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The Economic and Social Benefits of OSHA-10 Training in the Building and Construction Trades

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ABSTRACT

OSHA-10 training saves lives and reduces accidents and illnesses across the building and construction trades. Three examples from a survey of 195 workers on self-reported actions before and after training are that 75 percent of trainees carried things on ladders before training and after only 26 percent did, 37 percent of trainees reported checking a scaffold to see if it was constructed properly before training and after training the percent had increased to 79 percent, and only two-thirds had asked for PPE before training versus over 90 percent after.

Based on interviews with trainees and trainers, there are many real stories of OSHA-10 training making a difference. The savings, from accidents averted, run in the millions of dollars. If training could reduce injuries by just 2 percent a year, the savings would be \$336 million; if by 6 percent, then more than \$1 billion could be saved. Many of the savings discussed herein are rarely discussed in other analyses.

KEY FINDINGS

- OSHA-10 training promotes safer work practices.
- OSHA-10 training helps to prevent accidents and exposures.
- Accident prevention, resulting from OSHA-10 training, saves money for workers, employers, insurers, taxpayers.
- The full benefits of OSHA-10 training are not properly or fully measured.
- A new paradigm for measuring the full economic and social benefits of OSHA-10 training – and other health and safety programs -- is emerging and will help strengthen the case for strong occupational safety and health programs.

**THE ECONOMIC AND SOCIAL BENEFITS OF OSHA-10 TRAINING
IN THE BUILDING AND CONSTRUCTION TRADES**

TABLE OF CONTENTS

I. SETTING..... 3

II. RESEARCH STRATEGY 4
 A. Significance..... 4
 B. Innovation 4
 C. Approach..... 5

III. LITERATURE REVIEW 5
 A. Training Yields Results..... 7
 B. Short Review of Statistical Value of Life and Cost of Injury Literature 9

IV. RESULTS AND ANALYSIS OF OSHA-10 SURVEYS, INTERVIEWS,
 AND STORIES..... 11
 A. Survey Results 11
 B. Interviews with Apprentice Trainers, Coordinators, and Trainees 13

V. CHANGING THE PARADIGM 16

VI. THE BENEFITS OF OSHA-10 TRAINING 19
 A. Costs of Accidents, Based on Type of Injury 20
 B. Cost of Injuries/Illnesses for Actual Incidents..... 21

VII. SUMMARY AND CONCLUSIONS 29

BIBLIOGRAPHY

Tables

- Table 1: Trainees Opinion on the Importance of OSHA 10 Training
- Table 2: Was there anything you learned in OSHA-10 that makes you feel safer at work?
- Table 3: Changes in Safety Actions, Before vs. After OSHA-10 Training
- Table 4: Percentage Changes in Safety Actions, Before vs. After OSHA-10 Training

Charts

- Chart 1: Changes in Safety Actions, Before vs. After OSHA-10 Training
- Chart 2: Carrying Things While on a Ladder: Pre-Training vs. Post-OSHA-10 Training

Appendices

- Appendix I: Protection of Human Subjects
- Appendix II: Survey - Impact of OSHA-10 Training
- Appendix III: Elements of a New Paradigm

THE ECONOMIC AND SOCIAL BENEFITS OF OSHA-10 TRAINING IN THE BUILDING AND CONSTRUCTION TRADES

OSHA-10 training saves lives and reduces accidents and illnesses across the building and construction trades. Just three examples from a survey of 195 workers are:

- *Before training, 75 percent of trainees carried things on ladders. After training, there was a precipitous drop to 26 percent.*
- *Before training, only 37 percent of trainees reported checking a scaffold to see if it was constructed properly. After training, the percent had increased to 79 percent.*
- *Whereas two-thirds had asked for PPE before training, over 90 percent had asked for PPE after training.*

Based on interviews with trainees and trainers, there are many real stories of OSHA-10 training making a difference. The savings, from accidents averted, run in the millions of dollars. If OSHA-10 training could reduce injuries by just 2 percent a year, the savings would be \$336 million; if by 6 percent, then more than \$1 billion could be saved. The savings are far beyond what the Office of Management and Budget and OSHA calculate, because many of the savings discussed herein are rarely discussed in other analyses. A new paradigm is needed to embrace the full impact of saving life, limb, and health through training.

Major Findings:

- **OSHA-10 training promotes safer work practices.**
- **OSHA-10 training helps to prevent accidents and exposures.**
- **Accident prevention, resulting from OSHA-10 training, saves money for workers, employers, insurers, taxpayers.**
- **The full benefits of OSHA-10 training are not properly or fully measured.**
- **A new paradigm for measuring the full economic and social benefits of OSHA-10 training – and other health and safety programs -- is emerging and will help strengthen the case for strong occupational safety and health programs.**

“The Economic and Social Benefits of OSHA-10 Training in the Building and Construction Trades” is both a statistical and primary data study of the lives saved, accidents and illnesses averted, and unexpended funds resulting from basic health and safety awareness training. The study also documents ways that training helps to build basic work place safety infrastructure. Benefits of avoiding injury and illness accrue not only to workers and their employers, but also to insurers and taxpayers. In addition to a review of existing studies, this study includes surveys of apprentices and targeted confidential follow-up interviews with apprentice instructors and apprentices.¹ Surveys

¹ See Appendix I for discussion of Protection of Human Subjects and Appendix II for copy of survey.

were from at least six states and eight different building and construction trades unions. Interviews included additional states and building and construction trade unions.

The first hypothesis of this research (and one reinforced by new survey findings reported herein) is that OSHA-10 training has made a difference in hazard identification, in behavior modification, and work practice improvements; and that trades people work more safely – and suffer fewer accidents and exposures – because of OSHA-10 training. Less carrying on ladders, less standing on the top of ladders, checking on proper construction of scaffolds, more use of fall protection, and demands for other indicated personal protective equipment are just some of the work place improvements that have been documented in the past,² and are again documented in this study.

The second hypothesis of the paper is that these health and safety improvements not only save life, limb, and health, but they also save money for a wide range of people and organizations. With occupational safety and health actions and health and safety regulations being labeled, by some in today’s political environment, as high in cost and “job killers,” it is especially important to clearly and fully measure the benefits of OSHA-10 training as well as its costs.

The research of this report can help in the building of a new and improved paradigm for making health and safety decisions -- since it charts the course for inclusion of a broader range of impacts than occurs in most studies. Appendix III discusses more than two dozen elements of a new paradigm. In Section V of the text, the paradigm elements are discussed as they specifically relate to OSHA-10 training.

This study focuses on NORA goal *11.1.4* of the National Institute for Occupational Safety and Health (NIOSH): *“Identify methods of analysis and measures for effectiveness evaluation of training. Identify and address training effectiveness gaps of special relevance for construction.”*³

Expected outcomes of this research are:

- Specific monetary and other savings to workers, employers, insurers, and taxpayers
- Documentation of an improved environment for work place safety and health
- A catalogue of examples where training has made a difference

² See, for example, Ruttenberg, R. and Lazo (Obando), M. “Spanish-Speaking Construction Workers Discuss Their Safety Needs and Experiences,” Residential Construction Training Program Evaluation Report, The Center to Protect Workers’ Rights, 2003.

³ Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, NIOSH Program Portfolio, “NORA Construction Sector Strategic Goals,” <http://www.cdc.gov/niosh/programs/const/noragoals/Goal11.0/11.1.html>.

- Discussion of a model for an improved paradigm for health and safety decision making.

I. SETTING

Every year at least 4,500 workers die on the job and well over 3 million are injured.⁴ At least one leading scholar has put the numbers at 5,600 and 8.5 million.⁵ While lower than the number of victims before the advent of OSHA, the numbers are still far too high. And, these numbers do not include the tens of thousands more who die each year from work place illness. Training is one widely acknowledged strategy for achieving further reductions in injury and illness rates. By teaching workers about the hazards they face and how to do their jobs more safely, there are significant opportunities to improve work place safety and health. The following example is just one from an earlier survey of OSHA-10 trainees (targeting Hispanic workers):⁶

“I follow all the safety tips I learned in training. I was taught also how to build scaffolds and where to place them. I always check all the cables... Before the training, I had some safety instruction, but I could not understand everything. Sometimes I felt like nothing was understood. Before the training, I used to carry things on ladders: paper rolls, tools, lunch box, insulation, etc. I used to place them on my shoulder and climb. Now, I know that I should never carry things on ladders; now I use ropes. Also, before the training I used to think what a waste of time it was to place the safety flags, but now I know the importance of doing it.”

Training is an important component of any safety and health program. Over the years OSHA-10 training, in some cities and states, has become mandatory, before an individual can work on a construction site. OSHA’s outreach training program (which also includes the OSHA-30) reached over 750,000 workers in 2010. And 80 percent, or 600,000, were construction workers.⁷

The OSHA-10 program for construction requires -- besides a 2-hour introduction to OSHA, workers’ rights, and employer responsibilities -- 5 hours of modules on falls, electrocution, struck by, caught-in or between (the “focus four” group), personal protective equipment, and health hazards. The remaining 3 hours contain modules chosen from among: cranes, excavation, materials handling, scaffolds, ladders, and

⁴ U.S. Department of Labor, Occupational Safety and Health Administration, “Outreach Training Program,” <http://www.osha.gov/oshstats/commonstats.html>, 2010.

⁵ Leigh, J. P., “Economic Burden of Occupational Injury and Illness in the United States,” *Milbank Quarterly*, December 2011.

⁶ Ruttenberg, R. and Lazo (Obando), M., 2003.

⁷ U.S. Department of Labor, Occupational Safety and Health Administration, “Outreach Training Program: Construction Industry Procedures,” <http://www.osha.gov/dte/outreach/index.html>, accessed 2012.

power and hand tools.⁸ Enhancing this risk-specific training is the Smart Mark program for OSHA-10, developed by the Building and Construction Trades Department, AFL-CIO and CPWR-The Center for Construction Research and Training.

II. RESEARCH STRATEGY

The significance, innovation, and approach to this research are discussed below:

A. SIGNIFICANCE

A critical barrier to progress in assessing the effectiveness of training is the lack of a good benefits methodology. If policy makers consider costs without a full accounting of benefits, their decisions are likely to be flawed.

The results of this research improve the technical capacity for economists and others involved in regulatory analysis to better assess the full impact of OSHA-10 training. The methodology used in this research can then be applied to other training and regulatory arenas.

The results of this research should change decision-making at the work place. They should also change the expected parameters of regulatory analysis and the methods for assessing regulations. Instead of being seen as a “job killer,” OSHA training should be recognized for its net benefits in lives and health saved as well as in positive economic returns for workers, employers, insurers, and taxpayers and government – as well as the improvements in work environment.

B. INNOVATION

The results of this study should challenge and shift current paradigms, so that they do what basic economic theory requires: to bring all externalities into the equation. Currently many direct as well as indirect impacts, and a majority of benefits, are inappropriately left out of most, if not all, cost-benefit analysis.

The theoretical concept of including all externalities has long existed (by economists across the political spectrum), but the practice has been largely ignored. In part, this is because incorporating externalities can be extremely difficult. The methodology used in this research has significant advantages over current practice, because it brings practice closer to the theoretical goal of incorporating externalities.

This paper refines and improves existing methods for assessing benefits. It looks long-run as well as short run, indirect as well as direct, positive as well as negative. It also looks at the impact on workers, insurers, and taxpayers and government – not just at the costs to employers of health and safety improvements.

⁸ Ibid.

C. APPROACH

The strategy to identify economic and social benefits resulting from OSHA-10 training has three main parts:

1. The paper starts with a literature review and analysis of existing studies of the benefits of safety and health training.
2. The author then outlines the elements of a model for estimating the benefits of a health and safety action, with a clear focus on analyzing the impact of training.
3. This model is tested and enhanced through primary data collection, using surveys and follow-up interviews with apprentices who have received OSHA-10 training as well as apprentice instructors and coordinators who have provided the training.

Focus is on identifying changes in work practice and behavior as well as active efforts to improve safety. From the surveys, those, who said they had real life work place incidents to discuss, were interviewed. These “I have a story to tell” interviews identified incidents and exposures avoided as well as near misses. Two types of stories were sought: (1) those where an incident occurred before training and training could have made a difference; (2) those where, after training, an incident occurred or was avoided or mitigated because of training. Details of these incidents will be used to identify costs incurred and costs foregone (benefits).

Costs avoided, both economic and social, were calculated for incidents/exposures identified. General methods for doing this have already been tested by the author.⁹ These methods are further developed in this research paper. Foregone costs range from lost work days avoided to lower workers compensation costs to public sector costs saved because, for example, families (due to workers not being hurt) will not have to rely as much on safety net programs.

III. LITERATURE REVIEW

Training helps to build an environment of improved work place safety and health. Even before Dr. David Michaels became the head of OSHA, he explained the need for “A bold campaign to change the workplace culture of safety should be initiated. This can’t happen unless workers are trained and given the opportunity to play an active role.”¹⁰ According

⁹ Shapiro, S., Ruttenberg, R., and Leigh, J. P., “The Social Costs of Dangerous Products: An Empirical Investigation,” *Cornell Journal of Law and Public Policy*, Summer 2009 and Ruttenberg, R., Cardi, J., and Fenton, E., “Taxpayer Burden from Product-Related Harm,” *Kansas Journal of Law and Public Policy*, Fall 2011.

¹⁰ Walter, L., “Michaels: Focus on Workplace Safety Culture, Not Enforcement,” *EHS Today*, 2009, <http://ehstoday.com/standards/osha/workplace-safety-culture-not-enforcement-8275/>.

to OSHA, in the Michaels Administration, these improvements “have the single greatest impact on accident reduction of any process.”¹¹

Another view of the necessity of training in an environment conducive to work place improvements, comes from the private sector and Jane Ardern, the manager of Education and Information Services, for WorkSafe, who lists as one of seven critical criteria: “Training and improvement is provided for everyone.”¹²

According to an official of the International Union of Operating Engineers, “I have seen many construction accidents and have found almost all accidents were caused by a lack of training.”¹³

In Massachusetts, where OSHA-10 training is required for all workers employed at publicly-funded construction sites, University of Massachusetts-Lowell researcher Cora Roelofs found a strong consensus on the value of the training. One-third of 100 respondents, in the Roelofs research, said that following training they were more likely to take health and safety action.¹⁴

The director of Occupational Health Surveillance Program at the Massachusetts Department of Public Health, Letitia Davis, speaking of the requirement in Massachusetts requiring OSHA-10 training for construction workers on work sites with public funding, asserted that OSHA-10 “has helped young construction workers have an expectation of a safer construction workplace.”¹⁵

Jean Manoli, who provides training and compliance assistance as staff at the Massachusetts Department of Labor Standards, believes that OSHA-10 training is “becoming ‘industry standard’ and the ‘way of doing business’ in both construction and general industry.”¹⁶

A loss control specialist with Liberty Mutual Insurance, Ted Christensen, has said of many employers: “They recognize that you have to spend the money in training and

¹¹ U. S. Department of Labor, Occupational Safety and Health Administration, “Creating a Safety Culture,” http://www.osha.gov/SLTC/etools/safetyhealth/mod4_factsheets_culture.html, accessed August 2012.

