TRAINING TRAINERS on Construction Confined Spaces

By Koshy Koshy and Michael Presutti

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KEY TAKEAWAYS

- **Rutgers School of Public Health developed a construction industry confined spaces training intended to increase worker awareness and help employers educate and train their workforces in changes to corresponding OSHA standards.**
- **Subsequently, many participants were able to effectively integrate materials received into their downstream training. Site-specific hazard scenarios and other training strategies helped engage trainees in the learning process.**

OSHA CODIFIED THE CONFINED SPACES IN CONSTRUCTION standard in 2015 with the intention of preventing an estimated 780 serious injuries and five fatalities annually. The need to advance awareness of the new construction industry standard prompted OSHA to award the Rutgers School of Public Health (SPH) a Susan Harwood grant to develop and deliver construction confined spaces training for workers and managers, which also included many trainers in New Jersey and New York. Of 168 training participants, 81% had site safety and health compliance oversight responsibilities, and about half (49%) provided injury and illness prevention training. The goal of the program was to increase participant knowledge and understanding of hazards associated with confined spaces and permit-required confined spaces to assist managers, employers and trainers in developing their own downstream workshops. Trainee feedback during the courses and in succeeding follow-up interactions and surveys was vital to help identify issues that could impede the developmental effective training programs.

Background

Various industry-specific standards exist to help control and lessen risk. After development, promulgation and review, on May 1, 2015, OSHA released the final rule on confined spaces in construction, 29 CFR 1926 Subpart AA, with requirements applicable to construction activities.

The construction confined spaces standard requires communication and sharing of information between controlling contractors (controlling employers), host employers, entrant employer's competent persons, and other employers that may be exposed to or create hazards on sites or in facilities where a confined space may devolve into a permit-required confined space (OSHA, 2001).

OSHA defines confined spaces as large enough for workers to enter and perform tasks, limited or restricted means of entry, and not designed for continuous worker occupancy. Examples of confined spaces on construction sites include crawl spaces, tanks and vaults (OSHA, 2015a, n.d.a).

Some differences set the confined spaces in construction standard apart from permit-required confined spaces in the general industry standard:

1. At risk construction sites must have a "competent person" capable of identifying hazards in the workplace and having the authority to abate them immediately and communicate with a host employer or controlling contractor.
2. The construction standard allows for a temporary suspension of the permit as an alternative to cancellation.
3. Construction entry supervisors must be "qualified persons."
4. The construction standard encourages continuous atmospheric monitoring and requires an early warning system for engulfment hazards (OSHA, 2015b).
5. A professional engineer must design rescue equipment unless manufactured for such use.

Data from Bureau of Labor Statistics (BLS, 2018) show that fatal occupational injuries involving confined spaces increased 15% from 144 in 2016 to 166 in 2017. Since 2012, the number of confined spaces fatalities increased by 89%, and confined spaces fatalities in the construction industry increased by 80%, from 41 in 2012 to 74 in 2017. For example, in 2017, nine fatal occupational injuries involving confined spaces occurred in New York and New Jersey.

Safety training is critical and warranted (Burke et al., 2006; Colligan & Cohen, 2004; Hughes, 2012; Weinstock & Slatin, 2012). Indeed, fatality assessment and control evaluation (FACE) reports cite a lack of training as a major contributing factor in confined spaces fatalities (California FACE Program, 2013; Iowa FACE Program, 2014; NIOSH, 2008, n.d.).

Rutgers developed a 7.5-hour Managing Construction Confined Spaces course as part of this program. Course topics included an introduction to confined spaces, worker rights and responsibilities, a starter kit for a confined spaces training program and developing site-specific checklists. These materials are accessible at **http://rutgerstraining.sph.rutgers.edu/harwoodccs.zip** (Rutgers SPH, 2017). This article summarizes the training, program evaluations, benefits and pedagogical challenges to training such topics.

