Pipeline Standards and Training

At a deeper level, this article is not just about training and standards. It is about imparting (by the teacher or teaching media) and gaining (by the student) the knowledge, skills, and attitudes required to safely, efficiently, and reliably transport oil and gas in an environmentally responsible manner from the production pad to the consumer. Industry standard are one means to capture knowledge. Training imparts (transfers) knowledge to students. This is why I have adopted the term *knowledge transfer modules* for my instructional materials.

Industry Standards

The pipeline industry adheres to many different standards. Operating standards, engineering standards, control system standards, fire prevention standards, and accounting standards are just some examples. Some standards such as accounting and fire prevention standards apply to many industries. Other standards are unique to the pipeline industry. Whether used across industries or unique to one industry, standards represent the current practice in that industry.

History of standards

Standards have been in use since ancient times. One of the earliest examples of standardization is the creation of a calendar. The Egyptians were the first to develop the 365-day calendar. Henry I of England standardized measurement in 1,120 AD by instituting the ell, which was equivalent to the length of his arm.

During the Civil War, the U.S. government recognized the military and economic advantages to having a standardized track gauge. The government worked with the railroads to promote use of the most common railroad gauge in the U.S. at the time, which measured 4 feet, 8 ½ inches, a track size that originated in England. This gauge was mandated for use in the Transcontinental Railroad in 1864 and by 1886 had become the U.S. standard.

In 1904, a fire broke out in the basement of the John E. Hurst & Company Building in Baltimore. After taking hold of the entire structure, it leaped from building to building until it engulfed an 80-block area of the city. To help combat the flames, reinforcements from New York, Philadelphia and Washington, DC immediately responded—but to no avail. Their fire hoses could not connect to the fire hydrants in Baltimore because they did not fit the hydrants in Baltimore. The fire destroyed approximately 2,500 buildings and burned for more than 30 hours.

It was evident that a new national standard had to be developed to prevent a similar occurrence in the future. Up until that time, each municipality had its own unique set of standards for firefighting equipment. As a result, research was conducted of over 600 fire hose couplings from around the country and one year later a national standard was created to ensure uniform fire safety equipment and the safety of Americans nationwide.[i]

History of technical standards

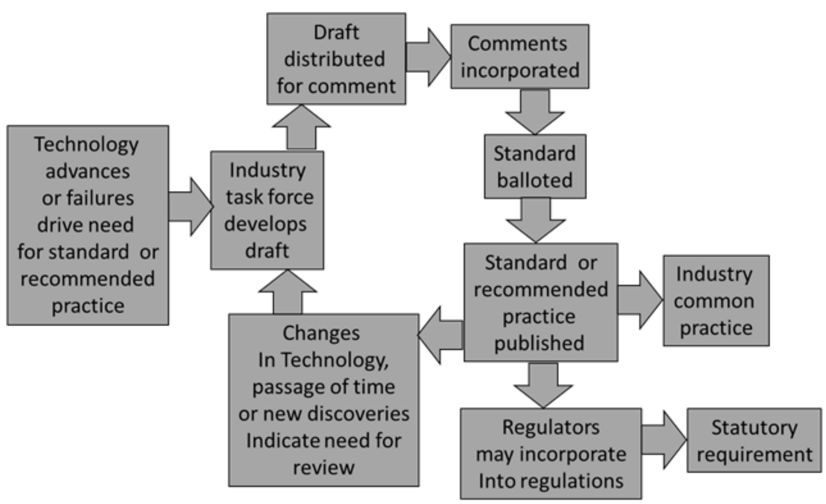
Established in 1880, ASME is one of the longest standing standards organizations. Initially ASME was simply a group of engineers meeting periodically to discuss development of standard tools and machine parts as well as uniform work practices. One of the common industrial accidents at that time was boiler explosions, and in 1884 ASME established the Boiler Testing Code as a voluntary standard. Nine years later, on March 10, 1905, at the Grover Shoe Factory in Brockton, Massachusetts, a boiler exploded, rocketing through three floors and the building's roof. Broken beams and heavy machinery trapped many workers who survived the initial explosion and collapse. Burning coals thrown from the boiler landed throughout the crumbling superstructure, starting fires that were fed by broken gas lines. The explosion resulted in 58 deaths and 117 injuries.

This catastrophe gave the state of Massachusetts the impetus to establish a five-man Board of Boiler Rules, whose charge was to write a boiler law for the state. In 1911, ASME published Boiler & Pressure Vessel Code (BPVC) which was incorporated into laws in most US states and Canadian provinces.[ii]

Standards development process

Industry standards are usually developed by a task force of leading experts working under the auspices of an industry organization. The task force first develops draft standards which are then distributed to a wider audience for comments. The task force reviews the comments, incorporating improvements and clarifications as appropriate. Next the revised standard is "balloted", that is voted on, by the larger organization. Finally, it is issued by the industry association. Sponsorship by an association, which exists to serve the industry and not to make money, is one of the keys to having objective standards and avoiding potential commercial conflicts of interest with experts who might participate in the standards setting process.