¹² Ardern, J., WorkSafe, “Creating a Safety Culture,” http://www.commerce.wa.gov.au/worksafe/PDF/Forums/safety_culture-Jane_.pdf, accessed August 2012.

¹³ Emrick, R., IUOE, Deputy Project Director, Operating Engineer HAZMAT Training Program, “Testimony Before ODHS Hearing on Accreditation of Training Programs for Hazardous Waste Operations,” Docket #5-760-B, 1991.

¹⁴ Roelofs, C., “Evaluation of the Implementation and Impact of a Massachusetts Construction OHS Training Rule,” The Center for Construction Research and Training, Silver Spring, Maryland, June 2012, p. 25, <http://www.cpwr.com/pdfs/RoelofsReportOHSTrainingweb.pdf>.

¹⁵ Ibid.

¹⁶ Ibid., p. 22.

equipment and safety provides a return on the investment.” The value of training for worker safety, but also for the bottom line, is a growing realization among employers.¹⁷

OSHA-10 training is deemed so critical on construction work sites that it is now a requirement for work in many cities and states across the nation. New York City is just one of the cities. Connecticut, Massachusetts, Missouri, Nevada, New Hampshire, New York, and Rhode Island are states with OSHA-10 requirements. In addition, many general contractors have their own requirements for training as a prerequisite for working on one of their sites.

When CFR 1910.120 - Hazardous Waste Operations and Emergency Response (HAZWOPER) was promulgated, Hazmat clean-up companies complained about the potential cost associated with training. Years later, with an excellent record and few injuries, businesses seem to have stopped complaining.¹⁸

A. TRAINING YIELDS RESULTS

A study of over 9,200 World Trade Center rescue and recovery workers by the Centers for Disease Control found that “The strongest predictors of using adequate RPE [respiratory protective equipment] were being affiliated with construction, utilities or environmental remediation organizations and having received RPE training.”¹⁹ And workers who used respirators were less likely to have adverse respiratory outcomes. In discussing the study findings, Walter Jones, of the Laborers Health and Safety Fund of North America, points to the “statistically significant association that was found between prior worker training in respirator protection and subsequent effective usage during a disaster response.”²⁰

A 2007 study by a Tennessee sheet metal worker,²¹ concluded that OSHA-10 training was so valuable in preventing accidents that it should be required of all building and construction workers who work on public construction sites. His survey of 200 construction workers found:

¹⁷ Ibid., p. 19.

¹⁸ Jajuga, H., *Rail Workers Hazardous Materials Training Program Needs Assessment*, National Labor College, Silver Spring, Maryland, 2008 in Obando (Lazo), M., “Evaluation of the U.S. Department of Transportation Hazardous Materials Instructor Training Program,” Senior Project, National Labor College, Silver Spring, Maryland, 2009, p. 6.

¹⁹ Antao, V. D., Pallos, L. L., Shim, Y. K., Sapp, J. H., Brackbill, R. M., Cone, J. E., and Stellman, S. D., Farfel, M.R., “Respiratory protective equipment, mask use, and respiratory outcomes among World Trade Center rescue and recovery workers,” *Am J Ind Med*, 54(12), December 2011, abstract.

²⁰ Jones, W., “Prior Training Key to Successful PPE Use After 9/11,” *Lifelines*, Laborers Health and Safety Fund of North America, Vol. 9, Num. 8, January 2013.

²¹ Sanyang, A., “OSHA 10: Key in Construction Safety Awareness,” *Blueprints*, Vol. 7, No. 1, American Society for Safety Engineers, 2007.

- ✓ 89% said that taking the OSHA-10 made them more aware of work place hazards
- ✓ 87% believe that the OSHA-10 should be a requirement on construction sites
- ✓ 38% said that the knowledge gained from the OSHA-10 helped them prevent a possible accident.

For his 2010 Master’s Thesis from the University of Wisconsin-Stout, a student surveyed union construction workers in Eau Claire, Wisconsin, and 95 percent thought that the OSHA-10 should be required.²² And, nearly 90 percent said that they would feel safer at work if their co-workers had received OSHA-10 training.

A pilot project in Texas by the Texas Engineering Extension Service in partnership with the Texas Industrial Vocational Association introduced OSHA-10 into the public schools. The project was aimed at vocational high school students across Texas, and students received completion cards.²³

A study led by R. Sokas, of the University of Illinois-Chicago,²⁴ found that union construction workers, even after two training sessions as part of the OSHA-10, had improvements in knowledge and attitude three months after the training.

A study, by Dong et al., found that of more than 8,000 laborers in the state of Washington who had completed an OSHA training program, there was a 12 percent decline in workers’ compensation costs. The researchers came to this conclusion after evaluating health insurance records, union training records, and workers' compensation data for the two-year period 1993–1994.²⁵

A 2000 study out of the Medical College of Ohio found that safety orientation and training could reduce work place injuries for construction workers. Among plumbing and pipefitting workers who received safety orientations, “only 3.4% experienced injuries, compared with 11.1% of workers without orientations. Safety orientations were

²² Fechhelm, A., “Perceptions of OSHA 10-hour Training Effectiveness within Eau Claire, Wisconsin Trade Unions,” Masters Thesis, University of Wisconsin-Stout, May 2010.

²³ Schulte, P. A., Stephenson, C. M., Okun, A. H., Palassis, J., and Biddle, E., “Integrating Occupational Safety and Health Information Into Vocational and Technical Education and Other Workforce Preparation Programs,” *American Journal of Public Health*: March 2005, Vol. 95, No. 3, pp. 404-411. Article available at <http://ajph.aphapublications.org/doi/full/10.2105/AJPH.2004.047241>.

²⁴ Sokas, R., Jorgensen, E., Nickels, L., Gao, W., and Gittleman, J., “An Intervention Effectiveness Study of Hazard Awareness Training in the Construction Building Trades,” *Public Health Rep.* 2009; 124(Suppl 1): 161–168, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2708667/?tool=pubmed>.

²⁵ Dong, X., Entzel, P., Men, Y., Chowdhury, R., and Schneider, S., “Effects of safety and health training on work-related injury among construction laborers,” *J Occup Environ Med*, 46(12), December 2004 in Sokas, et al., 2009.

associated with a significant reduction in injuries (odds ratio, 0.23; 95% confidence interval, 0.15 to 0.35).”²⁶

A study of the Centers for Disease Control found that lack of training, was an important contributory factor in the higher rate of fatalities and injuries for Hispanic workers on construction sites: “inadequate knowledge and control of safety hazards and inadequate training and supervision of workers, often exacerbated by different languages and literacy levels of workers” as contributory factors based on federal and state investigations of the deaths of 200 Hispanic workers.”²⁷

At the Latino Health and Safety Summit in 2010, Secretary of Labor Hilda Solis said that “worker training was a central strategy to reduce Latino risk.”²⁸

B. SHORT REVIEW OF STATISTICAL VALUE OF LIFE AND COST OF INJURY LITERATURE

1. Statistical Value of Life

While distasteful, it is necessary, in today’s political environment, to assess the statistical value of a human life. This is a partial value, at best. Although the value of one’s life is impossible to measure *ex ante* (how much money would you take to give up, or give to keep, your life?), the value of life is typically measured by the economic consequences of a lost life to those still living. Economists use several different methods for estimating this cost, and estimates have a wide range.

A review of the literature done at the Wake Forest University Law School²⁹ cited the 2004 work of Joseph Aldy and W. Kip Viscusi,³⁰ who estimated the value of statistical life at more than \$5 million to \$6 million (\$6.1 million to \$7.3 million in 2012 dollars)

²⁶ Kinn, S., Khuder, S. A., Bisesi, M. S., and Woolley, S., “Evaluation of safety orientation and training programs for reducing injuries in the plumbing and pipefitting industry,” *J Occup Environ, Med*, 42(12), December 2000, abstract, <http://www.ncbi.nlm.nih.gov/pubmed/11125676/>.

²⁷ Centers for Disease Control and Prevention (CDC), “Work-related injury deaths among hispanics–United States, 1992-2006, *MMWR*, 2008, 57:597-600 in Roelofs, C., Sprague-Martinez, L., Brunette, M. and Azaroff, L., A qualitative investigation of Hispanic construction worker perspectives on factors impacting worksite safety and risk, *Environmental Health* 2011, 10:84, 2011, <http://www.ehjournal.net/content/10/1/84>.

²⁸ Roelofs, et al., *Environmental Health*, 2011.

²⁹ Palmiter, A. R., *Law & Valuation: Value of Life*, <http://users.wfu.edu/palmitar/Law&Valuation/chapter%202/2-1-5.htm> (last updated Mar. 15, 2005).

³⁰ Palmiter, citing Aldy, J. E. and Viscusi, W. K., *Age Variations in Workers’ Value of Statistical Life*, Harvard Law and Economics, Discussion Paper No. 468, 2004, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=607204.

for a person thirty to forty years old. Another Viscusi study,³¹ using 1997 data, found the value for blue collar workers at \$4.7 million to \$8.5 million (\$6.7 million to \$12.2 million in 2012 dollars), depending on gender and occupation. A 1999 study by Ludwig and Cook³² found the statistical value of life to be \$4.05 million to \$6.25 million, or \$5.6 million to \$8.6 million in 2012 dollars. The Office of Management and Budget, in its 2010 *Report to Congress on the Benefits and Costs of Federal Regulations*, actually recommends \$6.3 million, in 2008 dollars³³ (or \$6.7 million in 2012 dollars).

Work by the Food and Drug Administration, and cited by the Office of Management and Budget, introduces the idea of putting value on life years saved. This is significantly value laden, since, with this type of analysis, younger people are valued at a price far higher than older people. Working on an economic analysis related to tobacco, FDA estimated that the tobacco rule it was studying would save 900,000 life years, or four years per would-be smoker. It then used the controversial process of discounting those life years and found the monetized value of a life-year gained to be \$117,000.³⁴

2. Cost of Injury

According to a study published in the *American Journal of Industrial Medicine (JOEM)*, there were more than 3.2 million emergency room encounters with building and construction workers hurt on the job over a studied ten year period.³⁵ The study found that the average cost of these incidents was \$42,000 in 2002 dollars,³⁶ or \$54,000 in 2012

³¹ Viscusi, W. K., *The Value of Life: Estimates with Risks by Occupation and Industry*, Harvard Law Sch., Discussion Paper No. 422, 2003, http://www.law.harvard.edu/programs/olin_center/papers/pdf/422.pdf.

³² Ludwig, J. and Cook, P. J., *The Benefits of Reducing Gun Violence: Evidence from Contingent-Valuation Survey Data*, Nat'l Bureau of Econ. Research, Working Paper No. 7166, June 1999, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=171368.

³³ The White House, Office of Management and Budget, *2010 Report to Congress on the Benefits and Costs of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities*, 2010, http://www.whitehouse.gov/sites/default/files/omb/legislative/reports/2010_Benefit_Cost_Report.pdf.

³⁴ The White House, Office of Management and Budget, "Chapter III, Estimates of Benefits and Costs of 'Economically Significant' Rules," *Report to Congress on the Costs and Benefits of Federal Regulations*, http://www.whitehouse.gov/omb/inforeg_chap3/, accessed April 2013.

³⁵ Schoenfisch, A. L., Lipscomb, H. J., Shishlov, K., and Myers, D. J., "Nonfatal construction industry-related injuries treated in hospital emergency departments in the United States, 1998-2005," *American Journal of Industrial Medicine*, 53(6):570-80, June 2010.

³⁶ Waehrer, G. M., Dong, X. S., Miller, T., Men, Y., and Haile, E., "Occupational Injury Costs and Alternative Employment in Construction Trades," *Journal of Occupational and Environmental Medicine*, 2007, 49(11):1218-1227. These estimates include direct costs (such as payments for hospitals, physicians, medicines), indirect costs (wage losses and household production losses, costs of administering workers' compensation), and quality-of-life costs (value attributed to the pain and suffering that victims and their families experience as a result of injuries or illnesses).

dollars. Estimates by OSHA consultants for the Safety Pays³⁷ calculator, indicate direct plus indirect costs for injuries at \$20,000 (dermatitis) to \$310,000 (Multiple Injuries Including Both Physical and Psychological).

The *JOEM* study estimated that injuries account for 60 percent of the costs and fatalities 40 percent (fatality cost conservatively calculated as averaging \$4 million each in 2002 dollars, or \$5.1 million in 2012 dollars.)

Leigh et al. estimated the costs associated with occupational injury and illness³⁸ by assessing medical costs and insurance administration expenses as well as lost earnings, lost home production, and lost fringe benefits. They found that, in 2012 dollars, the average cost of an injury was \$19,036 and the average cost of an illness was \$46,077, for an average cost per incident of \$19,323.³⁹ These cost estimates are, in themselves, conservative because they do not include pain and suffering.

IV. RESULTS AND ANALYSIS OF OSHA-10 SURVEYS AND INTERVIEWS, AND STORIES

Building and construction trades workers are safer and healthier as a result of OSHA-10 training. The results of the surveys and interviews clearly indicate work place changes and practices post-training.

A. SURVEY RESULTS

Nearly 200 building and construction trades workers from at least eight unions⁴⁰ in six states⁴¹ completed surveys – either on-line or in hard copy -- about their experiences with OSHA-10 training. (See Appendix II for a copy of the survey.) Nearly half believed OSHA-10 training was “essential.” And the other half said that it was either “useful” or “very useful.” (See Table 1.) Nearly 90 percent said that as a result of OSHA-10, they had learned things that made them “feel safer at work.” (See Table 2.) If one can generalize from these 195 trade union construction workers, then 540,000 – over half a

³⁷ U.S. Department of Labor, Occupational Safety and Health Administration, “OSHA’s Safety Pays Program,” <http://www.osha.gov/dcsdp/smallbusiness/safetypays/index.html>.

³⁸ Leigh, J. P., et al., *Occupational Injury and Illness in the United States: Estimates of Costs, Morbidity, and Mortality*, 157 *Archives Internal Med.*, 1997, Abstract, <http://archinte.ama-assn.org/cgi/content/abstract/157/14/1557>.

³⁹ In the original 2002 dollars, these numbers were \$10,979, \$28,184, and \$12,102, respectively.

⁴⁰ International Association of Bridge, Structural, Ornamental and Reinforcing Iron Workers Union, International Association of Heat and Frost Insulators and Allied Workers, International Brotherhood of Electrical Workers, International Union of Bricklayers and Allied Craftworkers, Laborers International Union of North America, Sheet Metal Workers International Association, United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States, Canada and Australia, United Brotherhood of Carpenters.

⁴¹ California, Delaware, Illinois, Maryland, Ohio, Tennessee

million building and construction workers of the 600,000⁴² who have had OSHA-10 (and -30) feel safer at work. The two areas of most importance to these trainees were fall protection and ladder/scaffold safety, followed by PPE, general safety awareness, asking for MSDSs, and hazard recognition. Other responses ranged from learning about chemical exposure hazards to confined space, from CPR to avoiding asbestos.

