October 2013

NATIONAL OCCUPATIONAL RESEARCH AGENDA (NORA)

MID-DECADE REVIEW

SUPPLEMENT TO THE NATIONAL CONSTRUCTION AGENDA

FOR OCCUPATIONAL SAFETY AND HEALTH RESEARCH AND PRACTICE IN THE U.S. CONSTRUCTION SECTOR

Developed by NIOSH and the NORA Construction Sector Council

TABLE OF CONTENTS

(Note: A bookmark tab is provided on the PDF version)

INTRODUCTION

The National Occupational Research Agenda (NORA) is a partnership program to stimulate innovative research and improved workplace practices. NORA has become a research framework for NIOSH and the nation. Stakeholders collaborate to identify the most critical issues in workplace safety and health and then work together to develop goals and objectives for addressing these needs.

NORA entered its second decade in 2006 with a new sector-based structure to better move research to practice within workplaces. Construction is one of ten separate sectors involved in NORA. NIOSH is the steward of NORA and facilitates the work of the multi-stakeholder NORA Sector Councils, which develop and implement research agendas for the occupational safety and health community over the decade (2006-2016). The NORA Construction Sector Council was the first council to develop a national research agenda. The agenda was posted in October of 2008 at http://www.cdc.gov/niosh/nora/comment/agendas/construction/.

Each strategic goal is comprised of underlying intermediate goals describing the smaller steps needed to achieve the goal. Each intermediate goal is supported by underlying research and practice goals. More information about research projects related to the National Construction Agenda can be found at http://www.cdc.gov/niosh/programs/const/noragoals/

This was the first national effort to create an occupational safety and health research agenda for the construction industry. The goal was to address the question: “What information do we need to be more effective in preventing injuries and illnesses in construction?” The resulting agenda consists of 15 strategic goals designed to address 10 “top problems” in construction safety and health. These included seven “outcome” goals related to important sources of injury or illness, and eight “contributing factor” goals related to important influences that impact prevention and control measures throughout the industry. A description of research needs and information gaps is one important basis for the agenda. The other basis is “research to practice” (r2p): a description of how research findings could be used by various construction stakeholders to bring about needed changes in the industry. Developing the National Construction Agenda provided a vehicle for construction industry stakeholders to describe the most relevant issues, gaps, and safety and health needs in the industry.

RATIONALE FOR THE MID-DECADE REVIEW

The year 2011 was the half-way point in the decade-long NORA effort. The NIOSH Office of Construction Safety and Health and the NORA Construction Sector Council undertook a review of efforts to date. The review provided an opportunity to take stock of overall developments, look at NORA projects and partnerships underway, and provide additional strategic direction and fine-tuning.

The economic recession had significant impacts on construction, with a large drop in building activity and employment starting in 2008. These reductions impacted a wide variety of construction partners. The recession also reduced federal governmental agency research and travel budgets. These economic developments were viewed as external factors affecting capabilities to move forward on an ambitious National Construction Agenda consisting of 15 strategic goals.

PART 1 OF THE REVIEW

The NORA Construction Sector Council initiated discussions at the June 2011 meeting. Various workgroups used conference calls for additional follow-up discussions. The NIOSH Office of Construction Safety and Health prepared spreadsheets to facilitate discussion of individual goals. These described NORA-related activities including: 1) ongoing and completed intramural and extramural NORA research projects; and 2) ongoing and completed non-research partner r2p activities for each of the 15 goals.

The review began with general discussions about expectations and issues:

- **How will future evaluators look at the results of the NORA Construction Sector effort? What types of findings will they look for?**

  The Council agreed that evaluators would most likely look for evidence that NORA stimulated more activities on the NORA topics than would have occurred without NORA. They would look for evidence that researchers and practitioners worked together to bring about measurable changes. Lastly, evaluators would be likely to look to determine if NORA did achieve some of the construction goals by meeting the stated performance measures.

- **How have economic factors changed for the construction industry and government research support since the 2008 recession? Could these changes constrain progress on NORA goals? If so, can we expect to make progress on 15 goals? Should we make adjustments to the number of goals?**

  Council members agreed that the construction industry had experienced a sharp reduction in activity as evidenced by a 20% unemployment rate. This was viewed as likely to lead to overstretched industry safety and health professionals and leaner organizational budgets – both of which could affect partnering. In addition, smaller government budgets were also seen as supporting fewer new projects and meetings and less travel in the years ahead. Given the challenges to achieving even a few strategic goals, there was general agreement that adjustments were necessary.

- **Should we identify a subset of goals for emphasis over the remaining 5 years of NORA? What criteria can be used to identify a subset of goals?**

  Council members supported steps to identify a smaller subset of goals for emphasis. However, it was important not to view this selection as suggesting that the other goals were no longer important. Rather, the criteria should reflect which goals attracted the most interest from researchers and construction partners to date and a general sense of how developed or "ready" each topic was. Four criteria were identified for evaluating the goals:

  1) Number and type of research projects
  2) Number and type of partners and planned activities
  3) Number of intermediate goals being addressed by tangible activities
  4) Collective sense of:
     a. Industry drivers and influences over the next five years
     b. "Readiness for Impact"

  These criteria were then used to classify the 15 goal topics into three categories:

  1) **"Ready for Impact"**: topics where research and practice have led to a sufficient number of solutions so that construction safety and health professionals know what contractors and workers need to do to make an impact on end outcomes. The expectation is to meet the strategic goal performance measures.