TABLE 1
TRAINEE DEMOGRAPHICS

COMPANY DEMOGRAPHICS			TRAINEE DEMOGRAPHICS		
Sector			**Gender**		
Public	106	63.1%	Male	132	78.6%
Private	60	35.7%	Female	35	20.8%
Did not answer	2	1.2%	Did not answer	1	0.6%
Type			**Age**		
Utility	27	16.1%	18 to 29	15	8.9%
Non-utility	141	83.9%	30 to 49	65	38.7%
Size (No. of workers)			50 to 59	58	34.5%
< 25	28	16.7%	60+	28	16.7%
25 to 50	6	3.6%	Did not answer	2	1.2%
50 to 100	13	7.7%	**Years in the field**		
100 to 200	30	17.9%	1 to 5	30	17.9%
> 200	87	51.8%	6 to 10	25	14.9%
Did not answer	4	2.4%	11 to 15	22	13.1%
Age (years)			16 to 20	22	13.1%
< 5	6	3.6%	21+	66	39.3%
5 to 10	1	0.6%	Did not answer	3	1.8%
10 to 15	6	3.6%	**Safety professional**		
> 15	152	90.5%	Yes	136	81.0%
Did not answer	3	1.8%	No	32	19.0%
Primary language of workforce			**Trainee provides CS training**		
English	160	95.2%	Yes	78	46.4%
Spanish	4	2.4%	No	79	47.0%
Did not answer	4	2.4%	Did not answer	11	6.5%
Workers requiring training			**Type of course**		
1 to 5	30	17.9%	Stand-alone	42	25.0%
5 to 10	7	4.2%	Covered as part of outreach	22	13.1%
10 to 15	19	11.3%	Did not answer	104	61.9%
> 15	101	60.1%	**Anticipate providing training after taking course**		
Did not answer	11	6.5%			
Company provides CS training			Yes	93	55.4%
Yes	133	79.2%	No	51	30.4%
No	35	20.8%	Did not answer	24	14.3%
Did not answer	0	0.0%			
Company has written CS entry program					
Yes	135	80.4%			
No	23	13.7%			
Did not answer	10	6.0%			

Note. *n* = 168 participants; CS = confined spaces

Methods

Rutgers provided nine sessions of the 7.5-hour Managing Construction Confined Spaces courses to 168 trainees. The participant trainee assessment, in paper-based form, included trainee demographics, baseline knowledge assessment and post-training knowledge retention. Trainees completed a 10-question pre- and posttest. Participants were sent electronic follow-up surveys 3 to 6 months after training yielding data that was then assimilated, managed and analyzed using Microsoft Excel 2016 and IBM SPSS Statistics 25, respectively.

Outcomes

Table 1 summarizes trainee demographics. Training participants were mostly male (79%), safety professionals (81%) and under 60 years old (82%). Most (67%) trainees have established careers (i.e., worked in the field for 11 or more years).

Of the 168 training participants, 44% (74) were OSHA outreach trainers trained at Rutgers SPH. Among these OSHA outreach trainers, 72% (53) were construction trainers, 11% (8) general industry and 18% (13) had both construction and general industry credentials. About 64% (106) of the participants reported working in the public sector. Most of these participant trainees had safety and health responsibilities.

Nearly all (92%) training participants reported that the company they worked for had more than 15 years in business, and more than half (53%) reported their company's workforce had more than 200 workers. The data also suggests that about 85% (135) of the attendees had knowledge of their company's confined spaces entry program. Given that 81% were safety professionals, many would be involved in maintaining a confined spaces program. Furthermore, 55% (93) of the participants reported that they anticipated providing future confined spaces training to other workers at their company.

Presumably, after attending the 7.5-hour course, participant subject matter knowledge grew with an average posttest score (92%), nearly twice that of the average pretest score (47%).

Of the 138 follow-up surveys, 22 bounced back as undelivered. Of the 116 delivered surveys, 60 respondents (51.7%) reviewed the survey and 46 (40%) completed it. Studies have documented the typical response rate for online surveys is 10% to 20%; the response rate for this study was within the expected range (Pedersen & Nielsen, 2016). Of the 46 respondents who provided feedback, 31 (67%) acknowledged that they provided construction confined spaces training since completing the Rutgers training.

Respondent Trainer Feedback

After participating in the training sessions, many participant trainers presented their own downstream confined spaces training programs. Most respondents reported that they trained between one and 25 students (22, 71%), 16% reported training 26 to 50 students, 3% reported training 76 to 100 students and 10% reported training more than 100 students. These data suggest that participant respondents trained approximately 1,500 workers in their own respective confined spaces train-

ings within the span of some 6 months since having completed the Rutgers course.

Of the 31 follow-up survey respondents who stated that they provided construction confined spaces training, 26 (84%) said they were able to use the materials provided by the course to enhance their training. The type of training they provided included awareness/outreach (1 to 4 hours) or operations level (1 day or longer). Most respondents (21 of 31, 68%) reported that their construction confined spaces training was 4 hours or less. The remaining 10 participants reported offering longer training sessions. Additionally, 13 stated that they enhanced their training by creating field exercises. Respondents surveyed a relatively short time after completing the training (within 6 months) showed short-term gains and challenges.