What was the most important thing they learned from the OSHA-10? By far the most important thing that trainees learned was general safety importance and awareness (the major objective of OSHA-10). This was followed by proper use of PPE, ladder and scaffold safety, fall protection, hazard recognition, and personal responsibility for one's own safety. Other responses included knowledge about confined space, OSHA regulations and protections, MSDSs, and electrical safety.

Perhaps, most important, were changes in behavior that they reported making after their training. In all 13 areas of inquiry in the survey, trainees, post-training, were taking positive steps to improve their safety and health at work: (See Tables 3 and 4 and Chart A.)

- Before training, 75 percent of trainees carried things on ladders. After training, there was a precipitous drop to 26 percent.
- Before training, only 37 percent of trainees reported checking a scaffold to see if it was constructed properly. After training, the percent had increased to 79 percent.
- Before training, less than 40 percent had checked a Material Safety Data Sheet. After training, nearly 75 percent had checked an MSDS.
- Before training, less than 30 percent had asked about an emergency action plan. After training, the percent more than doubled to over 60 percent.
- Before training, fewer than 25 percent had looked up something about health and safety on line. After training, the percent had more than doubled to over 50 percent.
- Whereas two-thirds had asked for PPE before training, over 90 percent had asked for PPE after training.
- Fewer than 5 percent had looked at the 29CFR1926 before training, but nearly 30 percent had looked at it since training. In addition, the number who had thought about looking at the CFR but hadn't, nearly tripled.

⁴² OSHA's outreach training program (which also includes the OSHA-30) reached over 750,000 workers in 2010. And 80 percent, or 600,000, were construction workers. Based on 2010 numbers. U.S. Department of Labor, Occupational Safety and Health Administration, "Outreach Training Program, <http://www.osha.gov/dte/outreach/index.html>, accessed 2012.

- Only about 15 percent had contacted their health and safety committee, a journeyman, or an instructor at their school about a health and safety concern before training. Since training, the percentage rose to nearly 40 percent.
- Whereas just over half of trainees before training had suggested to a work colleague that he/she do something differently in order to work safer, after training, more than three-quarters had done so.
- While only just over 35 percent had fixed or reported an electrical hazard at work before training, over 55 percent had done so since training.
- Less than half of those surveyed had worried about getting cancer or lung disease from chemical exposure. Since training, more than two-thirds had worried about chemical exposure making them sick.
- While two-thirds had talked with fellow workers about a safety problem before training, since training over 85 percent had had conversations with fellow workers about safety problems.
- Before training, less than 3 percent had filed a complaint with OSHA. Since training, the percent rose to over 5 percent. And, the number who thought about filing a complaint more than doubled.

The suggestion from the above data is that fewer people are likely to fall, have a scaffold or ladder accident, or be exposed to hazardous noise or chemicals. If previously cited research⁴³ is correct, then of 600,000 construction workers receiving OSHA-10, 40,200 fewer injuries are likely (3.4% with training vs. 11.1% without).

B. INTERVIEWS WITH APPRENTICE TRAINERS, COORDINATORS, AND TRAINEES

Telephone interviews were conducted with trainers and coordinators from more than half a dozen different crafts and more than half a dozen different states. These individuals, all highly involved with OSHA-10 training were asked to provide cases of two types: (1) examples they knew of where an accident/exposure was avoided or lessened because of OSHA-10 training or (2) examples where an accident/exposure occurred, but might have been avoided or lessened if there had been training.

1. Common Unsafe Acts

- A seasoned instructor, when interviewed, admitted that he had frequently stood on the top of a ladder and worked on unsafe scaffolds – simply because he had to get a job done.

⁴³ Kinn, S., Khuder, S.A., Bisesi, M.S., and Woolley, S., “Evaluation of safety orientation and training programs for reducing injuries in the plumbing and pipefitting industry,” *J Occup Environ, Med*, 42(12), December 2000, abstract, <http://www.ncbi.nlm.nih.gov/pubmed/11125676/>.

- Another seasoned instructor was on site and saw an electrician standing on the top step of a 15 foot ladder. Why? The boss said there was just one connection, so he did not need to bother getting a taller ladder.
- A training coordinator admitted that he had three injuries from unsafe ladder use before he changed his personal practices. These included broken bones, with one requiring hospitalization and surgery, one involving a hospital emergency room, and one with a doctor's visit.
- A mid-western worker told of a major problem of having colleagues wear eye protection and eye shields, and the barbs that injure workers. He said that injuries often happen when there is just one small action that needs taken, so protection is not taken.

2. Training Made a Difference

- A training coordinator told of a trainee who had avoided injury and possible death by learning lock-out/tag-out in training. In training he had learned that when doing LO-TO one is supposed to measure voltage and report to the controller. After LO-TO, he got some strange voltage readings and checked it out. He saved himself from electrocution.
- One instructor said that OSHA-10 brings overall awareness. He says that he often gets apprentices looking at him and saying: "Do you know what my mechanic had me do yesterday?" This is because the mechanic is being pushed by management to move fast and save money. Training helps apprentices realize they have a voice and that they can speak up – especially on issues of fall protection and ladders. Apprentices often said that they should have tied off or not gone up a particular ladder. He thinks that training is getting folks to tie off.
- OSHA-10 saved the life of a Philadelphia glazier. The glazier was on a 2 point suspended scaffold outside a building and the motor froze in the down position. He tried to stop it, but it kept going. He was arrested by fall protection. The swing went down until it was vertical, but he was on his life line, dangling one hundred feet in the air. The fire truck boomed out, 15 feet short of the boom. There were another six tradesmen on the roof, and they threw him down a life line and independent looped lifelines (for foot insertion) were lowered. He was 20 feet away from a window and glaziers took out a window and used ropes and brought him toward the window and saved him. The training coordinator visited him in the hospital and asked what he was thinking in the moments he was dangling. About his wife and kids? "No. I thought about my OSHA-10 training and that I only had 15 minutes." (to live, unless the rescue was successful)

What are the consequences of such an "arrest"? Besides potential death, there is the possibility of serious injuries such as orthostatic intolerance, suspension trauma, and venous pooling. There may be hypothermia, a change in heart rate, blood pressure and cerebral blood flow, and the

victim may lose active muscle function. In addition, there may be lingering fear, doubt, anxiety, and the possibility of job loss.

- An individual who frequently works in confined space said that training definitely reinforced the need for continuing vigilance and that almost weekly there is a problem with air that monitoring detects. Training and changed practice have saved lives.

3. Lack of Training Can Bring Serious Risk

- From a journeyman electrician: “There was only one time I was told to do something I felt was unsafe. The lead man on the job told me to climb a twelve foot ladder. The bottom two rungs were broken and he screwed 2x4 to hold it together. He told me to climb up the ladder and off the top of it. I looked and said, ‘no-way.’ He said: ‘do it or you’re gone,’ and I tell him that’s not a problem and left. The next day I applied for the apprenticeship.”
- From a journeyman cement mason: “There is a case in ..., where an employer hadn’t trained his worker about working at heights, working on ladders etc. The employer had also not provided the necessary harnesses that this worker needed. The worker fell while working on a house and later died from his injuries, leaving behind a wife and child.”
- A trainer told of a story from a basic rigging class (not OSHA-10). “One guy was at a big mall, and the wind was so strong that a crane dropped a large load through the roof of the mall. The crane operator should have stopped earlier because of the wind. He was not from a main crane company, and he probably had not been properly trained. He probably had not known how to apply the math of the boom and load. This was part of a discussion where one trainee had come to get a card, because his employer had sent him out to a job where he needed to know rigging, but the contractor turned him away until he came back with a card.”
- A then 20 year old worker, now a seasoned trainer, worked with an electrician also in his 20’s who had a young child. One Christmas Eve, trying to get a plant up and running, that electrician was there working with the superintendent. The superintendent said something, and the electrician turned around and his elbow came in contact with the electrical panel. The superintendent grabbed the electrician, but the electrician died. Someone got wood to pry the superintendent away from the current. OSHA 10 teaches: when a person is working on a panel or in a box, never talk or interrupt, as a split second or inch of movement can cause death. That lesson, if learned by the superintendent, would have saved the electrician’s life.

- A superintendent's life was changed forever when pouring footers and putting forms together, simply because there were no rebar caps. The superintendent tripped and was impaled on 2 pieces of rebar. It was a miracle that no vital organs were hit as one went through his abdomen and one through his ribs. A torch cut the two rebar, and he was sent to the hospital with them still embedded. He'll never be able to really work construction again and it changed him and his attitude and personality. OSHA-10 training might have helped prevent the trip. Knowledge of fall hazards might have had easy to use recaps on the rebar.

V. CHANGING THE PARADIGM

This study helps to build a new paradigm – a new model for measuring the social and economic benefits and costs, associated with decisions to improve occupational safety and health. Considered here are more than two dozen elements of a measurement system, ranging from including all the externalities associated with a decision to assuming that new and more cost efficient techniques are likely to occur once industry is pushed in the direction of safer work places. While the model is not yet fully developed, these new elements are part of the analysis that follows. The elements of this newly emerging paradigm are defined and further discussed in Appendix III.

WHAT NEEDS TO BE DONE: BEGINNING OF A “PROGRESSIVE METHODOLOGY”

Below are short explanations and examples of how addressing the following 26 issues could help provide a fuller view of the economic and social impacts of OSHA-10 training.

1. It is important to ask the right questions. What happens to a family when a loved one dies or is hurt at work? If OSHA-10 training could prevent just one fall per year at a construction site, how would that improve on-time completion? What happens to workers compensation insurance rates if, after training, everyone wears, as needed, a harness/eye protection/chemical resistant gloves/hearing protection?
2. It is important to give a full accounting. As an example, all the out of pocket costs to a worker hurt at work – including transportation to medical appointments, babysitting while one is at a doctor's office, need for medically indicated but non-insured actions such as massage therapy or yoga – need to be included. Impacts on the victims' family members also need to be assessed.
3. It is important to build models and data bases to make the full costs and benefits clear to decision makers. If decision makers consider no more than just the short-run, direct, monetized costs to a company, one can not expect a good decision. OSHA-10 training may change work practices and behaviors in a number of ways – from compliance to awareness, from taking responsibility for safe personal actions and the actions of others, to insisting on proper testing of tools and equipment before using them. These, and many others need consideration.

4. Long-run costs and benefits need to be included and valued in analysis. OSHA-10 training can prevent workers from unknown silica exposure, saving them from death and/or fatal lung disease. But, those benefits may be 20 years post-training.
5. Indirect costs and benefits need to be part of analysis. OSHA-10 training by one employer may have benefits for other employers, as trained workers move from job to job. This is just one example.
6. The positive as well as the negative impacts of an action are crucial. Saving an employer from high workers compensation rates or higher health premiums can be, in part, the result of OSHA-10 training that reduces accidents and exposures.
7. Nonquantitative costs and benefits as well as those that are not best expressed in dollars need to be included. The empowerment felt by a worker to promote safe work practices can be infectious across work sites. It is important to determine what costs and benefits are best monetized, which are best quantified but not monetized, and which need to be stated qualitatively. The effect on children becoming orphans has some financial impacts that can be monetized. One can count the number of children orphaned. However, the full cost and emotional impact of having a parent die should be included but remain qualitative.
8. Analysis should be dynamic rather than static. No work site stays the same. Serious problems with welding fumes – and worker awareness -- may lead to new and improved welding hoods, changing work practice and chemical exposure. With workers exposed to fewer toxic chemicals, they may feel better and thereby be able to work more efficiently. If one makes decisions based on a static model, projections are unlikely to be accurate.
9. Time frame of costs and benefits needs to shift. The cost of OSHA-10 training occurs in the short-run, but the benefits – especially health benefits – may take years to emerge. This unevenness in timing requires an adjustment in analysis.
10. Distribution of costs and benefits needs focus. Costs and benefits do not fall equally on all parties. When an insured worker avoids an accident, the insurance company directly benefits. When an uninsured worker avoids an accident, the employer and the worker directly benefit, from a financial perspective. A worker may take training on his/her unpaid working time, but the employer benefits from that training. A worker's training may be paid for by the employer, but the employer may never know if that expenditure actually prevented an accident.
11. Corporate activities need to be viewed as inextricably interdependent. While a training department might be quite separate than a health benefits department in a company, their costs and benefits need to be viewed in a blended way. The training department cannot expect to account for the benefits that emanate from their expenditure of funds. The same is true with production or expenditures on plant and equipment, which may be partly for safety, but likely improve efficiency and effectiveness as well.

All affect the bottom line. Checking tools and electrical connections not only potentially saves life and limb, it also may save plant and equipment.

12. Incorporate externalities. Out-of-pocket costs for workers following an accident are often left out of analysis. So too are impacts on family members of victims. Costs associated with an OSHA accident inspection are related to an accident when, for example, an untrained worker does not use fall protection. Nonetheless, it may be a cost related to lack of training.

13. Transparency in methodology is an underpinning of analytic integrity. Each and every number used in analysis needs to be clearly cited and each and every step of a methodology to calculate costs and benefits needs to be explained. When measuring lost income, for example, when a job change is required, is it salary only or benefits as well that are being calculated? Are reductions, for example, in retirement and Social Security also calculated?

14. Carefully define “cost” and “benefit.” Is the cost of training a national average? For non-profits? For large corporations? Is the amount of health care dollars saved reflected in billings? Payments by insurance companies? Does it include out-of-pocket expenses to the victim? What about taxpayer support for hospital emergency rooms?

15. Correct for underreporting of fatalities, injuries, and illnesses. It is very difficult to accurately estimate accidents that were averted by training. It should be easier to estimate the number of fatalities, injuries, and illnesses that actually occur, but many go unreported. Existing statistics need a correction factor for unreported events.

16. Duplication with other rules needs to be subtracted out. Use of respirators, for example, may be necessary for silica, asbestos, and lead exposure, all present at the same work site. If one is taking action because of regulatory mandate, care must be taken not to attribute the cost of supplying the respirator three times – once for each hazard requirement.

17. Include a “technology improvement” discount in cost assessment. Do not rely on current technology only. All decision makers should assume that technological improvements will occur before making decisions. Blended on-line and classroom training allows technology when appropriate and the cost savings that can come with it. When for example, the hazards of carrying on ladders becomes a clear awareness of those with OSHA-10 training, new and innovative ways of finding alternatives to carrying are likely to emerge.

18. Look beyond the specific company or industry making a decision. Look too at the impact on the pollution control and hazard abatement industry. Many for-profit corporations have subdivisions that offer training not only internally, but to other companies. Training may become, for them, a profit center rather than a cost center.