Industry Standards and Recommended Practice Flow Chart



Courtesy Pipeline Knowledge & Development, pipelineknowledge.com

Examples of standards setting industry associations

Including a complete list of standards is well beyond the scope of this short article, but a sampling of organizations issuing standards related to oil and gas pipelines follows:

- American National Standards Institute (ANSI)
- American Petroleum Institute (API)
- American Society for Testing and Materials (ASTM)

- ASME International (ASME)
- ASTM International (ASTM)
- Australian Standards (AS)
- British Standards Institution (BSI)
- European Committee for Standardization (CEN)
- Gas Technology Institute (GTI):
- International Organization for Standardization (ISO)
- Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
- NACE International (NACE):
- National Fire Protection Association (NFPA)
- Pipeline Research Council International (PRCI)
- Plastics Pipe Institute, Inc. (PPI):
- Russian Standards (GOST, SNiP, OST, GTN, VNTP)

Pipelines obey the laws of physics universally, so it is no surprise standards across country lines are quite similar.

Across countries and standards organizations many of the standards are quite similar if not exactly the same – not surprising as the laws of physics apply universally.

Recommended practices

Recommended practices have not yet progressed to standards status. Developing technologies and operating practices commonly produce recommended practices which tend to evolve into standards as the technology or practice matures and becomes generally accepted practice. An example is API RP 1165, Recommended Practice for Scada Displays - currently a recommended practice, it may, over time, become a standard rather than a recommended practice as it becomes more widely accepted.

Standards, recommended practices, and regulations

Since standards represent common practice in the industry, many regulatory bodies capitalize on industry experience and expertise by incorporating industry technical standards by reference directly into laws and regulations. Regulatory bodies may also adopt recommended practices into laws and regulations.

Regulatory bodies often incorporate standards and recommended practices into regulations.

Company standards - interpreting industry standards and recommended practices

Industry standards represent the current industry common practice and are by nature somewhat general. Individual companies further interpret these standards for their people with company specific and more detailed, engineering, operating, materials, and maintenance standards and procedure manuals.

Company standards - leading industry standards and recommended practices

In addition to interpreting industry standards, firms may publish company specific standards driven ether **proactively** by industry though leaders at the company, or **reactively** based on leanings from company or industry incidents. Whether proactive or reactive, though leaders and incident learnings provide valuable knowledge to improve standards and recommended practices.

Social media sites do not comprise industry standards

A "pet peeve" (or perhaps a word to the wise) – just because a self-proclaimed "industry expert" answers a social media query, or writes in a blog, does not mean their answer becomes common industry practice. To be clear, social media, blogs, and other collaboration tools can be valuable sources from which to get ideas and thoughts, and I believe they are a great source of knowledge sharing, but those ideas and thoughts should not be considered definitive. Wise people do not accept social media comments without extensive investigation and never allow social media posting to take the place of industry technical standards.

> Social media is valuable knowledge sharing platform but can also be misinformation and self-aggrandizing – beware.

A final caution regarding industry standards

Engineering and design are two interrelated, but very different, functions. Standards are about engineering and depend on scientific knowledge and the laws of physics. Design, on the other hand, is about art and depends on knowledge and experience. As wise pipeline designer once said, "Don't mistake technical standards for design manuals". One of the most common mistakes engineers and designers make is forgetting to involve experienced operational experts in their designs.

> Industry standards are not design manuals. Design follows standards but relies heavily on knowledge and

Training

There are many different training approaches and models, but in general training:

- imparts factual information (knowledge),
- enables students to understand how and when to apply that factual knowledge,
- provides students with specific skills to apply that knowledge – how to start a pump or compressor for example,
- teaches students to plan, monitor, and make revisions to their activities, and
- shapes students beliefs and opinions – for example towards safety.

> Supervisors provide training and development *opportunities*. Employees train and develop *themselves*.

Captured in the text box above is the notion that motivated students can seek out knowledge and train themselves. (My son, for example, actively seeks out on-line tutorials to learn computer animation and video and audio editing skills. Then he practices the skills.) Support from the company and supervisors, however, makes acquiring knowledge easier and benefits both the company and the employee.

Effective teachers

Effective instructors;

- first understand the factual knowledge they teach, that is they have content knowledge.
- Second, they have pedagogy knowledge. In other words they understand instructional theory.

- Third, effective instructors know when and how to apply the pedagogy knowledge to the content knowledge.
- Fourth, they have the instructional skills to do so.
- Fifth, effective instructors plan their instruction and monitor its delivery, seeing critique and feedback and making adjustments both during the class and for the next class.
- Finally they have empathy for their students. That is they care if students learn and can sense when students understand and when they don't.