From the course material, participants who performed downstream training were able to create handouts, develop workshop course content and integrate supplemental site-specific materials. Several survey respondents stated that they were able to use specific examples from the course to help clarify construction concepts and situations for their own trainees. Both trainer and worker participants found group exercises and consequent discussions beneficial, describing these activities as "useful," "engaging" and "insightful." One respondent described how group discussions gave the class a better insight into what workers experienced on a regular basis and alerted them to potentially overlooked problems.

Pedagogical Challenges & Recommendations for Training Confined Spaces in the Construction Industry

The development team applied learning strategies and training tools to their confined spaces course designed to increase attention and retention, and provide a practical pedagogical model for downstream trainings for employers and trainers who wished to train others. Naturally, underlying the development of the curriculum and delivery of the coursework, the team relied heavily on best practice models such as analysis, design, development, implementation and evaluation (the ADDIE model; Hidayanto et al., 2017), and ANSI/ASSP Z490.1-2016 Criteria for Accepted Practices in Safety, Health and Environmental Training (Table 2, p. 36). The following pedagogical approaches may be helpful when training managers and workers.

1. Know Your Audience

To design any course, developers must first know and understand their audience's needs, vulnerabilities, interests, aptitudes, background and collective commonalities (Ozdilek & Robeck, 2009). The most basic starting point here was a given susceptibility that for decades construction personnel did not have an industry-specific confined spaces standard and had to borrow from horizontal standards, found in the general industry, to successfully accomplish permitted entries. Construction professionals continue to rely on associated general industry standards such as respiratory protection (29 CFR 1910.134), the control of hazardous energy through locking out and tagging out (29 CFR 1910.147) and hazard communication (29 CFR 1910.1200). The team overcame this challenge by providing regulatory context to trainees on OSHA's incorporated by reference standards and discussions of how the OSH Act of 1970's General Duty Clause works in practice.

In addition, past experiences demonstrated that managers and workers devoted disproportionate resources to the most obvious and more tangible hazards. Intuitively, these hazards include the OSHA's "focus four" leading causes of fatalities (i.e., falls, struck-by, electrical, caught-in-between). Courses possessing more intangible and science-based content, such as trainings on the revised Hazard Communication Standard (Globally Harmonized System), circadian rhythm disturbances of night-shift workers, and an examination of injury and illness prevention systems required more teaching as opposed to training in hazard recognition and standards alone.

2. Create Ownership & Enfranchise Trainees

To help demonstrate how to achieve buy-in and instill a sense of ownership in the processes of developing a job hazard analysis, the course instructors had trainees create their own scenarios with potential hazards and controls (Purvis et al., 2015; Rutgers SPH, 2017, pp. 49-51). The course emphasized the importance of ownership benchmarked from research that suggests people place greater value on potential losses than opportunities of equal gain (Kahneman & Tversky, 1979). Hence, by incorporating and enfranchising workers into any administrative effort, employers and controlling employers have opportunities to create value in a multilateral noncoercive manner, making all stakeholders accountable. Such cooperation also helps develop more practical procedures that workers can more easily follow.

3. Competitive Group Exercises

The development team used game-based competitive group exercises as a learning tool to practice newly acquired terms, concepts and hazard controls. The exercise was creative, where each group built a task-hazard-control "straw man" scenario and worked within the bounds of the game. Game-based learning tools represent great pedagogical potential (Pho & Dinscore, 2015). The game's reward system and structure placed values on identifying and controlling hazards, where advanced hierarchical controls added more points. In all presented courses, this portion of the class increased engagement and inevitably led to friendly multilateral banter and theoretical parsing between teams. Evidently, the lighthearted banter and laughter prompted one trainee in a debriefing to state, "This doesn't feel like a class, but we learned a lot and used what we learned." That trainee was an OSHA outreach authorized trainer, who in a sidebar conversation months later noted how he applied the same techniques (OSHA, 2019).

4. Provide Examples of Human Error Traps & Reduction Techniques

Since the confined spaces in construction standard relies on written permits that can include checklists, the developers sought an opportunity to identify an often-ignored occupational hazard with limited means of hazard control: human error. The curriculum incorporates an exercise in the area of human performance improvement that provides a working example of a checklist developed to hedge against "pencil whipping," whereby participants tend to hurry through common repetitive paperwork tasks (Rutgers SPH, 2017, pp. 46-48; Tuttle & Sink, 1984).