19. Measure the value of years of the “free passes.” Companies sometimes complain about the costs of providing training. Not usually included in those cost estimates are the countervailing non-expenditure in the past.
20. Include sensitivity analysis. When studying the costs of a decision, multiple estimates should be made to determine how sensitive the resulting cost is to changes in assumptions.
21. Include a “best case” and “uncertainty” analysis. Too often corporate decision making is based on the worst case level of costs. Training can provide major savings when accidents are prevented. The uncertainty of the number of possible accidents that could occur without training should also be included in analyses.
22. The baseline for cost estimation should be from the level of compliance that exists at the time of regulation, not a zero compliance baseline. Even though a company might not be in compliance with rules for OSHA-10 training, it is likely some employees have OSHA-10 cards. So, in estimating the cost of training a work force, the baseline should not be zero.
23. Measure the costs of not taking action, or of serious delays. Not training workers, or not training them until well after they begin to work on a job site, leaves many more dead, maimed, and otherwise injured. Very often, it is those newest to construction who are injured. Increasingly, for example, union apprentice programs are making OSHA-10 mandatory before their students are on-the-job.
24. Consider a social cost-benefit analysis as a partner to the conventional economic cost-benefit analysis. As indicated in the work of this paper, a social cost-benefit analysis on the impact of OSHA-10 training would clearly show the enormous social benefits that can result.
25. Reject remaining life years. While remaining life years were used as an illustrative example in this report, they should be rejected as an analytic technique. The use of remaining life years seriously prejudices analysis against older workers.
26. Have a rigorous analysis of past studies and decisions. The actual costs of training should be compared to what analysts thought training would cost prior to regulations. In addition, because early studies on the economic impact of training did not seriously consider or identify specific economic and social benefits, reviewing those old studies would reveal serious analytic flaws.

VI. THE BENEFITS OF OSHA-10 TRAINING

Every accident or illness prevented saves companies tens, if not hundreds, of thousands of dollars. Prevention of an incident means that company sales can go to other expenses and profit rather than paying medical bills and related expenses. This section of the study first explains some of those costs savings on a per accident basis, based on stories from trainers, coordinators and trainees about incidents averted by OSHA-10 training, or

occurring in part because of lack of training. The economic benefits alone can be significant.

A. COSTS OF ACCIDENTS, BASED ON TYPE OF INJURY

A single accident can easily cost a company \$100,000 to \$200,000. A calculator was developed by the National Council on Compensation Insurance, coupled with research by Stanford University and the Business Roundtable, for use by OSHA and its web site users. According to the calculator, the direct costs, for example, for an electric shock is over \$90,000 and the indirect costs over \$100,000 – for a total of nearly \$195,000. The direct costs of a fracture are \$45,000 with indirect costs of \$50,000.⁴⁴ According to OSHA’s Safety Pays calculator, with a profit margin of 3% (the calculator’s default), a company would need, to pay for both direct and indirect costs, \$6.5 million and \$3.1 million respectively. Avoiding an accident or illness, seen through this lens is very important, just for a quick economic perspective.

The Safety Pays calculator estimates the direct and indirect costs of accidents, as well as the amount of sales a company would need in order to pay for those costs. Costs are calculated by the National Council on Compensation Insurance, which manages the nation’s largest data base of workers compensation information, and reflects the average cost of lost time workers compensation insurance claims.

Indirect costs are from the Business Roundtable, based on a study by the Stanford University, Department of Civil Engineering.⁴⁵ Indirect costs include:

- Wages paid to injured workers for absences not covered by workers’ compensation
- Wage costs related to time lost through work stoppage associated with the worker injury
- Overtime costs necessitated by the injury
- Administrative time spent by supervisors, safety personnel, and clerical workers after an injury
- Training costs for a replacement worker
- Lost productivity related to work rescheduling, new employee learning curves, and accommodation of injured employees
- Clean-up, repair, and replacement costs of damaged material, machinery, and property.

⁴⁴ U.S. Department of Labor, OSHA, “Safety Pays.”

⁴⁵ Safety Pays uses a sliding scale to determine indirect costs:

Direct Costs	Indirect Cost Ratio
\$0-\$2,999	4.5
\$3,000-\$4,999	1.6
\$5,000-\$9,999	1.2
More than \$10,000	1.1

But the indirect costs do not include, according to OSHA:

- The costs of OSHA fines and any associated legal action
- Third-party liability and legal costs
- Worker pain and suffering
- Loss of good will from bad publicity.

Indirect costs also do not include impacts on a worker's family, such as a spouse or child needing to quit a job to take care of the injured family member or a family member having to leave school to either take care of the injured family member or find a job to make up for lost family income. It does not take into account costs associated with psychological problems caused by an injury that may lead to substance abuse, physical abuse, or other damaging behavior. In other words, the high costs of accidents calculated by Safety Pays is still only part of the full picture. The data in the Safety Pays calculator is from 2006-2008. If adjusted to 2013 dollars, the costs would be still higher.

B. COST OF INJURIES/ILLNESSES FOR ACTUAL INCIDENTS

Below are just five examples of stories, told to the author, by trainees, trainers, and training coordinators. They involve common hazards, and OSHA-10 either did make a difference or could have made a difference. In some cases details, about the family members affected and long-term effects, were known and in others they were assumed. The nature of the incident is based on interview. The aftermaths and family details are based as much as possible on fact as told to the author, but post-injury or death details are mostly composites from other, but similar, case studies with which the author is familiar. The portion of each scenario that comes specifically from an interview is underlined. While not all injuries lead to extreme family impact, far more have such far-reaching effects, but it is rare for these effects to be fully accounted for or fully known.

- For each death, an additional \$500,000 or more was calculated, beyond the OMB statistical value of a human life.
- For each significant injury, additional costs ranged from tens of thousands of dollars to hundreds of thousands of dollars, often tripling the direct and indirect costs estimated by OSHA in its Safety Pays calculator. There is a lot of academic work to do, to fully assess the economic and social costs of OSHA-10 training.

1. OSHA-10 is key in saving the life of a 30 year old glazier, because he and his fellow workers knew, as a result of training, that he had only 15 minutes while dangling at 100 feet in his harness after a fall due to mechanical failure. The worker himself says the motivation for rapid rescue, while hanging suspended, was his knowledge from OSHA-10 that he had only 15 minutes to live, unless the rescue was successful.

According to OMB estimates, his death would have had direct and indirect costs of more than \$6.7 million.⁴⁶ According to OSHA,⁴⁷ an injury with multiple injuries, both physical and psychological, would have average direct plus indirect costs of \$310,264, and in a firm with a three percent profit margin, would require over \$10.3 million in additional sales to cover the cost of the injury.⁴⁸ Averting death, or serious injury, saved at least \$300,000 and as much as \$7 million.

Not included in these totals are other family impacts that might have been averted by the successful rescue. Long-term care is included in the OSHA estimates, which are averages. In some cases, long-term care for a younger worker can be well over \$1 million – certainly beyond the maximum for workers compensation. In addition, had he died, his children would have been eligible for Social Security survivor benefits. The lack of income might have made his family of 4 survivors eligible for food stamps and Medicaid, say for 5 years until the widow re-established a stable household. Had he been seriously injured, he might have been eligible for long-term Social Security disability benefits. The family of five (children aged 10, 12, and 14) would have been eligible for food stamps and Medicaid, say for 5 years until the family re-established a stable household. In either case, his widow might have required a year of weekly grief counseling and psychotherapy. In either case, his children would have been deprived a parent. In all likelihood the family would have to move to cheaper housing to adapt to new financial reality, causing many additional disruptions to the family.

⁴⁶ See section in literature review on estimating the statistical value of human life.

⁴⁷ U.S. Department of Labor, OSHA, “Safety Pays.”

⁴⁸ If using the FDA and OMB-used concept of life years saved, with a 2012 value of at least \$117,000, then this 30 year old worker, if he were to live to 75 years of age, would have prevented costs of \$5.3 million. If he would live to 85 years of age the costs averted would be \$6.4 million. In the author’s opinion, the life years saved concept, is seriously flawed in many ways, and breaks down from an economic perspective: A person living the ten years from ages 75-85, according to the life years saved concept, would have the value of saving his life at age 30 rise from \$5.3 million to \$6.4 million, but during that 10 year span, he is likely to be costing society and the taxpayer rather than “paying in.”

**Benefits from Avoiding Death or More Serious Injury
High Level Fall Rescue**

	Direct & Indirect Costs	Social Security for Survivors ⁴⁹	Soc. Sec. Disability for Victim ⁵⁰	Medicaid ⁵¹	Food Stamps ⁵²	Psycho-Therapy for Widow ⁵³	Total Costs
If he had died	\$6.7 million	\$162,000	na	\$139,400	\$25,920	\$5,882	\$7,033,202
If seriously injured	\$310,264	na	\$447,720	\$167,280	\$32,400	na	\$957,664

By leaving out such factors as Social Security disability or survivor benefits, health care for family members, and social safety net factors, the OSHA estimates rise by over \$330,000 in the event of a fatality, and more than triple if the result of the accident was a serious injury.

2. *OSHA-10 saves worker from electrocution because he did a check of equipment before he started work, and it was faulty. It could have saved another worker from death. A 20 year old electrical worker, on a Christmas Eve, trying to get a plant up and running, was working with his superintendent. The superintendent said something and the electrician turned around and his elbow came in contact with the electrical panel. The superintendent grabbed the electrician, but the worker died. Someone got wood to pry the superintendent away from the current. OSHA-10 teaches: when a person is working on a panel or in a box, never talk or interrupt, as a split second or inch of movement can*

⁴⁹ Eighteen combined years of survivor benefits for the 3 children at \$750 a month amounts to \$486,000.

⁵⁰ U.S. Social Security Administration, "Supplemental Security Income benefit amount - How much will I receive in Supplemental Security Income (SSI) benefits?" http://ssa-custhelp.ssa.gov/app/answers/detail/a_id/85, accessed April 2013. Effective January 2013, the maximum Federal SSI payment for an eligible individual is \$710 per month and for an eligible couple \$1,066 per month. However, some states supplement the federal SSI payment. SSI benefit amounts and state supplemental payment amounts vary based upon ... income, living arrangements and other factors. A couple with 35 years until age 65, would collect \$447,720, not including cost of living increases.

⁵¹ Federal and state government spent approximately \$5,296 a year in 2010 (\$5,576 in 2012 dollars) on each person on Medicaid. Gilmer, T. and Kronick, R., "Reinventing Medicaid: Differences In The Volume Of Services And In Prices Drive Big Variations In Medicaid Spending Among US States And Regions," *Health Aff*, July 2011, cited in 24/7 Wall Street, <http://247wallst.com/2011/07/15/the-states-that-spend-the-most-and-least-on-healthcare-for-the-poor/>.

⁵² Average Food Stamp cost per individual was \$101 in 2009, or \$108 in 2012 dollars. U.S. Department of Agriculture, *Supplemental Nutrition Assistance Program: Frequently Asked Questions*, <http://www.fns.usda.gov/snap/faqs.htm#9> (last modified May 11, 2011.)

⁵³ National average for psychotherapy costs is \$113.12 in 2012 dollars. Based on calculations in Shapiro, S., Ruttenberg, R., Leigh, P., "The Social Costs of Dangerous Products: An Empirical Investigation," *Cornell Journal of Law and Public Policy*, Volume 18, Number 3, Summer 2009.

cause death. That lesson, if learned by the superintendent, could have saved the electrician's life.

According to Safety Pays, direct cost of an electric shock is \$92,000, with total cost of \$194,000, when indirect costs are added. This injury requires the company to take in \$6.5 million more in sales, just to pay the expenses associated with the accident. According to the Office of Management and Budget, the statistical value of the life lost is \$6.7 million.

In addition, the family will never be able to joyfully celebrate Christmas again. The wife, in a deep depression, needs weekly psychotherapy for two years. Unable to work because of her depression, she and her son lose their home and they live in transitional housing for the homeless, for twelve months. She gets back on her feet slowly, requiring food stamps and Medicaid for an additional 5 years, until she finally, through retraining, gets a job that can support the family.

Also, the individual responsible for diverting the attention of the working electrician is never the same. He loses his job and is without income until he finds work again after a year. His family of six requires social services, namely Medicaid and food stamps for that year. He is despondent and after 3 years commits suicide, largely, according to his family, from the on-going guilt he feels for the Christmas Eve tragedy. His four children (then 5, 7, 9 and 11) receive Social Security survivor payments for a total of 40 years collectively). There may be a long-term need for continuing services for this family, but they are not included here.

As seen in the table below, basic safety practices around electrical work could have saved two lives and immeasurable heart ache, not to speak of over \$7.2 million (and the statistical value of the superintendent's life is not even included).

**Benefits from Avoiding Death or More Serious Injury
Electrocution**

	Direct & Indirect Costs	Psycho-Therapy ⁵⁴	Home-Less Shelter ⁵⁵	Food Stamps ⁵⁶	Medicaid ⁵⁷	One Year Lost Income of Associate ⁵⁸	Survivor Benefits for Assoc. Children ⁵⁹	Total
If he had died	\$6.7 million	\$11,764	\$36,192	\$12,960	\$89,216	\$50,232	\$360,000	\$7,260,364
If seriously injured	\$194,000	na	na	\$19,440	\$89,216	\$50,232	na	\$352,888

3. Injury by the “just one more:” The cost of standing on top of a ladder for one more action leads to an ambulance, broken and dislocated shoulder, and surgery. This 35 year old individual had to suffer this, a third ladder injury, to finally adopt ladder safety in his work practice. The first two injuries were not as serious as the third. In the third, the break was severe, and he was out of work for three months. Even though he received workers’ compensation, he fell behind on many family payments, and his son

⁵⁴ National average for psychotherapy costs is \$113.12 in 2012 dollars. Based on calculations in Shapiro, Rutenberg, and Leigh, 2009..

⁵⁵ According to HUD, the costs per household per month for transitional housing for the homeless, in 2006, ranged from \$813 to \$4,482, for an average of \$2,648 (or \$3,016 in 2012 dollars). U.S. Department of Housing and Urban Development, Office of Policy Development and Research, *Costs Associated with First-Time Homelessness for Families and Individuals*, March 2010, http://www.huduser.org/portal/publications/povsoc/cost_homelessness.html.

⁵⁶ Average Food Stamp cost per individual was \$101 in 2009, or \$108 in 2012 dollars. *Supplemental Nutrition Assistance Program: Frequently Asked Questions*, U.S. Department of Agriculture., available at <http://www.fns.usda.gov/snap/faqs.htm#9> (last modified May 11, 2011).

⁵⁷ Federal and state government spent approximately \$5,296 a year in 2010 (\$5,576 in 2012 dollars) on each person on Medicaid. Gilmer, T. and Kronick, R., “Reinventing Medicaid: Differences In The Volume Of Services And In Prices Drive Big Variations In Medicaid Spending Among US States And Regions,” *Health Aff*, July 2011, cited in 24/7 Wall Street, <http://247wallst.com/2011/07/15/the-states-that-spend-the-most-and-least-on-healthcare-for-the-poor/>. The total represents Medicaid payments for the first household of two for five years and for the second household of six for one year.