  2) **"Developmental"**: topics where research has been done and where some solutions exist, but where the number and quality are insufficient for achieving impact on end outcomes. The expectation is to meet several of the intermediate goals.

  3) **"Exploratory"**: topics where less work has been done and where researchers and practitioners are still defining the problems and looking to identify potential solutions. The expectation is to meet at least one research sub-goal.

The NORA Construction Sector Council then reviewed the individual goals. Goals were organized into five categories, and discussion of each category was led by two sector council member co-chairs. The five categories of Strategic Goals (abbreviated as SG) were:

1) Traumatic Injury
   SG1.0: FALLS
   SG2.0: ELECTROCUTION
   SG3.0: STRUCK-BY HAZARDS

2) Health Effects
   SG4.0: NOISE AND HEARING LOSS
   SG5.0: SILICA EXPOSURES AND ILLNESSES
   SG6.0: WELDING FUMES AND ILLNESSES

3) Musculoskeletal Disorders
   SG7.0: MUSCULOSKELETAL DISORDERS

4) Contributing Factors–Group 1
   SG8.0: CONSTRUCTION CULTURE
   SG9.0: CONSTRUCTION SAFETY AND HEALTH MANAGEMENT
   SG10.0: CONSTRUCTION INDUSTRY AND WORK ORGANIZATION
   SG11.0: TRAINING AND EDUCATION ISSUES

5) Contributing Factors–Group 2
   SG12.0: DISPARITIES IN HEALTH AND SAFETY IN CONSTRUCTION
   SG13.0: CONSTRUCTION HAZARDS PREVENTION THROUGH DESIGN
   SG14.0: IMPROVING SURVEILLANCE OF HAZARDS AND OUTCOMES
   SG15.0: ENGAGING THE MEDIA TO RAISE AWARENESS AND IMPROVE SAFETY AND HEALTH IN CONSTRUCTION

Results from the Part 1 Review

Six “Ready for Impact” goals were identified. These include three outcome goals and three contributing factor goals:

SG1.0: FALLS
SG3.0: STRUCK-BY HAZARDS
SG5.0: SILICA EXPOSURES AND ILLNESSES
SG8.0: CONSTRUCTION CULTURE
SG12.0: DISPARITIES IN HEALTH AND SAFETY IN CONSTRUCTION
SG13.0: CONSTRUCTION HAZARDS PREVENTION THROUGH DESIGN

Seven “Developmental” goals were identified:

SG2.0: ELECTROCUTION
SG4.0: NOISE AND HEARING LOSS
SG6.0: WELDING FUMES AND ILLNESSES
SG7.0: MUSCULOSKELETAL DISORDERS
SG9.0: CONSTRUCTION SAFETY AND HEALTH MANAGEMENT
SG11.0: TRAINING AND EDUCATION ISSUES
SG14.0: IMPROVING SURVEILLANCE OF HAZARDS AND OUTCOMES

Two “Exploratory” goals were identified:

SG10.0 CONSTRUCTION INDUSTRY AND WORK ORGANIZATION
SG15.0: ENGAGING THE MEDIA TO RAISE AWARENESS AND IMPROVE SAFETY AND HEALTH IN CONSTRUCTION

PART 2 OF THE REVIEW

The NORA Construction Sector Council continued discussions at the November 2011 meeting. This second part of the review focused on each of the six “Ready for Impact” goals. The review covered the following issues:

- **Performance Measures**
  How sufficient is the current strategic goal performance measure? Is there an objective basis for evaluating the measure? How is performance at the mid-decade point? Given external factors, should the original performance measure be amended? If so, what should it be?

- **Roadmaps and achievable steps**
  What steps do we need to take to achieve our performance measure? What set of recommended priority activities, outputs, and partners should be pursued?

Workgroups were used to discuss these issues for each Ready for Impact Goal. This included additional breakout group discussions and follow-up conference calls.

Note that the review was not intended to provide a summary of research projects or outputs finished to date. The primary purpose of the roadmap is to identify and describe research to practice partnership activities and opportunities that can drive changes in the construction industry for that strategic goal.

Results from the Part 2 Review

This section describes the results of the review for each of the six goals. Each description begins with the evaluation of the performance measure and then provides the road map steps identified.

STRATEGIC GOAL 1

Reduce Construction Worker fatalities and serious injuries caused by falls to a lower level

Performance Measure: Address technical solution gaps, increase implementation of effective fall prevention measures, and utilize design approaches and social marketing campaigns to support a 33% reduction in the rate of fatal falls among construction workers over the decade.