Validating testimony and feedback from trainees was invaluable. Anecdotally, during many sessions, trainees would validate this human tendency by stating they too have seen instances of pencil-whipped paperwork such as hot work permits and competent person scaffold and excavation checklists. The human performance improvement model checklist served several functions:

TABLE 2

CHALLENGES TO EFFECTIVELY TRAINING CONSTRUCTION CONFINED SPACES PROGRAMS

Issue	Challenge	Resolutions and resources
Know your audience	• Find commonality in a diversified group. • Assess different needs. • Create a common learner profile.	• Listening skills of instructors and familiarity with industry • Analysis, design, development, implementation and evaluation (ADDIE model; Ozdilek & Robeck, 2009)
Create ownership and enfranchise trainees	Many employees have a disconnect to their work organization systems. They feel there is an "us" and "them." They feel disenfranchised from processes.	• Benchmarking across disciplines—finance and behavioral economics (Kahneman & Tversky, 1979) • OSHA's $afety Pays program (OSHA, n.d.b) • Purvis et al., 2014 • Using multiple training delivery method, where on-the-job training is part of the delivery and a better way to get worker buy-in to the severity of the hazard (ANSI/ASSP Z490.1, E4.4.1)
Competitive group exercises	Create real-world exercises that lead to effective learning and learner engagement.	• Confined spaces in construction exercise (Rutgers SPH, 2017, pp. 49-51) • Hidayanto et al., 2017
Human error traps and reduction techniques	Trainees do not realize that humans make mistakes, these mistakes are more frequent than we think, and we tend to make the same mistakes despite evidence (e.g., statistics).	• Checklist exercise (Rutgers SPH, 2017, pp. 46-48) • U.S. Department of Energy, 2009 • Hallinan, 2010
Strive to create understanding	Adults often want to get a correct answer on a test, but effective training occurs when trainees understand concepts, not merely know rules.	• Answer the "whys" and the "hows" so a topic makes cognitive sense to the adult learner. • Allow adult learners to "connect the dots" and find justification for standards and regulations. • Wiggins & McTighe, 2005
Concurrent feedback and debriefing	Abide by coursework content in disparate one enrollment groups	• Evaluate, modify and execute training according to constant feedback in real time. • Encourage and ask questions to assess saturation of information. • General industry and construction confined spaces standards (29 CFR 1910.146 and 29 CFR 1926 Subpart AA) • Garvin, 2000 • Observations, audits and inspection data should be used to enhance training design and delivery. Organizational support is needed to incorporate this data into training programs (ANSI/ASSP Z490.1, 6.3.1-6.3.2).
Make efficient use of time	Open enrollment training with varying participant experience and no prerequisite	• Shaw et al., 2010 • Whitman, 1988
Context and the shared responsibility on multi-employer workplaces	Lack of situational "big picture" context fails to have trainees see where they stand in an organization and the overall dynamic of the system they are working.	• OSHA's (1999) multiemployer citation policy • "Managing the Construction Industry Confined Spaces Program" (Rutgers SPH, 2017, pp. 5-7)

•validates that humans, whether at work, at home or elsewhere tend to make common errors of expediency that could result in injury, illness or death

•provides a practical example to help "human proof" their own downstream checklists

•introduces trainees to the field of human performance improvement

•dispels the notion that people who pencil whip checklists are intentionally trying to cheat or have insubordinate intent but rather fall into common human error traps, and managers and employers should aim to fix the problem not affix blame

5. Strive to Create Understanding

Imparting an understanding of a topic, beyond merely providing knowledge is fundamental to effective occupational training (Wiggins & McTighe, 2005). The difference between knowing and understanding is a timeless argument that analogy perhaps best explains: We may know, for example, with extreme accuracy when a certain tide rises and falls, but not necessarily understand why the tide does so. Training to a deeper, more cognitive level invites an understanding of the interactions of gravitational forces of the moon, the earth and

the sun along with the earth's rotation and inertia, and beyond. This course sought not merely to recite regulatory requirements and review flowcharts but to examine and explain the dynamic nature of permit-required confined spaces as well as the nature of many of the more common physical and chemical hazards within.

Inevitably any confined spaces training must answer the hows and whys implicit to such regulation. The developers tailored the confined spaces curriculum to explain why algorithmic flowcharts exist, what such terms within the flowcharts mean and how certain invisible hazardous atmospheres can immediately cause death, injury or serious illness.

6. Concurrent Feedback & Debriefing

Throughout each session, instructors encouraged real-time trainee feedback and concurrent facilitation between trainees. In these classes, adult learners often gain valuable information from sharing of experiences with other trainees. Trainers can also gain valuable feedback and evaluate the effectiveness of their techniques by listening and learning from the trainee-centric discussion.