> Effective teachers know the content and teach from the heart with stories, not just from the screen with Power Points

Training providers
In the past couple of years a myriad of trainers and training companies have sprung up. But, the training industry itself is not regulated, and the quality between trainers and training companies varies significantly. In general, when deciding on training, look for well established companies run by industry experts, rather recent entries seeking to make a quick dollar.

> Some of the training/trainers offered are – frankly – trash.
> *From a well respected, long time, trainer.*

Effective learners
Students, however, don't necessarily need effective trainers (but it helps). First and foremost, effective students understand learning is their responsibility and they look for opportunities to learn. Whether people, technology, or reflection on personal experiences, effective learners lever their resources. Some people are naturally inquisitive and others not so much. Active learning is a valuable trait for which many employers screen.

> Some people learn from others mistakes. Some people learn from their own mistakes. And, some people never learn.
> *Gilbert Miesner*

Delivery methods
Training is delivered in multiple formats by multiple methods including the following:

- On the job training (OJT)
- Lecture
- Discussion
- Demonstration or behavioral modeling
- Coaching
- Equipment simulators
- Business games
- Case studies
- Worked problems
- Role play
- E-learning
- Hybrid

On-line training portal example

A thorough treatment of each training method is beyond the scope of this this article. Suffice-it-to-say, each method has its advantages and disadvantages, and knowledge transfer is best accomplished by a combination of delivery methods depending on the type of knowledge.

Transferring factual (explicit) knowledge is often accomplished through a combination of classroom lectures coupled with discussion. Skills are often taught through a combination of demonstrating or modeling behavior followed up with coaching. OJT can be essentially a combination of lecture, demonstration, and coaching as the master tells the student the needed information, demonstrates the skill, and then coaches the student as they apply their skills. Of course training is not the objective, knowledge, or rather the ability to apply that knowledge productively, is the objective – leading to the topic of evaluations.

Explicit knowledge – facts, numbers, drawings, and the like, which can be captured and reduced to words, pictures, and videos.

Tacit knowledge – insights, intuitions, hunches, and the like, collected over a life time of experiences which are difficult to capture and document.

Evaluation

At the most elemental level, a student's explicit knowledge is usually evaluated through written (hard copy or electronic) or oral testing – they regurgitate what they have memorized and are either "right" or 'wrong". Testing explicit knowledge is rather straight forward and easily automated. Students simply answer questions presented to them on an electronic device which records their answers and scores the test.

Evaluating tacit knowledge, on the other hand, may require evaluating the student's performance, including their ability to solve problems, make decisions, and extend their knowledge into new areas.

The evolving role of technology

In the early 1980's, many of us looked to what was then called Computer Based Training (CBT) as a training panacea – just develop training modules, put them on the computer, have student learn the material and then present a test to determine how much they had learned.

In my experience, CBT turned out to be a valuable way for motivated students to gain explicit knowledge. I have also observed that transforming hard copy information and tests to digital streamlined training delivery and documentation, but I believe CBT had little impact on training effectiveness.

While the future can never be proven until it is the past, my view is that the four most promising areas for improvements in knowledge transfer in the near to midterm are:

1. **Playback** – capturing events from scada and other displays and then showing them to students provides a much denser training experience than providing students the opportunity to watch events unfold during OJT.
2. **Simulators** – allowing hands on interactions with the equipment and systems in an off line environment builds student knowledge and skills without the risk of impacting operations.

3. **Video** – viewing operations, maintenance, and other activities in video format presents a richer learning experience that still pictures. Videos are also an effective way to capture and share tacit knowledge.
4. **Collaborative and social media** – sharing thoughts and experiences provides a forum for learning and expanding knowledge. As noted earlier, however, statements made on social media should be investigated thoroughly before they are adopted.

None of these is the ideal tool. They must each be used appropriately.

Conclusion

Learning what to do and how to do it allows students to perform their jobs. In addition to learning what and how, some will also ask why. While I don't recall the exact context, years ago one of my direct reports said, "Those who ask what and how will always have a job. Those who ask why will always be the boss.

About the author: Tom Miesner is the founder of Pipeline Knowledge & Development http://www.pipelineknowledge.com/ Developing and providing pipeline related training and solving pipeline related challenges are the mission of Pipeline Knowledge & Development. Last year PKD taught 26 pipeline classes. Some of these were public classes, but most were taught privately for operating companies and suppliers. Private classes allow customization for maximum efficiency, they cost less per student, and they save employee travel time. PKD also offers on-line courses so students can proceed at their own pace. For more information, go to http://www.pipelineknowledge.com/. Since Tom founded PKD in 2003, it has been bringing knowledge, creativity, and an outside, independent, opinion to business analysis, improvement efforts, and problem solving, and situational analysis. To determine if PKD is the right consultancy for your needs, send an e-mail to contact@pipelineknowledge.com or call +1 281-579-8877 for a confidential consultation.

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[i] Extracted February 5, 2014 from http://www.ansi.org/consumer_affairs/history_standards.aspx?menuid=5
[ii] Extracted February 5, 2014 from https://www.asme.