Revised Goal and Performance Measure

No changes made

Objective Basis for Performance Measure

This is one of the NORA goals where relevant US Bureau of Labor Statistics (BLS) data are available. The Center for Construction Research and Training (CPWR) generated fatal injury rates via access to BLS Census of Fatal Occupational Injuries (CFOI) microdata combined with Current Employment Statistics, 2003-2009 data for private wage and salary workers. The results suggest the best available metric is the rate of falls to lower level (OIICS 11[1]) for NAICS[2] code 23 (all construction) for private wage and salary workers. The 2006 baseline for this measure is 4.40 fatal injuries/100,000 employees. The NORA 2016 target is a 33% reduction to achieve 2.95 fatal injuries/100,000 employees

The SG1 workgroup did consider whether the 33% reduction goal was overly ambitious or not, and did agreed to retain this goal. The qualitative component of the performance measure (i.e. *Address technical solution gaps, increase implementation of effective fall prevention measures, and utilize design approaches and social marketing campaigns*) was also considered. The issue of preventing falls is a high priority issue for the construction industry and development and implementation of a falls prevention campaign was selected by the NORA Construction Sector Council as one of two focus areas for emphasis during 2011-2013. The “Stop Construction Falls Campaign” (see http://stopconstructionfalls.com/) was launched in 2012 and re-launched in 2013 and has generated numerous partnership activities. The campaign was initially motivated by Intermediate Goal 1.5 - *Work with construction partners to develop and implement a national campaign to reduce fatal and serious injuries associated with construction falls to a lower level.* NORA has stimulated a number of activities related to SG1 and the qualitative language was also retained.

[1] OIICS is the US Bureau of Labor Statistics Occupational Injury and Illness Classification System. See http://wwwn.cdc.gov/wisards/oiics/

[2] NAICS is the North American Industrial Classification System. See http://www.census.gov/eos/www/naics/

Roadmap for additional activities

Intermediate Goal 1.1 – Partner with construction stakeholders and safety professionals to identify the top three fall-related problems requiring technical engineering solutions and develop and evaluate options to fill these gaps.

Activities	Outputs -Lead and Partners
1) Develop, evaluate, and transfer engineering control solutions for residential fall prevention.	A) NIOSH Roof Bracket Project and Outputs 1) Patent, 2) Guidance on use, 3) Partnership to make device available on market -NIOSH and various project partners B) Develop, design and evaluate the use of the fall protection netting systems that can be hung over floor joists that would provide both fall protection and falling object protection for workers down below. -NIOSH -Washington University and their partnership with Habitat for Humanity, and the National Association of Home Builders (NAHB) C) Develop product describing available Residential Fall Prevention Solutions -CPWR/Washington University -NAHB D) International Safety Equipment Association (ISEA) Fall Prevention Guide – incorporate into Campaign materials -ISEA -CPWR, NIOSH
2) Develop, evaluate, and transfer engineering improvements to aerial lifts (such as PFAS (Personal Fall Arrest System) anchorage methodology)	2) NIOSH Aerial Lift Project and outputs -NIOSH and various project partners
3) Explore whether head protection used by workers at heights should be redesigned to reduce the potential/severity for traumatic brain injury (TBI)	3) Assemble interested researchers and stakeholders to gauge interest. Convene meetings to discuss and if appropriate develop a research strategy

	-Liberty Mutual and partners such as NIOSH, Turner Construction, ISEA, Associated General Contractors (AGC)
4) Evaluate PFAS anchorage methodology for scaffolds & lifts. Evaluate adequacy of scaffold components as anchorage points during scaffold erection, focusing on dominant types used: • fabricated frame, • tube & clamp • system scaffold	4) Develop a user's guide (English & Spanish) for erectors and scaffold competent persons to convey the information to erectors. -NIOSH Scaffold Industry manufacturers, SunBelt Rental, Safway Scaffold Systems, Brand Scaffolding, Brock Scaffolding, Virginia Tech Construction Group, Scaffold Training Institute

Intermediate Goal 1.2 – Partner with Construction stakeholders to expand awareness and use of existing effective fall prevention and protection solutions by construction employers and workers

Activities	Outputs -Lead and Partners
1) Develop and publicize an OSHA 10-hour course on best practices in Home Building	1) OSHA 10 hour course materials on best practices for Home Builders. -Kentucky Labor Cabinet OSHA, OSHA Training Institute and Outreach Centers, Oshcon Program Representatives in all OSHA Planned States, NAHB, AGC, Community Colleges, Building Trade Unions etc.
2) Partner to develop web-based Fall Protection Competent Person course and exam.	2) 8 hour web-based course with 14 modules, hands-on with equipment materials, and 100 question test. (Launch in May of 2015 with two month pilot program) -Safety Council of Texas City -NIOSH, LJB Engineers and industry partners
3) Utilize output of Fatality Campaign Focus Groups to develop compelling "hooks" for dissemination of knowledge **(Completed/On-going)**	3) Develop additional materials for use in Fall Prevention Campaign -CPWR -NORA Falls Campaign Materials Development Workgroup

Intermediate Goal 1.3 – Partner with Construction stakeholders to provide the industry with the information and tools to reduce portable ladder fall injuries.