Coincidently, the usefulness and necessity of debriefing as a pedagogical and management tool was reinforced by the applicable construction and general industry standards where language directs entrant employers to "debrief the contractor at the conclusion of the entry operations regarding the permit space program followed and regarding any hazards confronted or created in permit spaces during entry operations" [29 CFR 1910.146(c)(8)(v)]; 29 CFR 1926.1203(h)(5)(i)]. Trainees who were themselves trainers appeared to appreciate the connectivity between standards pedagogy and administration; several comments in class mentioned that debriefings should take place in other areas of construction activities.

> Training complicated topics such as the confined spaces in construction standard requires training toward general understandings whereby trainees can practice conceptual procedures and understand the whys and hows of a subject area.

7. Make Efficient Use of Time

Time management is always important but becomes critical when training more complex topics where knowledge transfer is more challenging, especially given a 7.5-hour program. During informal greetings and introductions at the beginning of the day, instructors would attempt to identify more experienced individuals to help share experiences and later act as team leaders in group exercises. In an effort to enrich the program through facilitation of each group's collective experiences and make more efficient use of time, instructors encouraged more experienced individuals to concurrently share their own stories with less-seasoned trainees. This facilitation occurred during group breakout sessions and throughout the day generally. In a group activity in which each team's task was to determine responsibilities of host employers, controlling contractors, entry employers and the rescue team for a mock tabletop exercise, the respective team leaders guided their less experienced teammates. Additionally, instructors discouraged team leaders from acting as their team's spokesperson, allowing others in the group to share their findings to gauge saturation of information.

8. Context & Shared Responsibility in Multiemployer Workplaces

Broadening the situational "big picture" context provided an opportunity for trainees to understand shared roles and responsibilities on multiemployer jobsites. The inclusion of host employers and controlling contractors in the new confined spaces standard gave workers and management alike a sense that OSHA was encouraging a team effort, wanting all stakeholders to work together to protect workers who work in and around permit-required confined spaces. This expanded holistic dichotomy departs from the more common understanding of merely an employer-employee relationship.

A graphic (flowchart of roles and responsibilities) allowed subcontractor participants to see that they were not alone in the protection of their employees, while general contractor participants too realized a need to increase supervisory site-specific training and become more involved at managing subcontractors, to familiarize them with confined spaces programs (Rutgers SPH, 2017, p. 7). A pretraining survey identified this supervisory deficiency. Effective site safety and health management requires training of contractors to develop familiarity with site-specific procedures (Shamsuddin et al., 2015).

By seeing context, all trainees established a consensus that controlling contractors should encourage subcontractors to participate in and share information in their confined spaces and permit-required confined spaces program orientations prior to engaging in confined-spaces-related activities, and multilaterally, subcontractors should open dialogue between controlling contractors and other employers in multiemployer jobsites.

Survey data verified that the flowchart illustrations were helpful for downstream trainings. Several participant trainers were able to use the flowcharts from the training material to demonstrate how the respective standard applies to specific industries and situations.

Limitations

The data presented in this study is from a small sample from one geographic area of the U.S. Data from the initial and follow-up surveys were self-reported and may not reflect every challenge that existed in managing a confined spaces program. The survey did not link pretest and posttest scores with individual identifiers. Thus, further analysis based on trainee characteristics such as experience was not possible. Additionally, survey data did not assess for impact upon trainees in downstream trainings performed by trainer participants.

Conclusions & Recommendations

Permit-required construction confined spaces pose serious risks to worker safety and health at construction sites. Many participants who completed the Rutgers construction confined spaces training were able to use their knowledge and understanding to develop and enhance their own downstream programs and training programs.

Training complicated topics such as the confined spaces in construction standard requires training toward general under-

standings whereby trainees can practice conceptual procedures and understand the whys and hows of a subject area. The Rutgers curriculum is a starting point for employers, managers and trainers to help enfranchise their respective workers into their injury and illness prevention programs and system processes. Several resources and references are available including systems such as the ADDIE model and ANSI/ASSP Z490.1, and review of such programs is both desirable and mandatory. **PSJ**

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Koshy Koshy, Ph.D., is an assistant professor in the Department of Environmental and Occupational Health and advisor for the OSH concentration at Rutgers School of Public Health. He also manages the Region 2 OSHA Training Institute Education Center at Rutgers SPH. Koshy is a professional member of ASSP's New Jersey Chapter.

Michael Presutti, B.A., is a course instructor at the Center for Public Health Workforce Development, Region 2 OSHA Training Institute Education Center at Rutgers School of Public Health. He is a risk control consultant with more than 2 decades of experience working in both the public and private sectors of industry.

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