classroom training prior to taking the exams. After the Web-based training and the competency qualification hands-on training, the ASNT NDT Level III practitioner should fill in observed gaps in learning with face-to-face, hands-on training before proceeding to the final written and practical exams.

A new proposed blended training approach can be found in Figure 2. It presents a standard 40-hour course conducted in a new manner with a blend of Web-based training and instructor-led training, with an exam proctor and a Level III practitioner conducting the qualification and certification functions (Allgaier, 2009).

This new approach would yield approximately two to three days of Web-based training with no instructor or proctor (although many times, one hour of classroom time equals two or more hours of time spent on Web-based training), one to two days of on-the-job training by a trained Level II or III professional, and a day of written exams with a proctor (non-Level III) and practicals with an applicable certifying Level III. Only a few hours are with the Level III instructor, compared to 40 hours before.

Conclusion

There is a need for more efficient and cost-effective training for all levels of NDT. The blended approach to teaching NDT includes Web-based training and instructor-led training. Although Web-based training requires more discipline and often more time from the student, it can be extremely beneficial for the student, proctor and employer. Web-based training is well-suited for knowledge transfer, is flexible and is cost-effective. Instructor-led training, performed with well-defined competency qualification exercises, will assure ability to perform each NDT technique needed. The Level III practitioner is still required for practical proficiency demonstrations evaluation, i.e. for the practical exam. Each industry may specify its education requirements, but all will benefit with a cost-effective and flexible blended approach of training and qualification of NDT personnel.

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