Activities	Outputs -Lead and Partners
1) Develop a checklist of ladder skills and competencies that every construction worker should have. Transmit to OSHA 10 hour trainers to promote consistent and comprehensive training that covers issues such as pre-job planning and working on ladders.	1) Two page checklist -NIOSH and CPWR -Liberty Mutual, Laborers Health and Safety Fund of North America (LHSFNA), OSHA Training Institute, American Society of Safety Engineers (ASSE)
2) Develop and maintain a Stop Construction Falls Ladders topic page as a resource for a wide variety of ladder training materials and resources. This can include existing materials and new materials developed for the campaign.	2) Falls Campaign Topic Page -CPWR -NIOSH, OSHA
3) Develop a "Ladders Last" checklist to describe common tasks where alternatives to ladders are the preferred option.	3) Two to three page publication -Liberty Mutual and Turner Construction (PENDING DISCUSSIONS)

Intermediate Goal 1.4 – Partner with architects, engineers, and construction organizations to expand the use of "safe-by-design" practices for fall prevention via demonstration projects and guidance.

Activities	Outputs -Lead and Partners
1) Develop Prevention through Design (PtD) factsheets related to falls. Disseminate to architects, engineers, and safety and health professionals	1) Six 2-3 page fact sheets were developed with NIOSH and stakeholder input for the OSHA Construction Alliance. Discussions are underway to convert these into OSHA products. NIOSH is also developing Workplace Design Solution products for one or more of these topics. Once finalized, these will be disseminated to key design audiences. -OSHA Construction Alliance, plus -NIOSH, OSHA, LHSFNA. Academic PtD partners
2) Partner with the NORA Green Construction Coordinating committee (this group described further in SG13) to develop a "Safe Roof Design Guide" to promote best practices for preventing	2) A 10-20 page NIOSH or NORA web publication with photos and diagrams to describe roof-related fall hazards and design solutions. Can also be used as reference for USGBC LEED reference

falls by construction and maintenance workers by proper design. Disseminate to architects, engineers, and safety and health professionals.	guide. Outline already developed. Once finalized, disseminate to key design audiences -NIOSH, and NORA Green Construction Coordinating Committee -OSHA, ASSE, National Safety Council (NSC), Workers Comp carriers, National Roofing Contractors Association (NRCA), Roofers Union, and subject matter experts.

Intermediate Goal 1.5 – Work with construction partners to develop and implement a national campaign to reduce fatal and serious injuries associated with construction falls to a lower level.

Activities	Outputs -Lead and Partners
1) Develop and implement a national campaign **INITIATED** via 2012 launch on workers memorial day. Re-launched via 2013 workers memorial day activities. Will continue to support campaign with new materials.	1) Three websites were developed: http://www.cdc.gov/niosh/construction/stopfalls.html http://stopconstructionfalls.com/ http://www.osha.gov/stopfalls/ along with several focus group-tested campaign materials and secondary products. Additional materials and strategies for the second year re-launch are under development. -NIOSH, OSHA; CPWR and NORA Campaign coordinating committee and Materials Development Work Group -Partial list of re-launch partners includes: KY OSHA, Mass Dept. of Health, Montgomery County, MD
2) Involve the building trades in campaign **COMPLETED**	2) Presentations at monthly meetings and recruitment to campaign -CPWR -Various construction unions
3) Involve state epidemiologists/health departments in campaign **COMPLETED**	3) Presentations at meetings and developments of links and FACE reports related to fatal falls, and development of state fall-related materials. -NIOSH FACE program -Various state health departments and the Council of State & Territorial Epidemiologists (CSTE)

4) Involve (a) equipment leasing companies & (b) retailers in campaign	4) Work with (a) Sunbelt Equipment (in Kentucky) to post (publish) materials, and with (b) Home Depot, Lowes, & ABC Supply – involvement in distribution of materials -KY OSHA, NIOSH, NRCA -Numerous trade organizations, such as Laborers' Union, Roofers' Union, American Ladder Institute, & Scaffold Industry Association

SG1 Appendix A Listing of additional topics that may be used for future activities

Activities and Opportunities	Additional information on contacts, outputs or suggested partners for future use
1.1 Significant development of technical innovation in commercial fall protection equipment • Personnel nets for use in residential (EU) • Composite trusses & joist • Anchorage of PFAS • Restraint device for work in advance of truss installation • Work platform for installation of trusses • Catch platform for truss installation (address falling objects) • Means for preventing ladder base slippage • Study of differential risk associated with crane suspended personnel baskets vs. MEWPS • Study of misuse of MEWP • Model UK process for offering free training, followed by enforcement, followed by more training • Partner with diverse stakeholders to develop a plan for incorporating work readiness initiatives, equipment supplier celebrations of "saves"	Scaffold Industry Association Scaffold Suppliers & Rental Companies Retailers (Home Depot, Lowes, etc.) Tool Rental Companies (National Association) American Rental Association NAHB – Susan Harwood Training Grant http://www.modular.org/
Modular Construction • investigate PtD implications for integrated fall protection, PFAS anchorages in manufactured modules • Network with manufacturers on fall protection used during the production process remaining with modules shipped to construction sites	Modular Building Institute