⁵⁸ Average hourly earnings for non-supervisory construction workers in December 2012 was \$24.15 (not including benefits, to be conservative in estimates), U.S. Department of Labor, Bureau of Labor Statistics, *Industries at a Glance, Construction: NAICS 23*, <http://www.bls.gov/iag/tgs/iag23.htm#earnings>, accessed April 2013. Full-time pay, therefore, would be \$50,232.

⁵⁹ Children survivors are eligible for 75% of the worker’s benefit. If Social Security benefits would have been \$1,000 a month for the worker, then each of the 4 children would receive \$750 per month until age 18. These 40 years of payments would amount to \$360,000 (not including cost-of-living increases).

left school for a semester to help the family make car and mortgage payments. According to Safety Pays, the cost of a dislocation is over \$145,000, requiring additional sales by the company of \$4.8 million.

His loss in hourly rate, after six months of unemployment, is \$10 per hour. Ten dollars less per hour over 30 years is \$600,000. As a result of reduced income, his son has to quit his music lessons and daughter drops out of ballet and leaves the swim team. Both children begin doing poorly in their school work because of the 20 hour a week after school jobs they take to keep the family on an even keel. While previously on a college prep track, they now terminate their education after high school, implying, for the two of them, over \$425,000 less in life-time earnings. The direct and indirect costs as calculated by OSHA are only about 10 percent of total cost and the direct costs only about 5 percent.

One small step to the top of the ladder affected an entire family and cost nearly \$1.3 million.

Benefits from Avoiding Death or More Serious Injury Fall from Top of Ladder

	Direct & Indirect Costs	½ Year Postponed Salary-Son⁶⁰	Lower Wage Rate Over Working Life-Time -30 Years	Reduced Children’s Lifetime Earnings for Not Going to College⁶¹	Total Costs
If seriously injured	\$145,000	\$15,000	\$600,000	\$427,749	\$1,287,749

4. *Injury by the “just one more:” A worker stands on the top of a fifteen foot ladder. He knew he should get a taller ladder, but his foreman told him that there was just one more connection, so he should continue using the ladder he was on – not safe use of a ladder and not tied off.*⁶² While this worker was lucky and finished the job unhurt, just before that another worker had fallen from 15 feet, due to unsafe actions, and crushed his femur.

⁶⁰ Assumed to be \$15 per hour for six months.

⁶¹ Based on calculations in Shapiro, Ruttenberg, and Leigh, 2009. The article uses data from Cosca, Theresa, “Earnings of College Graduates 1996,” *Occupational Outlook*, Fall 1998 that indicates persons with a high school degree earn 36 percent less than persons with a Bachelor’s degree. The Cornell Journal article is in 2008 dollars; the 2012 value is \$427,749.

⁶² While scenario 4 is similar to scenario 3, it is included because so many accidents are caused by ignoring safety for “just one more” weld or “just one more” electrical connection or “just one more” spot to paint. This is one practice where safety thinking needs to improve.

According to Safety Pays, a crushing injury has direct costs, on average, of \$49,817 and indirect costs of \$54,798, for a total of \$104,615. An additional \$3.5 million in sales would be needed to compensate for these costs. As a result of his long convalescence, the injured worker became despondent and his excess drinking left him an alcoholic. He required a rehabilitation program for alcoholism. After a year away from work with only half that time covered by workers compensation, with retraining complete, he returns to a non-construction job. (Not counted here is the financially “poor investment” in an expensive apprenticeship.)

Standing on top of a ladder cost hospitalization and rehabilitation, loss of a career, alcoholism, and \$140,000.

**Benefits from Avoiding Death or More Serious Injury
Fall from Top of Ladder**

	Direct & Indirect Costs	Alcohol Recovery⁶³	Retraining⁶⁴	Six Months Lost Income⁶⁵	Total Costs
If seriously injured	\$104,615	\$4,901	\$5,000	\$25,116	\$139,632

5. OSHA-10 training on how to prevent trips and falls could have saved a worker who, untrained, navigated a scaffold unsafely, tripped, fell, and was impaled on two rebar. Before ambulance transport to the hospital the rebar were cut and the impaled sections went with the individual to the hospital. The rebar narrowly missed vital organs. At the hospital he had surgery, followed by a week in intensive care, another week in the hospital, yet another week in a rehabilitation facility and bed rest and recuperation for another month. He suffered multiple injuries, both physical and psychological, which Safety Pays estimates at a cost of over \$300,000. At age 45, his career as a construction worker was over. He became angry at his physical state and became abusive of his wife. Within a year he harmed her physically. She had \$10,000 of medical bills and \$20,000 in lost wages. He spent 3 months in prison. Each had \$10,000 in legal bills. It was two years before he received a disability check, by which time he was in bankruptcy. By this time his two daughters had dropped out of college for financial reasons, and took jobs. They never went back to school. The costs beyond OSHA’s direct and indirect estimates

⁶³ U.S. Department of Health and Human Services, Substance Abuse and Mental Health Services Administration, "Alcohol and Drug Services Study Cost Study," SAMSHA News Release, December 31, 2008, <http://alcoholism.about.com/od/pro/a/blsam040527.htm> , accessed April 2013. The study finds that residential treatment for alcohol or drug abuse cost \$3,840 per admission, or \$4901 in 2012 dollars.

⁶⁴ There are a wide range of estimates and a wide array of opportunities for retraining. An amount of \$5,000 could cover, for example an academic certificate program.

⁶⁵ Average hourly earnings for non-supervisory construction workers in December 2012 was \$24.15 (not including benefits, to be conservative in estimates), <http://www.bls.gov/iag/tgs/iag23.htm#earnings>. Six months of pay, would be \$25,116.

are more than twice the OSHA estimate. The quantifiable costs associated with this one trip on the job: nearly \$1 million. The heartache: infinite.

**Benefits from Avoiding Death or More Serious Injury
Impaled on Two Rebar**

	Direct and Indirect Costs	Treatment for Wife	Wife's Lost Wages	Legal Costs	Prison Cost ⁶⁶	His Disability Until Age ⁶⁷ 65 (18 Years)	Lost Wages of 2 Daughters for Not Having Gone to College ⁶⁸	Total Costs
If he had died	\$6.7 million	na	na	na	na	na	na	\$6,700,000
If seriously injured	\$310,264	\$10,000	\$20,000	\$20,000	\$16,250	\$153,360	\$427,749	\$957,623

* * * * *

Who bears the costs of the above incidents? According to research published in the *Journal of Occupational and Environmental Medicine*,⁶⁹ Workers' Compensation only pays for 46 percent of the medical costs of work-related injuries. Private insurance pays 32 percent. The worker pays 9 percent (and for Hispanic workers, out-of-pocket is 23 percent). Remaining 13 percent is paid by other sources – including Medicare, Medicaid, Veterans Affairs, Civilian Health and Medical Program of the Uniformed Services, and other local, state, or federal programs.

Certainly not all injuries lead to severe family hardship as in the cases above, but a significant number do. When they do, the “ancillary” costs associated with the injury – from abuse, legal problems, children dropping out of school, disability or survivor benefits through Social Security, etc. are almost never calculated into the costs of the accident.

⁶⁶ Pew Center on the States, “One in 100: Behind Bars in America,” 2008, http://www.pewstates.org/uploadedFiles/PCS_Assets/2008/one%20in%20100.pdf. Researchers cite \$65,000 per bed as the best approximation for a typical medium security facility for a year.

⁶⁷ Effective January 2013, the maximum Federal SSI payment for an eligible individual is \$710 per month. However, some states supplement the federal SSI payment. SSI benefit amounts and state supplemental payment amounts vary based upon ... income, living arrangements and other factors, http://ssa-custhelp.ssa.gov/app/answers/detail/a_id/85. A 45-year old individual, with 20 years until age 65, would collect \$170,400, not including cost of living increases.

⁶⁸ Based on calculations in Shapiro, Rутtenberg, and Leigh, 2009. The article uses data from Cosca that indicates persons with a high school degree earn 36 percent less than persons with a Bachelor's degree. The Cornell Journal article is in 2008 dollars; the 2012 value is \$427,749.

⁶⁹ Dong, X., Ringen, K., Men, Y., and Fujimoto, A., “Medical Costs and Sources of Payment for Work-Related Injuries Among Hispanic Construction Workers,” *Journal of Occupational and Environmental Medicine*, Volume 49, Number 12, December 2007.

The direct and indirect costs of fatalities and injuries in construction are estimated at \$13 billion per year in 2002 dollars,⁷⁰ or more than \$16.8 billion in 2012 dollars. If OSHA-10 training could reduce injuries by just 2 percent a year, the savings would be \$336 million; if by 6 percent, then more than \$1 billion could be saved.

VII. SUMMARY AND CONCLUSIONS

Very clear from this research is the profound importance of OSHA-10 training and its contribution to improving the safety and health of workers. The worker survey was clear on changes in work practice and behavior as a result of basic awareness training. If just a few percent of falls, trips, electrocutions, caught between could be avoided or lessened in severity, not only would many thousands more workers be alive and healthy, but millions – hundreds of millions -- of dollars would be saved. With an average cost of \$210 per trainee⁷¹ and savings per incident well over \$100,000, the cost-benefit ratio is an extremely positive number. From the surveys and interviews, it is clear that many more building and construction trades workers are wearing fall protection as well as eye and hearing protection. They are talking to their work colleagues about unsafe practices they see. They feel increasingly empowered and are asking about emergency action plans and material safety data sheet. They are looking on-line for information about hazards. They are checking scaffolds and ladders before using them and have cut back on such unsafe activities as standing on the top of ladders and carrying things as they climb.

Injuries, illnesses, and fatalities come with a high toll. Total direct and indirect costs for injuries range, according to OSHA, from \$20,000 to over \$300,000 – with indirect costs usually accounting for 50 percent or more of the total. In years past, these indirect costs were rarely measured. Today, as demonstrated in this study, there is another group of costs that can easily double, or even triple, the direct and indirect totals. These are social and economic impacts that are also incurred because of an incident. They often involve third-party payments, or stress on the victim or his/her family members. The financial pressures on a family can include the need for a caregiver, need for additional income to fill in the gap between previous earnings and workers compensation, or psychotherapy for family members to cope with new realities. When children lose their chance at college and higher future earnings, the impact can be hundreds of thousands of dollars. When an injured worker loses a career path and for the remaining years of working life is slated for a job earning less per hour, or a job with no retirement benefits, the results can also be hundreds of thousands of dollars.

The costs of injuries, in incidents based on stories, told to the author by CPWR training recipients and advisors, could easily amount to a million dollars or more. Many of the costs are not usually considered. The statistical costs of each fatality, as calculated in this

⁷⁰ Waehrer, et al., 2007.

⁷¹ This is the cost estimate of one large non-profit training provider – based on \$3,777 for a class of 18. This includes airfare, hotel, rental car and per diem for the instructor. When an instructor is local and these travel costs do not apply, the cost is significantly less than \$210 per student.

paper easily exceed \$7 million. For each death, an additional \$300,000 or more was calculated, beyond the OMB statistical value of a human life. There is a lot of academic work to do, to fully assess the economic and social costs of OSHA-10 training. These costs are just as real as costs associated with hospital stays or lost work days.

The array of costs and benefits needs a new lens for analysis. The distribution and timing of impact are just two key elements of the many discussed herein. A new paradigm is emerging and is further along because of this OSHA-10 study.

**THE CENTER FOR CONSTRUCTION RESEARCH AND TRAINING (CPWR)
IMPACT OF OSHA-10 TRAINING SURVEY**

TABLE 1

TRAINEES OPINION ON THE IMPORTANCE OF OSHA-10 TRAINING

I think OSHA-10 training is:	#	%
a. Essential	91	47.4
b. Very useful	54	28.1
c. Useful	34	17.7
d. Could be a lot better	9	4.7
e. A waste of my time	4	2.1
<i>TOTAL</i>	<i>192</i>	<i>100.0</i>
No answer	3	-

**THE CENTER FOR CONSTRUCTION RESEARCH AND TRAINING (CPWR)
IMPACT OF OSHA-10 TRAINING SURVEY**

TABLE 2

**WAS THERE ANYTHING YOU LEARNED IN OSHA-10
THAT MAKES YOU FEEL SAFER AT WORK?**

	#	%
Yes	171	87.7
No	24	12.3
<i>Total</i>	<i>195</i>	<i>100</i>

**THE CENTER FOR CONSTRUCTION RESEARCH AND TRAINING (CPWR)
IMPACT OF OSHA-10 TRAINING SURVEY**

**TABLE 3
CHANGES IN SAFETY ACTIONS, BEFORE VS. AFTER OSHA-10 TRAINING**

	<u>Before receiving OSHA-10 training</u>				<u>Since receiving OSHA-10 training</u>			
	Yes	No, But I Thought About It	No	# Responses	Yes	No, But I Thought About It	No	# Responses
Check an MSDS	72	17	106	195	143	13	37	193
Ask for PPE	129	13	52	194	178	5	10	193
Carry things while on a ladder	146	18	30	194	50	12	129	191
Check a scaffold to see if it was constructed properly	71	36	85	192	151	7	34	192
File a complaint with OSHA	5	10	179	194	10	21	162	193
Contact your health and safety committee, a journeyman, or an instructor at your school about a health and safety concern	32	25	138	195	76	21	96	193
Look up something about health and safety on line	46	21	128	195	103	12	77	192
Look at the 29CFR1926	9	7	179	195	56	19	118	193
Worry about getting cancer or lung disease from chemical exposure	94	32	69	195	131	15	47	193
Fix or report an electrical hazard at work	71	19	104	194	109	9	75	193
Talk with fellow workers about a safety problem	130	14	51	195	165	5	23	193
Ask about an emergency action plan	56	28	111	195	120	16	57	193
Suggest to a work colleague that he/she do something differently in order to work safer	109	26	60	195	149	6	38	193
Had someone ask you a question because you were OSHA trained?	-	-	-	-	74	0	119	193

TABLE 3

**THE CENTER FOR CONSTRUCTION RESEARCH AND TRAINING (CPWR)
IMPACT OF OSHA-10 TRAINING SURVEY**

**TABLE 4
PERCENTAGE CHANGES IN SAFETY ACTIONS, BEFORE VS. AFTER OSHA-10 TRAINING**

	Before receiving OSHA-10 training				Since receiving OSHA-10 training			
	%				%			
	Yes	No, But I Thought About It	No	# Responses	Yes	No, But I Thought About It	No	# Responses
Check an MSDS	36.9	8.7	54.4	195	74.1	6.7	19.2	193
Ask for PPE	66.5	6.7	26.8	194	92.2	2.6	5.2	193
Carry things while on a ladder	75.3	9.3	15.5	194	26.2	6.3	67.5	191
Check a scaffold to see if it was constructed properly	37.0	18.8	44.3	192	78.6	3.7	17.7	192
File a complaint with OSHA	2.6	5.2	92.3	194	5.2	10.9	83.9	193
Contact your health and safety committee, a journeyman, or an instructor at your school about a health and safety concern	16.4	12.8	70.8	195	39.4	10.9	49.7	193
Look up something about health and safety on line	23.6	10.8	65.6	195	53.7	6.3	40.1	192
Look at the 29CFR1926	4.6	3.6	91.8	195	29.0	9.8	61.1	193
Worry about getting cancer or lung disease from chemical exposure	48.2	16.4	35.4	195	67.9	7.8	24.4	193
Fix or report an electrical hazard at work	36.6	9.8	53.6	194	56.5	4.7	38.9	193
Talk with fellow workers about a safety problem	66.7	7.2	26.2	195	85.5	2.6	11.9	193
Ask about an emergency action plan	28.7	14.4	56.9	195	62.2	8.3	29.5	193
Suggest to a work colleague that he/she do something differently in order to work safer	55.9	13.3	30.8	195	77.2	3.1	19.7	193
Had someone ask you a question because you were OSHA trained?	-	-	-	-	38.3	0.0	61.7	193