1.2 Engage developers in "Certified Safe-Built" (similar to "Green") Business Case & Information Access • Case Studies – Pre-task planning tools • Smart-phone apps for fall protection methodology • Engage retailers in dissemination of materials (NIOSH/Lowes-Cincinnati)	Sheet Metal Occupational Health Trust -Contracted for 5 apps with a developer Foreman's App
Mobile Equipment • Investigate partnerships with heavy equipment manufacturers/suppliers/users for best practice transfer related to equipment access/egress devices & methods	Association of Equipment Manufacturers (AEM) http://www.aem.org/
1.3 Fall Prevention NIOSH –Turner Construction Company: Ladders Last Business Case Study • Pre-task planning tool for selection of work-at-heights access • Assemble best practice use of ladders – training – observation/feedback • App for training/observation/feedback; "leaning" indicator (creative use of point in space sensing capabilities of "smart devices".) • Survey ASSE/AIHA members for intelligence on existing apps • Investigate OSHA sponsored app development strategy • Investigate equipment supplier apps • Investigate Saturday scheduling of Worker Memorial Day	
1.4 Prevention through Design • Case Study template for PtD success stories • PtD guidance document for temporary structures – responsibility of constructor vs. designer	
1.5 Member organizations support the Falls Campaign through publications, speaking at conferences and technical meetings, and so forth	

STRATEGIC GOAL 3

Revised Goal and Performance Measure

STRATEGIC GOAL 3.0: Reduce fatal and serious injuries associated with struck-by incidents associated with objects, vehicles, and collapsing materials and structures.

> **Revised Performance Measure One:** Identify risk factor gaps, develop new interventions, and increase dissemination and use of interventions to reduce the rate of construction-related struck-by fatalities associated with construction vehicles by 25%, and the rate of non-fatal injuries associated with nail guns by a similar 25%.
>
> **Performance Measure Two (New):** By 2016, document the use of NORA "struck-by" program outputs by 240,000 individuals/companies/organizations in the construction industry as a proxy for increased awareness of struck-by hazards and safe work practices. Documentation is based on actions taken by individuals and organizations to obtain NORA struck-by outputs, including web page hits, product downloads, peer-review citations, requested training programs and materials, and individuals taking training.

Objective Basis for Performance Measure

The SG3 workgroup noted that this goal was unusual compared to other NORA Construction goals because it combines several related but yet different categories with quite different exposures and injury prevention priorities based on type of work being done. . These include struck by object, by vehicle, by collapsing materials (such as from trenching collapses) and by collapsing structures. These categories were streamlined in a revised performance measure to focus on two types of struck-by hazards: nail guns and vehicle runovers/backovers. The workgroup anticipated that attention to a broader range of struck-by hazards could also be triggered based on momentum and information obtained in the initial focus areas.

<u>Changes to Performance Measure 1 – Struck-by Incidents</u>

The SG3 workgroup noted that the original performance measure language appeared to be based on a count not a rate. Counts are not considered as sensitive as rates but in the absence of major changes (design, equipment, hours worked) still are likely to be relatively stable over a decade. The workgroup felt that it would be preferable to use rates if they were available. The SG3 workgroup noted that the BLS Occupational Injury and Illness Classification System (OIICS) changed in 2011. This change will result in a break in series for BLS fatal and nonfatal injury data. Thus summary statistics from the 5-year period before this change (2006 through 2010) may be different than summary statistics for the 5-year period after this change (2011 through 2015). It is possible that the changes in classification system may increase the fatal and nonfatal injury capture rate of data systems, therefore a slightly more conservative value of 25% reduction in struck-by injury rates is being proposed (instead

of the initial 33% value) for the specific topics that are being focused on (i.e., nail guns, construction work zone vehicles, and trenching). A 25% reduction in injury rates for these three topics is a more reasonable and attainable value, especially lacking knowledge on how the break in series will affect the trend in subsequent injury rates.

The Center for Construction Research and Training (CPWR) generated rates via access to BLS Census of Fatal Occupational Injuries (CFOI) microdata combined with Current Employment Statistics, 2003-2009 data for private wage and salary workers.

The results suggest that the best available metric for runovers/backovers is the rate of fatal injuries from transportation-related struck by injuries (OIICS 43) for NAICS code 23 (all construction) for private wage and salary workers. The 2006 baseline for this measure is 1.40 fatal injuries/100,000 employees. The NORA 2016 target is a 25% reduction to achieve 1.05 fatal injuries/100,000.

Developing performance measures for Nail gun-related struck by injuries present several challenges. Simple injury rates based on hours of work for tool-related injuries are misleading, because they do not consider tool exposure time. Thus injury number-based measures will be used as a proxy, even with their limitations. Baseline information for the number of nail gun injuries treated in emergency departments is available for the period from 1998 to 2005 via research performed by Lipscomb and colleagues[3] . These researchers used the National Electronic Injury Surveillance System (NEISS-Work) to characterize construction industry non-fatal tool and equipment-related injuries treated at U.S. emergency rooms. The study estimated that 110,000 nail gun injuries occurred during this six year time period (equivalent to an average of 18333 per year). Updating this study could provide a suitable performance indicator to determine whether the estimated number of injuries has been reduced 25% (equal to finding a yearly average of 13750 nail gun injuries treated at U.S. emergency rooms.)

Care and caveats would be needed in interpreting these results given that residential construction activity is known to rise and fall with economic conditions and this would impact resulting injury numbers. Supplemental performance indicator ideas could help clarify this picture. NIOSH-funded nail gun research has produced a regional intervention in the St. Louis area focusing on two interventions: 1) increasing the availability of sequential trigger nail guns on jobsites, and 2) providing training on nail gun risk factors and injury prevention. This project is expected to finish in 2014 and research reports describing the impact on injury numbers and rates will follow. The data from this project also includes reports of hours of tool use by trigger configuration and training before nail gun injury. In addition, a regional survey about the availability of training and sequential trigger tools on St. Louis residential construction job sites could be performed and compared with previous survey results performed prior to the

[3] Lipscomb, H, Schoenfisch, A, Shishlov, K, and Myers, D.[2010]. Nonfatal Tool-or Equipment-Related Injuries Treated in US Emergency Departments Among Workers in the Construction Industry, 1998-2005. AJIM. 53:581-587

interventions. The work in this geographic area provides good intermediate and end measures of what can be accomplished in a highly targeted effort with willing collaborators and partners. Similar hazard surveillance data that documented access of workers to tools with sequential triggers and access to training before they sustained an injury could offer insight into uptake of interventions and provide a useful supplementary performance measure.

A performance measure for fatal trenching cave-ins was considered but there were a variety of problems with the applicability of the available rates so no measure was selected. .

New Performance Measure 2 – Struck-by Incidents

The SG3 workgroup considered that limiting the assessment of project/program effectiveness to performance measures defined by absolute rates of injury and illness reduction fails to account for externalities and other mitigating factors that affect the industry (subsector/trade) during and beyond the project life cycle. Project/program success can be demonstrated by measurable improvements in industry (subsector/trade) health/safety practices and hazard awareness attributable to project outputs and the translation of resulting information and/or technologies. Therefore, a secondary measure of program effectiveness (performance) is based on stakeholder knowledge/awareness/utilization of effective safety/health interventions as a direct result of project/program outputs.

The resulting measure calls for documenting the use of NORA “struck-by” program outputs by 240,000 individuals/companies/organizations in the construction industry by 2016 as a proxy for increased awareness of struck-by hazards and safe work practices. Documentation will focus on the outputs described in the roadmap and will rely upon on actions taken by individuals and organizations to obtain NORA struck-by outputs, including web page hits, product downloads, peer-review citations, requested training programs and materials, and individuals taking training.

Roadmap for additional activities

Intermediate Goal 3.1 – Objects: Improve understanding of risk factors associated with struck-by fatalities and serious injuries associated with falling, flying, swinging, and rolling objects; compare findings to existing regulations and guidance.

Activities	Outputs -Lead and Partners
1) Perform research • Study of sequential trigger nail gun finger biomechanics • Study involving 8 focus groups with residential carpenters and supervisors on nail gun use issues.	1) Peer reviewed articles, translational media -NIOSH and research partners

• Study of non-fatal contact injuries among workers in the construction industry treated in U.S. emergency departments.	

Intermediate Goal 3.2 – Objects: Use risk factor and gap information to develop and evaluate interventions and guidance for preventing struck-by injuries involving falling, flying, swinging, and rolling objects. Partner with construction stakeholders to disseminate resulting interventions.

Activities	Outputs -Lead and Partners
1) Prevention of pneumatic nail gun injuries through increased awareness and promotion of improved practices, including the widespread adoption of a safer trigger. • Develop and disseminate nail gun safety guidance • Participate in ANSI standard revision	1) Nail gun safety guidance document: "Nail Gun Safety: A Guide for Construction Contractors" was developed and disseminated widely in 2011. See http://www.cdc.gov/niosh/docs/2011-202/ A Spanish Language version was developed and disseminated in 2012. See http://www.cdc.gov/spanish/niosh/docs/2011-202_sp/ A website was created to provide links to information. http://www.nailgunfacts.org/ Information about nail gun safety was added to the Wikipedia nail gun page. An ASSE nail gun webinar was held on 2/1/2012. NIOSH and two academic partners participated on the American National Standards Institute (ANSI) SNT-101 standard revision effort for the standard covering nail guns and other fastening tools. Worker awareness materials under development: American Journal of Industrial Medicine published article, "Buyer beware: Personnel selling nail guns know little about dangerous tools." -NIOSH, OSHA, CPWR, Duke University, Advisory Committee for Construction Safety and Health (ACCSH),United Brotherhood of Carpenters (UBC), St Louis Carpenters, Carpenters Joint Apprenticeship Programs, ASSE, National Hispanic Construction Association, local Hispanic Contractors Association offices, NAHB, University of Texas,
2) Support additional evaluation research to update earlier nail gun studies to provide data that can be used for performance measures	2) Various academic and NIOSH researchers and nail gun partners

Intermediate Goal 3.3 – Vehicles: Evaluate strategies to reduce worker exposure to being run over by heavy construction vehicles and equipment.