TABLE 4

CHART 1

CHANGES IN SAFETY ACTIONS, BEFORE VS. AFTER OSHA-10 TRAINING

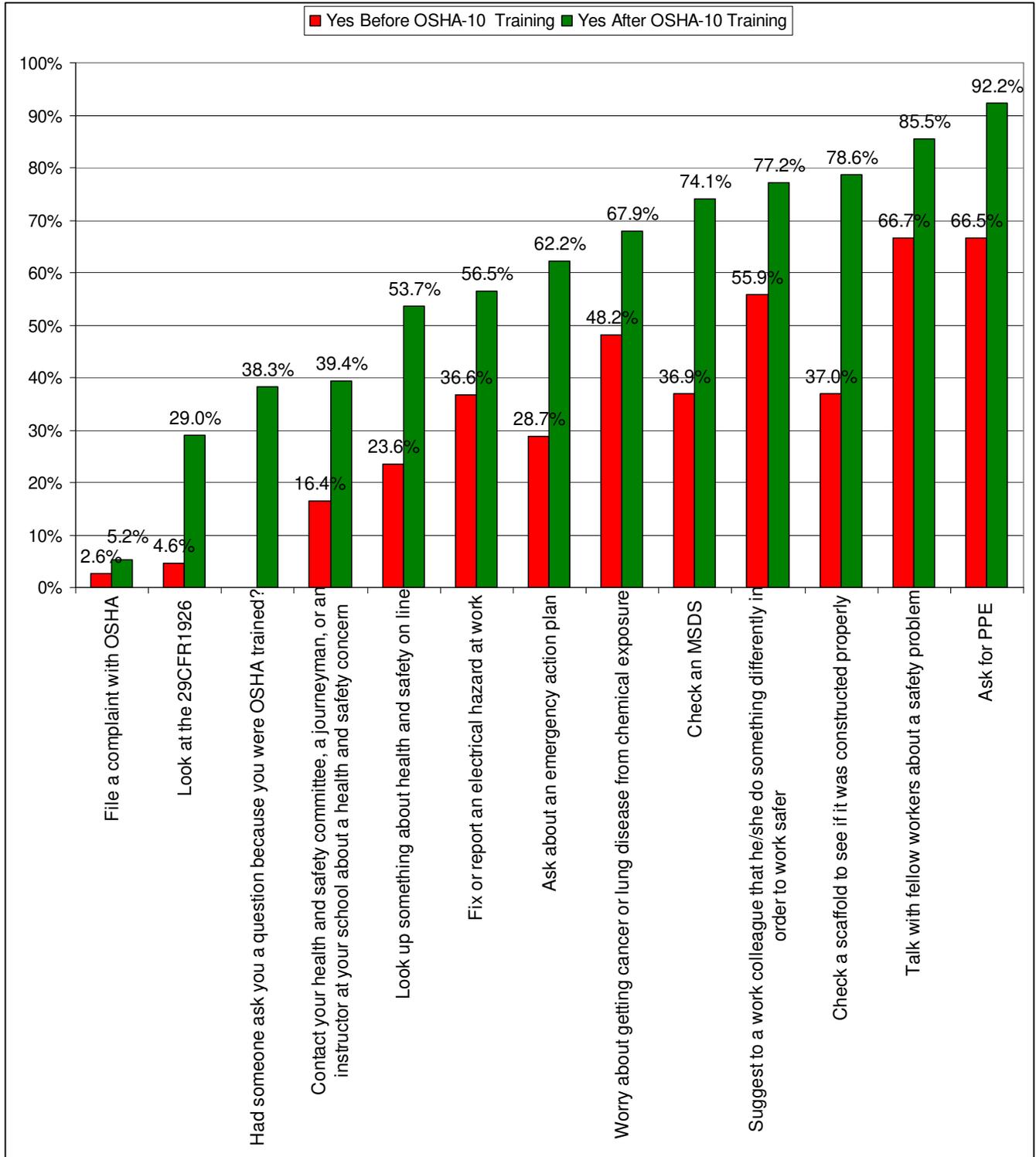
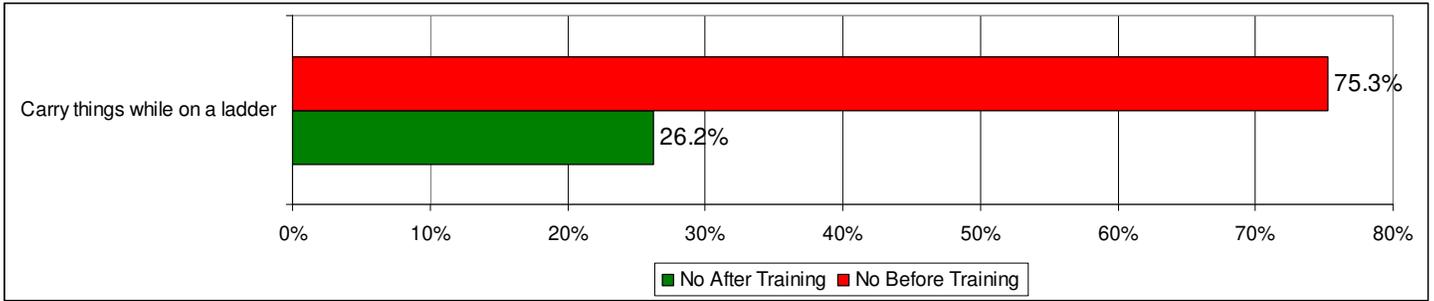


CHART 2

CARRYING THINGS WHILE ON A LADDER PRE-TRAINING VS. POST-OSHA-10 TRAINING



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APPENDIX I

PROTECTION OF HUMAN SUBJECTS

The study involves human subjects. All survey responses were anonymous and voluntary. (If a person had “a story to tell,” there was a tear off sheet to provide contact information, thus maintaining anonymity.) The only identifying information was craft and apprentice school location by state. All survey forms were destroyed once data were entered into the data base. Interviews were completely confidential and notes only identified craft and apprentice school’s state location.

The specific number of women, minorities, and children (ages 18-20) is unknown. If there are 200 apprentices surveyed and if the apprentices represent the general construction population (unlikely though since the Bureau of Labor Statistics shows fewer women and minorities in union work than in construction generally), then there would be 51 women, 127 Caucasians, 58 Hispanics, 12 African Americans, and 3 Asians. Informants were not asked their gender, race, or ethnicity, so the actual percentages are not known.

The study was eligible for expedited review by the CPWR IRB, since the surveys were all anonymous and the survey forms, contact information for interviews, and interview notes were first secured and then destroyed after data were entered. Respondents were informed that their participation was entirely voluntary.

APPENDIX II

SURVEY IMPACT OF OSHA-10 TRAINING

This is an anonymous survey. It in no way affects your training status. Your instructors will not see your individual survey, but you will all get the aggregated results, which are being filled out in apprentice training schools across the United States and across building and construction trade crafts. Completing this survey is voluntary, and you may choose not to take it. The objective is NOT to assess you in any way. Rather, it is being done by the Center for Construction Research and Training (CPWR is part of the AFL-CIO) in a study of the value of OSHA-10 training. We appreciate your help. Since it is anonymous, please be completely honest. Please provide as much detail as possible. We don't know who you are, so please don't be concerned with grammar or spelling. If you'd rather take this survey in Spanish, please call Maria at 301-978-1271.

1. What is the most important thing that you remember from OSHA-10 training?

2. Was there anything you learned in OSHA-10 that makes you feel safer at work?

Yes No

If so, what? _____

3. Before receiving OSHA-10 training, did you ever	YES	NO, BUT I THOUGHT ABOUT IT	NO
Check an MSDS			
Ask for PPE			
Carry things while on a ladder			
Check a scaffold to see if it was constructed properly			
File a complaint with OSHA			
Contact your health and safety committee, a journeyman, or an instructor at your school about a health and safety concern			
Look up something about health and safety on line			
Look at the 29CFR1926			
Worry about getting cancer or lung disease from chemical exposure			
Fix or report an electrical hazard at work			
Talk with fellow workers about a safety problem			
Ask about an emergency action plan			
Suggest to a work colleague that he/she do something differently in order to work safer			

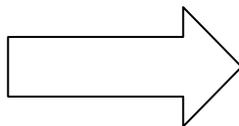
5. Since receiving OSHA-10 training have you:	YES	NO, BUT I THOUGHT ABOUT IT	NO
Checked an MSDS			
Asked for PPE			
Carried things while on a ladder			
Checked a scaffold to see if it was constructed properly			
Filed a complaint with OSHA			
Contacted your health and safety committee, a journeyman, an instructor at your school about a health and safety concern			
Looked up something about health and safety on line			
Looked at the 29CFR1926			
Worried about getting cancer or lung disease from chemical exposure			
Fixed or reported an electrical hazard at work			
Talked with fellow workers about a safety problem			
Asked about an emergency action plan			
Suggested to a work colleague that he/she do something differently in order to work safer			
Had someone ask you a question because you were OSHA trained?			

6. I think OSHA-10 training is: (Please select the best answer.)

- a. Essential
- b. Very useful
- c. Useful
- d. Could be a lot better
- e. A waste of my time

DO YOU HAVE A SAFETY STORY TO TELL?

Before training, were you or someone at work involved in an accident that might have been avoided if you had already received OSHA-10 training? Have you been in a situation, since OSHA-10 training, where an accident was avoided or less serious because of training? If so, we would like to talk with you. If you are willing, please fill out the form on the next page and separate it from this survey when you turn it in, so that your survey answers will remain anonymous.



If you have a story to tell, please fill out this form and detach it from your survey (so your survey will stay anonymous), and had in both your survey form and the "I have a story to tell form.

DO YOU HAVE A STORY TO TELL?

Before training were you or someone at work involved in an accident that might have been avoided if you had already received OSHA-10 training? Have you been in a situation, since OSHA-10 training, where an accident was avoided or less serious because of training? If so, please provide your name, e-mail and phone number, so that we may talk with you and hear your experiences.

I have a story to tell. Please contact me at:

NAME: _____

TELEPHONE: _____

Best time to be contacted: _____

EMAIL: _____

Thanks very much for completing the survey.

Ruth Ruttenberg and Maria Obando
for the Center for Construction Research and Training, AFL-CIO

APPENDIX III

ELEMENTS OF A NEW PARADIGM

A new paradigm – a “progressive methodology” -- is necessary to more fully assess the costs and benefits of occupational safety and health decisions. We need to remember the reason for safety and health activities – to protect lives and health. Measuring the costs of making safety and health improvement only, is not just lacking in logical balance, it is lacking in logic altogether. Below are more than two dozen elements of what can help such a paradigm emerge:

1. It is Important to Ask the Right Questions

“How much did this action cost?” is the simplest and most frequently asked question, but there are literally hundreds of different methodologies that can be used to answer this question. The question needs to be clearly defined and targeted: What is the expected economic cost to businesses over, say, 10 years – taking into account likely methods of compliance, learning curves, development of substitute products and, processes, and other investment cycles and depreciation schedules already in place. Or, assuming that nothing has been done to comply with currently existing regulations (i.e., a zero baseline), what outlay in retrofitting technology that is currently in place would be necessary in the short-run? These are just two questions and the answers to them would be significantly different. Left as just a general “how much does it cost?” question allows a wide range of definitions of cost and assumptions about cost estimates.

2. It is Important to Give a Full Accounting

The benefits of healthier and more productive members of society are crucial to include in any analysis. EPA ignores a long list of unquantified social benefits and says that these social benefits “could overwhelm the benefits it does quantify.”⁷²

3. It is Important to Build Models and Data Bases to Make the Full Costs and Benefits Clear to Decision Makers

And, it is important “to present these full costs and benefits in academically sound and analytically rigorous ways.”⁷³ The dictionary definitions of cost focus not on dollars, but on sacrifice, distress, pain, and suffering. Likewise, definitions of benefits focus on value and welfare.

⁷² EPA cited in Harrington, W., Morgenstern, R.D and Nelson, P., *On the Accuracy of Regulatory Cost Estimates*, Resources for the Future, Discussion Paper 99-18, 1999.

⁷³ Ruttenberg, R. “Can Protecting Human Health and the Environment Be Justified on Cost-Benefit Grounds?” *Preventive Strategies for Living in a Chemical World*, Volume 837 of the *Annals of the New York Academy of Sciences*, December 26, 1997, p. 456.

4. Long-Run Costs and Benefits Need to Be Included and Valued In Analysis

Decision making information definitely needs to go beyond reports on quarterly profits or year-end balance sheets and needs to include the impact of diseases with 20 years or more of latency. As a result, discounting becomes inappropriate. By making the present more important than the future, the value of preventing future disease is valued less and less as the latency period becomes longer.

It is, therefore, inappropriate to discount when dealing with the long latency periods that are associated with disease from environmental, product, or work-place hazards. A health policy which mandates healthful environments, despite latency periods for the onset of disease after 20 or more years, cannot be analyzed within an economic framework in which time is money. Public health policy has mandated the risk of disease is as important as the risk of injury. And treating occupational diseases usually costs more than treating injuries. But what does the economist say? Economists, being well aware that a dollar today is worth more than a dollar tomorrow, use the concept of discounted present value when comparing flows of money (costs and benefits) during various time periods. If one can postpone a payment of say \$50,000 for ten years, one has that \$50,000 to invest in moneymaking activities for that 10 year period. If the economist wants to compare the value of \$50,000 today with the value of \$50,000 in ten years, one needs to take into account the income that could be earned if the \$50,000 payment were delayed for 10 years. If for example one could earn 10% per year on the money, then one only needs to put \$19,300 into an investment earning 10% annually to be able to withdraw \$50,000 at the end of 10 years. Clearly a businessperson acting in his or her self-interest would prefer paying \$19,300 than \$50,000. It should be clear why the economic system works so poorly when disease latency periods are long. If one could postpone payment for 30 years using the above example, one need only put up \$2,850 today. Need one ask why industry prefers compensation 30 years down the road to preventive engineering today? Discounting is a disruptive tool for making intergenerational welfare comparisons.⁷⁴

5. Indirect Costs and Benefits Need to Be Part of Analysis

Indirect costs and benefits include effects on families when a worker is injured or becomes chronically ill; the economic effect on a community when, because of badly polluted air, it becomes difficult to recruit new businesses. The public sector suffers, since as victims cease to be wage earners, they pay fewer taxes and may need safety net programs, Social Security, and/or workers, compensation.

6. The Positive As Well As the Negative Impacts of an Action are Crucial

Benefit analysis must be part of any decision making. There needs to be a focus on the economic and social assets of healthy workers and healthy community residents. Since the main purpose of health and safety improvements is to achieve benefits, measuring the benefits should be the chief and number one priority. It is unacceptable for costs that should have always been the responsibility of industry to dominate the debate.

⁷⁴ Harrington, Heinzerling, and Nelson, 2009, pp. 15, 42.

The benefits of work place health and safety improvements are profound and may be measured in a number of ways. Just a few:

- They change the culture. Environmental regulations have brought focus to clean air, clean water, and safe soil. Occupational safety and health decisions begin to change the culture of safety in many industries and work places – changes that alter investment in plant and equipment, training, analysis of near misses, and demands for safer practices.
- Investment in safety and health directly saves lives – a fall that is broken by a safety harness or a life saved when measuring confined space shows lethal doses of toxic gases.
- Engineering controls eliminate many hazards.
- Training empowers workers to protect their safety and health on a daily basis and teaches them what to do in an emergency.

7. Nonquantitative Costs and Benefits As Well As Those That are Not Best Expressed in Dollars Need to Be Included

A focus is needed on life, good health, and a longer life. It is important to determine what costs and benefits are best monetized, which are best quantified but not monetized, and which need to be stated qualitatively. Clearly the easiest comparison of costs and benefits is if all are monetized. But since regulatory policy emerges when the market fails to allocate health and safety and environmental quality according to societal values, to use only economics to assess the impact of regulation is counterintuitive. Some costs and benefits are better quantified than monetized. Some are best expressed in qualitative terms.

8. Analysis Should Be Dynamic Rather Than Static

Most analysis “fails to capture the dynamic and innovative ways in which regulatees often comply.”⁷⁵ Regulation and other pressures to make health and safety improvements can indeed be the “mother of invention.”⁷⁶ Once forced to comply, industry will seek the cheapest, most cost-efficient solution – not static, more expensive ones. But, instead of looking toward this inevitable dynamic, more expensive, “off the shelf” technologies are often used in cost equations. It is this very fact according to the Office of Technology Assessment, is the cause of most of OSHA’s overestimates of cost.⁷⁷ Even the Office of Management and Budget concurs, saying that “technological improvements are often cited as the reason that predicted costs of compliance often turn out to be less than actual costs.”⁷⁸

⁷⁵ McGarity and Ruttenberg, p. 2048.

⁷⁶ Ruttenberg, R., “Regulation is the Mother of Invention,” *Working Papers for a New Society*, 42, 44-45, May/June 1981.

⁷⁷ U.S. Congress, Office of Technology Assessment, *Gauging Control Technology and Regulatory Impacts in Occupational Safety and Health*, 1995, p. 64.

⁷⁸ Office of Management and Budget, “Third Annual OMB Report on the Costs and Benefits of Regulation,” p. 13, cited in McGarity and Ruttenberg, p. 2049.

Another static problem with most analyses is that they ignore depreciation schedules and reinvestment cycles that are part of how industry operates. Replacement costs may differ significantly depending on when in that reinvestment cycle new capital is purchased. Regulation and other pressures to improve health and safety could help industry be more cost efficient by taking such cycles and schedules into account when determining compliance deadlines.

9. Time Frame Of Costs And Benefits Needs To Shift

Because the time frame for the development of technological improvements and for the purchase and depreciation of capital are well beyond the one year limit, the use of the concept “profit” which focuses on year-end net income only, is inappropriate as a key measure. The year of a major capital investment in equipment, which will further the protection of worker health and safety over decades, is not the proper time frame to account for the cost of that equipment. The concept of “profitability,” on the other hand, which extends the time frame of analysis, and looks rather at the longer-run viability and profit-making ability of a corporation is more appropriate, and should be used at least in conjunction with more traditional measures of year-end profits.

Profitability should be a partner goal with profit in corporate decision making. Analysis should consider long-run economic health to be as important as short-run economic health within a corporation.⁷⁹

As long as industry efforts at compliance are mostly determined by minimum short-run expenditures, compliance research and development will continue to be thought of as separate from innovative research and development, and the frequent complaint of drains on productivity, innovation, and growth should not be unexpected.⁸⁰

10. Distribution of Costs and Benefits Needs Focus

Most direct costs of improving occupational safety and health are borne by the industries that cause the risks, while most of the benefits go to otherwise endangered workers, consumers, and community residents. Within a company, the division that saves money (where medical payments are made) are likely to benefit more than the part of the company that pays for the improvement (production). An action’s impact becomes as much a question of equity and of the redistribution of costs and benefits as a problem reducible to a simple cost/benefit ratio.⁸¹

11. Corporate Activities Need To Be Viewed As Inextricably Interdependent

Even if they are activities of different subsidiaries within a single corporation, the finance, production, personnel, marketing, accounting, safety and health, should all be part of a

⁷⁹ Ruttenberg, R. “As the Economy Changes – So Must Our Economic Decision Making,” *Hazardous Materials Management Journal*, May/June 1980, p.11.

⁸⁰ Ibid.

⁸¹ Ruttenberg, R., “Why Social Regulatory Policy Requires New Definitions and Techniques for Assessing Costs and Benefits: The Case of Occupational Safety and Health, *Labor Studies Journal*, Spring 1981, p.115.

coordinated analysis. Those, within a single corporate entity, who pay compensation and those who pay to maintain a production facility often lack communication. This author studied a case years ago in which 3 workers over a period of a few years became totally and permanently disabled in a city repair shop, easily costing more than a million dollars. When less than \$100 was spent to cover a hole into which workers were falling, the hazard was eliminated. Those in management said that a coordinated view would probably have led to a quicker resolution of the problem.⁸²

R&D for safety and health needs to be integrated into innovative R&D. Just as innovations in energy conservation are becoming integrated into other research activities, so too should environmental and occupational safety and health.

There are many offsets to health and safety expenditures. These offsets should be transparent and integrated into cost and benefit calculations. Ingersoll-Rand, for example, turned organic waste into compacted, sulfur-free fuel pellets, so fuel became a by-product of pollution control. Occidental Petroleum turned waste to energy, producing steam and electrical energy from refuse. Celanese Corporation found a way to use bacteria to convert contaminants in an effluent to methane gas, which in turn is used to meet part of that plant's fuel requirements.⁸³

Not all change is due to health and safety improvements, so not all costs should be counted as health and safety burden. The Environmental Protection Agency in its 1990 report,⁸⁴ for example, acknowledges that some costs would have existed anyway; e.g., all capital sewerage costs are not because of regulation.

12. Incorporate Externalities

Economic theory, regardless of the political persuasion of the economist, teaches to eliminate externalities. External costs should be internalized and that should be a major aim of occupational safety and health analyses. Industry should pay the price to clean up the air, water and workplace hazards it creates. Automobile drivers should pay the cost of cleaning up the air pollution and for the problems of congestion that their automobiles create. Manufacturers should pay the costs associated with making safe the drugs, food, and other consumer products they make. Economists, when they become policy makers, seem to forget this. Achieving such fundamental change in the allocation of costs in society cannot be expected without a fight from those who now hold the economic advantage, but economic policy (even if it defies politics) should not.

There is a fundamental paradigm conflict – when conventional economics and industry costs dominate the debate. The domination of economics in health and safety work place decisions poses a problem. Social regulatory policy, such as occupational safety and health, is in the

⁸² Ruttenberg, R., "Economic Impact of Extending OSHA Coverage to Public Employees," for American Federation of State, County, and Municipal Employees, 1994.

⁸³ Ruttenberg, R. *Hazardous Materials Management Journal*, p. 16.

⁸⁴ EPA cited in Shapiro, Ruttenberg, and Leigh, 2009.

public domain precisely because the economic system has failed to achieve an adequate solution to the problems of workplace hazards. To base decisions, on an analysis that uses the theories of an economic system that has failed, would seem to contradict basic logic. Yet, this is precisely what happens. Economists try to use conventional theories despite the fact that there are many critical and acknowledged externalities; despite the fact that many commodities involved (most importantly human life and human health) defy the dollar value which economists require for conventional analysis.

When something has no price, it escapes from the economic system. One way this commonly happens is when someone gets something for nothing or when whoever had the product loses it without being paid for it (creating an externality). Common goods – public goods – have historically fallen into this category. A business could use up a community’s clean air or clean water, never having paid for it to begin with. The business got something for nothing. The community is left without its common “property” and is also uncompensated for its loss. The market has failed. When workers lose their health, and even their lives; they are often left uncompensated or are less than fully compensated for what they have lost. A business may have hired a healthy worker, but used up that health without paying for what it took. Without a price, the market simply cannot work. So to use that failed market as the focus for analyzing health and safety decisions or regulatory impact, is flawed. A new paradigm is needed.

Built into the economic analysis that leads to industrial decisions are the costs industry is likely to incur and the income that is likely to accrue. If industry does not pay for (or pays little for) a degraded environment or for sick or injured or dead workers, these problems are likely to be ignored. If a business incurs no consequences for the pain and suffering of an individual worker and his/her family; if a business continues to have a ready supply of labor; if a business incurs no additional costs despite increases in public expenditures for hospitals, research and transfer payments; then all these issues remain external to business decision-making, and are treated as if they are zero. Business has been getting valuable goods for free. But when asked to clean up or prevent the negative consequences of their actions, they often respond as if the burden should not be theirs.

The quality of life, the quality of family life, the physical and mental health of all concerned, the quality of the natural environment, the general business climate in a community are all enhanced by a reduction in the numbers and severity of occupational accidents and illnesses. Far more than lost work days and foregone future earnings need to be measured

13. Transparency In Methodology Is An Underpinning Of Analytic Integrity

A keystone in academic training is to document one’s methodology sufficiently that another can retrace the steps and obtain the same results. Somehow, though, this has been missing from far too many analyses of costs and benefits. With 39 years of experience, the author has found this to be a constant problem. When the author first began reviewing business decisions about investment in occupational safety and health, in 1974, she was asked to critique OSHA’s analysis for a proposed noise standard. When she asked OSHA for the equations that were the basis for the Bolt, Beranek, and Neuman study that OSHA had funded, OSHA responded that it had never seen them, and no one had ever asked for them before. They made a request and they were

finally produced for review. Fast forward to 2010-2011. The Small Business Administration's Office of Advocacy commissioned Crain & Crain to study the economic impact of regulation.⁸⁵ Only the barest bones of methodology were shared in the report. The response to a request to SBA for the background methodology was that they had never seen the equations or data and no one had every asked for them. They simply replied that "the data are publicly available." While their data sources may be available, how they used the data remains a mystery that they are unwilling or unable to explain. Authors should be held accountable, especially when relying on academic credentials. When private corporations are asked for the data upon which their decisions or arguments against health and safety investments are made, the right to keep decisions proprietary is frequently the response.

In their book, *Reforming Regulatory Impact Analysis*, Harrington, Heinzerling, and Morgenstern emphasize the need for transparency.⁸⁶ They provide five overarching recommendations for improvement of analysis of costs and benefits. One recommendation is to "ensure greater transparency at all stages of the process." This recommendation ranks with technical quality, relevance to decision making, treatment of new scientific findings, and balance of the analyses.

14. Carefully Define "Cost" And "Benefit"

What is a cost and what is a benefit? When, for example, a nonferrous smelting and refining facility comes into operation, what part of the capital cost of the facility should be expressed as costs associated with safety and health? What productivity gains above previous productivity levels should be expressed as benefits?⁸⁷ When a new cotton textile spinning machine is purchased that eliminates dust from the air, in order to keep the machine clean and functioning, is the cost of that machine appropriate to "charge" to the cost of keeping dust exposure from workers? When workers benefit from the clean air, does one also count the benefits to the capital equipment that simultaneously is not getting "gummed" up and not having to cause a shut down of the line to clean it?

Cost estimates have often been the "dumping ground" for a wide range of costs that are not due to a regulation being studied. In 1990, EPA sent *Environmental Investments: The Cost of a Clean Environment* to the Congress, putting a \$115 billion per year price tag on protecting and restoring the nation's air, water, and land. The estimate included all of the costs incurred by municipalities in trash pickup and disposal – not a burden that federal environmental programs typically pay.⁸⁸ Analysts need to be meticulous in reviewing what costs are appropriate to include. Nicole and Mark Crain in their recent study for the Small Business Administration⁸⁹

⁸⁵ Crain, N. V. & Crain, W. M., "The Impact of Regulatory Costs on Small Firms," (This report was developed under a contract with the Small Business Administration's Office of Advocacy), 2010, <http://www.sba.gov/sites/default/files/rs371tot.pdf>.

⁸⁶ Harrington, Heinzerling, and Morgenstern, 2009, pp. 221, 226.

⁸⁷ Ruttenberg, R., *Labor Studies Journal*, p. 120.

⁸⁸ Cited in McGarity and Ruttenberg, 2002, pp. 2018-2019.

⁸⁹ Crain & Crain, 2010.

used a range of studies that included as regulatory costs such items as the penalties companies paid for breaking environmental and health and safety laws, the costs of court and court settlements for breaking the law, and economic burdens of child labor laws (having to pay more to adults, when child labor would have cost less).

Think about the source of cost estimates. Reliance on industry surveys is not appropriate. When they know the purpose for which they are being asked about burden, there is an incentive to overestimate. How can one reasonably rely on data supplied by a party about to be regulated and have no process for validating the data received. As stated by McGarity and Ruttenberg: “Knowing that the agency is less likely to impose requirements that cost a great deal of money or that threaten to drive a substantial number of regulatees out of business, regulatees have a clear incentive to inflate cost estimates in the hope of securing a less stringent regulation.”⁹⁰

According to Resources for the Future,⁹¹ “finding bias in the cost estimates from industry ... sources is perhaps to be expected.”

15. Correct For Underreporting of Fatalities, Injuries, and Illnesses

The estimated numbers of fatalities, injuries, and illnesses associated work place incidents are underreported. They may be significantly low. There are many studies about the chronic problems of underreporting.⁹² There is documented underreporting of incidents by health providers, the injured, employers, and government agencies. Survey instruments are limited in scope, and there are problems with the recording of cause of death certificates, medical examiner reports, hospital discharge records, national surveys, and workers compensation. There are chronic problems with misclassification of the cause of an incident. Even with regard to work-based fatalities, for which one would think there would be good records, one former head of OSHA, has said that approximately 40 percent of occupational fatalities go unreported.⁹³

16. Duplication With Other Rules Needs To Be Subtracted Out

If a change in process eliminates hazards associated with two different rules it should only be counted once as a cost. In the textile industry, as an example, new equipment that increased productivity, simultaneously brought compliance with both OSHA cotton dust and OSHA noise standards. Not only should it not be counted twice, 100 percent of the cost should not be associated with regulations, since the main issue was, at least in the case of looms, to get faster bigger looms with much higher production rates. Reduced noise increased the useful life of these expensive machines and reduced cotton dust reduced the downtime of machines which might otherwise become choked on their own dust. EPA mentions this issue in a 1990 report.