Activities	Outputs -Lead and Partners
Research Injury Prevention Measures	Peer-review Publications—Graham and Burch [2006] Internal Traffic Control Plans: a worker safety planning tool. Presentations Injury Prevention Recommendations -NIOSH -Purdue University, Texas A&M University, Virginia Tech, West Virginia University (WVU), OSHA, LHSFNA, International Union of Operating Engineers (IUOE), National Asphalt Pavement Association (NAPA), AGC, American Road and Transportation Builders Association (ARTBA), Federal Highway Administration (FHWA), North American Association of Transportation Safety and Health Officials (NAATSHO), State Departments of Transportation, roadway construction companies, roadway construction workers

Intermediate Goal 3.4 – Vehicles: Promote the availability and use of operator visibility limit information for road construction equipment.

Activities	Outputs -Lead and Partners
1) Transfer Evaluation Results into Practice	1) Presentations Highway Work Zone Topic Page See http://www.cdc.gov/niosh/topics/highwayworkzones/default.html Preventing Backovers and Internal Traffic Control Training CD Construction Equipment Visibility Sub-topic Page Know Your Blind Spots Poster Blind Area Diagram Fact Sheet, Brochure, Posters, Clipboards Construction Equipment Visibility Blog Blind Area Toolbox Talks Blind Area Diagram Training modules (Roadway+) Blind Spot Video Clips - NIOSH, NAATSHO, ARTBA, OSHA

	Alliance, LHSFNA - Purdue University, Texas A&M University, Virginia Tech, WVU, OSHA, LHSFNA, IUOE, NAPA, AGC, ARTBA, FHWA, NAATSHO, State DOTs, roadway construction companies, roadway construction workers, AEM.
2) Encourage Original Equipment Manufacturer to Provide Blind Area Information for Construction Equipment	2) Presentations, Consensus Building, Standards Modification -NIOSH, AEM, ANSI/ International Standards Organization (ISO) - OSHA, LHSFNA, IUOE, NAPA, AGC, ARTBA, FHWA
3) Evaluate Transfer Products for Jobsite Training	3) Distribution of 500 Units of 4 Different Information Transfer Products, Rank Order of Products, Recommendations for Product Development and Use, Peer reviewed publications -NIOSH - OSHA, LHSFNA, IUOE, NAPA, AGC, ARTBA, FHWA, NAATSHO, AEM

Intermediate Goal 3.5 – Vehicles: Evaluate worker injury risks associated with the expanded use of night work in the road construction industry.

Activities	Outputs -Lead and Partners
1) Evaluate Safety of Nightime Construction	1) ePublications – worker injury prevention strategies and lighting impact on safety and productivity -Purdue University -FHWA, NIOSH
2) Evaluation of Fatigue During Accelerated Construction	2) Peer-review Publications, Fatigue Management Guidelines, Training Materials -Transportation Research Board (TRB) - LHSFNA, IUOE, NAPA, AGC, ARTBA, FHWA, NAATSHO, OSHA, NIOSH
3) Transfer NIOSH research results into Practice	3) Nighttime Roadway Construction Fact Sheet Blog -NIOSH - LHSFNA, IUOE, NAPA, AGC, ARTBA, FHWA, NAATSHO, OSHA

Intermediate Goal 3.6 – Vehicles: Gain widespread usage of effective prevention measures in the road construction industry.

Activities	Outputs -Lead and Partners
1) Transfer NIOSH Research Results into Practice	1) Highway Work Zone Topic Page Work Zone Safety Information Clearing House Best Practices Guide for Hot-mix Asphalt Paving Operations (Joint Publication) Toolbox talks Preventing Backovers Workplace Solution Proximity Warning System Workplace Solution/Report of Investigations NIOSH FACE Reports Peer-review Publications Proximity Warning System Licensing Proximity Warning System Recommendations for Roadway Construction Preventing Backover Webpage -NIOSH, FHWA, NAPA, OSHA Alliance, - Purdue University, Texas A&M University, Virginia Tech, WVU, OSHA, LHSFNA, IUOE, NAPA, AGC, ARTBA, FHWA, NAATSHO, State DOTs, roadway construction companies, roadway construction workers
2) Develop Training Programs	2) PowerPoint Training Modules Train-the Trainer Course on Internal Traffic Control Planning Internal Traffic Control Training Module (Roadway Safety+) Backing Prevention Training CD Highway Worker Safety Training -NIOSH, ARTBA, LHSFNA, NAATSHO, AGC - OSHA, LHSFNA, IUOE, NAPA, AGC, ARTBA, FHWA, NAATSHO, State DOTs
3) Deliver Training Programs	3) Roadway Safety training underway Train-the Trainer Course on Internal Traffic Control Planning (800 workers trained) Backing Prevention Training Highway Worker Safety Training -LHSFNA, ARTBA, State DOTs, AGC - OSHA, LHSFNA, IUOE, NAPA, AGC, ARTBA, FHWA, NAATSHO, State DOTs

4) Develop Standards	4) ANSI A10.47-- 2009, Work Zone Safety for Highway Construction Preventing Backover and Runover Work Group -LHSFNA, OSHA - OSHA, LHSFNA, IUOE, NAPA, AGC, ARTBA, FHWA, NAATSHO, State DOTs
5) Fatality Assessment and Control Evaluations	5) FACE Reports FACE Web Best practice and injury prevention recommendations NIOSH Documents (e.g., workplace solutions, fact sheets, monographs) -NIOSH, State Partners LHSFNA, IUOE, NAPA, AGC, ARTBA, FHWA, NAATSHO, State DOTs State and Federal OSHA, AEM, ASSE, NSC, Industry Trade Associations

Intermediate Goal 3.7 – Collapsing Materials/Structures: Characterize circumstances and risk factors associated with common construction collapses (e.g., scaffolding, cranes, formwork, demolition work, partially built structures).