⁹⁰ McGarity and Ruttenberg, p. 2044.

⁹¹ Harrington, Morgenstern, and Nelson, 1999, p. 2.

⁹² For one literature review, see Ruttenberg, R. and Lamba, A., “Review of the Literature on Underreporting/Issues in Occupational Injury and Injury and Illness Recordkeeping,” for the Occupational Safety and Health Administration, 1999 .

⁹³ Mick, Hans, *OSHA Recordkeeping: Is it Time for a Change?*, *Safety+Health*, November 1993.

Count only the parts of investments that are truly applicable to compliance. For example, if lockout-tagout is designed into a machine, do not count the whole cost of the machine. Compliance costs need to be sorted out from capital investment. In thinking about the source of cost estimates, it is important to realize the motivation in keeping the costs high.

17. Include a “Technological Improvement” Discount in Cost Assessment

There is well documented predictability of technological improvements, once there is a regulatory incentive for more cost-efficient compliance.⁹⁴ One should not rely on current level technology only. Reliance on what is currently “on the shelf” is not appropriate. When there is no economic or legal incentive to develop a safe product or to develop a process that protects workers, consumers, or the environment, then such a product or process is unlikely to be developed. Once, however, the incentive exists, development potential is likely to increase significantly.

One should include a “technological improvement” scenario in prospective analyses. An EPA policy analysis suggested such a scenario for analysis, which would give decision makers something to point to when industry claims that compliance would be expensive or unfeasible.⁹⁵

Regulation may provide such incentives. Pre-regulatory analysis needs to acknowledge post-regulatory experience of technology forcing and cost saving.

- Lockout/Tagout. According to OSHA’s 610 look-back on lockout/tagout, in the 9 years following the promulgation of the OSHA standard, “New advances and adaptations in lockout/tagout technology have increased the compliance options for industry, often with significant cost savings. Developments like lockout/tagout computer software, laser scanning devices, and advances in preventive maintenance technology provide improve accuracy and safety, and often save time as well. There are no indications that small businesses face technological or economic obstacles in complying with the standard.”⁹⁶
- Cotton Dust. From the *Harvard Business Review*: “Executives also admit, somewhat ruefully and only when their office doors are closed, that OSHA’s regulation on cotton dust has been the main factor in forcing technological innovation in a centuries-old and somewhat stagnant industry.”⁹⁷

⁹⁴ Rutenberg, R. *The Incorporation of Prospective Technological Changes into Regulatory Analysis Which is Used in the Planning of Occupational Safety and Health Regulations*, unpublished Ph.D. dissertation, University of Pennsylvania, 1981.

⁹⁵ GAO study cited in McGarity and Rutenberg, p. 2052.

⁹⁶ Rutenberg, R. and Lamba, A. *Summary of Data and Analysis for Section 610 and EO12866 Review of OSHA’s Control of Hazardous Energy Sources (Lockout/Tagout) Standard*, for OSHA’s Office of Regulatory Analysis, April 1998, p. ii.

⁹⁷ Jackall, R., *Harvard Business Review*, circa 1980.

Reflect on the over-estimate of costs in the past and the methodologies that lead to it. One reason for overestimation is the assumption of “current level technology only,” and this problem has been recognized for more than 30 years. An MIT-based study in 1979 concluded: “...Without exception, all previous OSHA economic impact statements have estimated compliance costs relative to proven control technologies...Limiting the cost analysis to existing technologies leads to overstatements in incremental cost of compliance and is, therefore, wrong.”⁹⁸

A 1995 study by the Office of Technology Assessment, in studying OSHA, found that “there are often sizable disparities between OSHA’s rule making projections of control technology adoption patterns, compliance spending, and other economic impacts, and what actually happens when affected industries respond to an enacted standard.”⁹⁹ The report went on to conclude that “the actual compliance measures that had not been emphasized in the rulemaking analyses, and the actual cost burden proved to be considerably less than what OSHA had estimated.”

In contractor work for OTA, in preparation for the 1995 study referenced above, overestimate of costs was consistently found to be the case:¹⁰⁰

OSHA Regulation	Ex-Ante Cost Estimate	Actual Cost
Vinyl Chloride	\$>1 billion	\$228-278 million
Cotton Dust	\$283 million	\$82.8 million
Occupational Lead	\$125 million	\$20 million
Formaldehyde	\$11.4 million	\$6 million

A study by Goodstein and Hodges in *The American Prospect* in 1997¹⁰¹ found that in 11 of the 12 regulations they examined that “the initial estimates were at least double the actual costs.” A 1999 review for Resources for the Future¹⁰² found that “ex ante estimates of total cost have tended to exceed actual.”

Incorporate the technology-forcing nature of regulation and “learning curves” into any decision analysis. Think about the progress that has been made in the engineering and science associated with smoke stack emissions. Initial efforts to abate smoke stack emissions began with little experience or knowledge. Now the process is quite sophisticated and with associated reductions in energy requirements and recovery of otherwise air polluting chemicals for reuse in production.

⁹⁸ ICF, In. and MIT Center for Policy Alternatives, “Regulatory Analysis Methods: A Review of Past Health-Related Efforts,” ICF, Inc., Washington, DC, November 1979, p. G3.

⁹⁹ Office of Technology Assessment, 1995, p. 11.

¹⁰⁰ Cited in McGarity and Ruttenberg, p. 2031.

¹⁰¹ Goodstein, E. and Hodges, H., “Polluted Data: Overestimating Environmental Costs,” *The American Prospect*, Nov/Dec 1997, p. 64.

¹⁰² Harrington et al., 1999.

Measure and account for a lower compliance cost if designed-in engineering controls and less hazardous substances were substituted.

18. Look Beyond the Specific Company or Industry Making a Decision. Look Too at the Impact on the Pollution Control and Hazard Abatement Industry

This industrial sector has been a growth area in the U.S. economy, for large and small companies alike. Many U.S. businesses license and sell hazard abatement technology and equipment. From safety boots to air scrubbers, from improved monitoring equipment to built-in engineering controls, the genius of U.S. science and engineering is generating hundreds of millions of dollars in new sales and thousands of new businesses. Just as one example, an EPA conference held shortly after promulgating regulations on asbestos brought over 600 businesses together to explore potential markets for asbestos control and/or products to substitute for asbestos.¹⁰³ Many small and minority businesses have been spawned to aid in compliance with lead abatement regulations.¹⁰⁴

- a. Include the small business and job creation in the hazard abatement and pollution control industry
- b. Include the profits from companies that make pollution control and hazard abatement products

19. Measure the Value of Years of the “Free Passes” that hazardous industries have had, when they passed the burden of harm to consumers, victims, and government.

20. Include Sensitivity Analysis

Each assumption made in an analysis alters the outcome. It is important to test the impact of alternative assumptions, to see how “sensitive” the outcomes are to an assumption. The National Academies believes sensitivity analysis should be used in risk assessment to characterize uncertainty¹⁰⁵ and that sensitivity analysis is a “minimum necessary component of a quality risk assessment report.”¹⁰⁶

21. Include a “Best Case” and “Uncertainty” Analysis

When there is resistance to making investment in safety and health and there is an effort to avoid underestimating the impact of that investment, cost analyses tend to resemble the “worst case.” A counter balance to put these overly conservative analyses into perspective would be to develop a range of potential impacts – from best to worst, with a section explaining areas of uncertainty.

¹⁰³ Ruttenberg, R., “Pollution Industrial Complex,” circa 1987.

¹⁰⁴ Ruttenberg, R., New York Academy, 1997.

¹⁰⁵ National Academies, Board on Environmental Studies and Toxicology, *Scientific Review of the Proposed Risk Assessment Bulletin from the Office of Management and Budget*, National Academies Press, 2007, p. 139.

¹⁰⁶ *Ibid.*, p. 140.

22. The Baseline for Cost Estimation Should Be From the Level Of Compliance That Exists at the Time Of Regulation, Not a Zero Compliance Baseline

OMB guidelines find the proper measure of compliance cost as the incremental cost above the “baseline” state of the world that would have existed in the absence of regulation. But establishing this baseline may be difficult, so many have used a zero baseline; i.e., reflecting an assumption that those regulated would not have taken any action at all to protect health, safety and the environment. The result is an overestimation of compliance cost. It also means that if the zero baseline would leave a company in violation of an existing regulation, but is still leaving industry with a larger cost than should be necessary to move from current to future regulation, the company is, in essence, being rewarded for non-compliance.¹⁰⁷

23. Measuring the Costs of Not Taking Action, or of Serious Delays

“The expected outcomes of a regulation cannot possibly be understood without reference to what would have happened in its absence.”¹⁰⁸

Part of the health and safety decision making and of the regulatory process, historically, has been industry “crying wolf,” claiming a regulation put them in economic danger, when it really did not. Analysis for the 21st century needs to take this historic reality into account. Just a few brief examples:

- a. In the 1980’s at administrative law hearings and in letters to the record on a proposed grain handling rule, 60 small businesses argued that their businesses might have to shut down if the rule was promulgated. In 1993, Ruth Ruttenberg and colleagues called the 60 companies and at least 59 were still in business (one number was disconnected so the business status could not be determined). After promulgation of the standard, investment in plant and equipment in the industry was up and wages were up as well.¹⁰⁹
- b. When OSHA was considering a rule to regulate vinyl chloride exposures that caused liver cancer in production workers, vinyl chloride producers claimed that the entire multibillion dollar industry would collapse. Within 18 months of promulgation of the standard, new and more productive facilities were on line and at least six technological changes made operations more efficient.¹¹⁰ Not only was the cry of collapse unfounded, the industry experienced significant growth.
- c. Industry spokespersons in the cotton textile industry foretold economic disaster if OSHA promulgated a cotton dust regulation. After promulgation, rather than the predicted use of retrofits, add-ons, and enclosures, industry achieved compliance primarily through designed-in engineering controls. Cotton textile manufacturing became more

¹⁰⁷ McGarity and Ruttenberg, p. 2047.

¹⁰⁸ Harrington, W., Heinzerling, L, and Morgenstern, L., “What We Learned,” in Harrington et al., 2009, p. 222.

¹⁰⁹ Ruttenberg, R. *Compliance with the OSHA Grain Handling Rule: Safety Measures Save Lives and Dollars*, Contract K3-0841.0, U.S. Office of Technology Assessment, Washington, DC, 1994.

¹¹⁰ Dirks-Mason, S. and Ruttenberg, R., “The effects of the OSHA vinyl chloride standard on the vinyl chloride industry,” prepared for the OSHA Policy Office, Washington, DC, 1979.

technologically consolidated, fully eliminating some of the processes that had previously been responsible for much worker exposure. New machine systems were faster and had fewer breakdowns.¹¹¹

- d. When EPA was considering controls on fluorocarbon aerosol spray, the chemical industry said there was no alternative. Literally, the day after the ban went into effect, there was a new pump spray that was free of fluorocarbons and was also cheaper than aerosols.¹¹²

Always consider the cost of not taking action. If health and safety and environmental controls save lives, then the cost of not making improvements may be death, injury, and illness. This has already been discussed relative to grain dust, cotton dust, vinyl chloride, hazardous waste operations, and lockout/tagout. A few other examples are listed below:

- CPSC and the withdrawal of 3-wheeled ATVs from the market. Though ATVs came on the market in the early 1970's, it was not until 1988 –the results of CPSC warning and court cases – that 3-wheeled ATVs were pulled from the market. Thousands died and at least three-quarters of a million reported injuries. The economic costs of not regulating aggressively are likely far higher, but the average court settlement was over \$859,000 and over 1000 cases had been resolved, suggesting that this failure to take action cost at least \$859 million.¹¹³
- Without OSHA-mandated training, workers would die. While it is often difficult to categorically identify lives saved because an event is avoided, this is not the case with confined space training. Just one example: A training program in New York taught about the need to monitor the air in confined space before entering it. Two workers, upon returning from training, insisted on monitoring the air they were about to enter and found lethal levels of chemicals. Days before, they would not have hesitated before entering the space, to their almost certain death.¹¹⁴ This story has been repeated many times.
- Despite concerns, FDA failed to prohibit the drug Baycol. FDA's approval of Baycol, and at high doses, was, in effect, not regulating. As a result, at a minimum, the cost of this non-regulation was \$1,154,343,835, the cost of 3,067 cases settled through January 2007. The likely costs were probably far higher.¹¹⁵

¹¹¹ Ruttenberg, R. "Compliance with the OSHA Cotton Dust Rule: The Role of Productivity Improving Technology," No. 233-7050.0, U.S. Office of Technology Assessment, Washington, DC, 1983.

¹¹² Ruttenberg, *Working Papers*, p. 46.

¹¹³ Shapiro, Ruttenberg, and Leigh, pp. 814, 186.

¹¹⁴ Ruttenberg, R., "Outcomes of Hazmat Training," draft prepared for National Institute of Environmental Health Sciences, Research Triangle Park, NC, 1993.

¹¹⁵ Cited in Shapiro et al., 2009, p. 806.

24. Consider a Social Cost Benefit Analysis As a Partner to the Conventional Economic Cost-Benefit Analysis

The social impact of decisions – on the lives of injured workers and their family members, the morale of plant employees, the fabric of an affected community – are critical elements of any analysis.

25. Reject Remaining Life Years

“Remaining Life Years” has been used in analyses published by the U.S. Office of Management and Budget. This values life at a decreasing rate as an individual has fewer expected life years remaining. A 10 year old is more valuable than a 30 year old and a 30 year old is more valuable than a 70 year old. (Actually economists would say the 30 year old is more valuable, because the 10 year old is still “sucking resources” from the system rather than adding to its growth and productivity.) Such analyses are not consistent with basic values and should be rejected.

26. Have a Rigorous Analysis of Past Studies and Decisions

There is much to be learned from the flaws and weaknesses of past studies. Companies should review the way they have made decisions in the past. The federal government mandates Look Back studies (610 reviews), to better understand the real costs and benefits, rather than ex ante ones from pre-regulatory studies.

27. One New Paradigm Might Be Human Resource Damage Assessment

Environmentalists have long used Natural Resource Damage Assessment. Long-term irreparable impact to a person can occur similarly to long-term irreparable impact to natural resources. The death or permanent disability of a human being leaves society with just as much of an irreplaceable natural resource as the loss of a vista or a recreation site. Suggested is using the unique and irreplaceable assets of an individual worker, not just lost work days, in analysis. The “nonuse” value of a human being deserves the same consideration as the nonuse value of natural resources. Somehow we understand that there is more to natural resources than their commercial value; so too should we understand that about human life and health.¹¹⁶

¹¹⁶ Ruttenberg, R., New York Academy, p. 457.