Activities	Outputs -Lead and Partners
1) Field investigations, computer simulations and physical tests	1) Peer-reviewed journal articles, book chapters, practitioner publications, Computer models, Sensor applications, Technology interventions Recommendations- designing/maintaining mast-scaffold stability; defining the role of harness/lanyard in maintaining stability; improved work practices when erecting, dismantling, and using mast-scaffolds -NIOSH -FRACO Inc. , KLIME R Inc., ANSI A92.9 standard committee, CPWR, OSHA, International Masonry Institute, I. U. of Bricklayers & Allied Craftworkers, Mastclimbers, LLC, SIA, Ohio's State Building Construction Trades Council, LHSFNA, Finishing Trades Institute, ISEA
2) Participate in ANSI A92.9 and Scaffold Industry Association meetings	2) Amended ANSI standard and acceptance of NORA mast-scaffold recommendations by committee members

	-NIOSH -ANSI 92.9 committee, FRACO, KLIMER Inc., LHSFNA
3) Fatality Assessment and Control Evaluations (FACE)	3) FACE Reports, FACE Web, Best practice and injury prevention recommendations NIOSH Documents (e.g., workplace solutions, fact sheets, monographs) -NIOSH, State partners -State and Federal OSHA, IUOE, AEM, ASSE, NSC, Industry Trade Associations

Intermediate Goal 3.8 – Collapsing Materials/Structures: Partner with construction stakeholders to greatly increase the diffusion of existing effective practices for preventing fatalities and serious injuries associated with trench collapses.

Activities	Outputs -Lead and Partners
Evaluation of Trenching Safety Awareness Training	Revised Trench Safety Awareness Training Module (CD-ROM and Web-based) Workplace Solutions Trenching/excavation safety document Trench safety awareness poster -NIOSH -CPWR, Kentucky Labor Cabinet, AGC (Kentucky Chapter), LHSFNA

SG3 Appendix A Listing of additional topics that may be used for future activities

Activities and Opportunities	**Additional information on contacts, outputs or suggested partners for future use**
3.1 Fatality Assessment and Control Evaluations to improve understanding of struck by risk factors.	FACE Reports, FACE Web Best practice and injury prevention recommendations, NIOSH Documents (e.g., workplace solutions, fact sheets, monographs), State Agency Documents -NIOSH, state partners
3.2 Development and dissemination of Construction Workplace Solutions for preventing injuries by flying objects	Workplace Solutions document based on FACE investigations -NIOSH

3.5 Conference on Injury Prevention during Night Work in Roadway Construction	Conference Proceedings, Best Practice Guidelines -NIOSH/FHWA/OSHA - LHSFNA, IUOE, NAPA, AGC, ARTBA, FHWA, NAATSHO

STRATEGIC GOAL 5

Reduce silica exposures and future silica-related health risks among construction workers by increasing the availability and use of silica dust controls and practices for tasks associated with important exposures.

> Performance Measure – A performance measure cannot be set for this strategic goal until better baseline information can be obtained and analyzed. Intermediate goal 1 will address this need and is expected to support a performance measure such as "Increase use of silica control solutions and exposure reduction practices by the construction community by 33% over baseline in ten years."

Revised Goal and Performance Measure

STRATEGIC GOAL 5.0: Reduce silica exposures and future silica-related health risks among construction workers by increasing the availability and use of silica dust controls and practices for 5 tasks associated with important exposures.

> Performance Measure - Increase the use of silica control solutions and exposure reduction practices for 5 important tasks by 25% by 2016

Objective Basis for Performance Measure

This performance measure acknowledged that a specific measure could not be established in 2007 when the goals were developed given the lack of baseline information. The workgroup discussed the overall status of silica activities along with options and available data that might be used to develop a baseline. Intermediate goal 1 called for creating a baseline, but this goal did not attract any research or partner proposals. There are constraints on governmental surveys that preclude quick or easy efforts at surveying more than 9 individuals or groups.

The workgroup explored several options. The one promising source of information identified was a survey performed by the CPWR/Masonry partnership. This group had performed two telephone surveys over the period July to October, 2011. One survey targeted signatory Contractors with International Union of Bricklayers and Allied Craftworkers (BAC). It included information from 145 contractors (68% response rate). The second survey targeted active BAC worker members. It included information from 214 workers (79% response rate) and was done as part of annual membership survey. There were two questions relevant to the NORA Silica goals:

1) *When your employees engage in tasks that produce dust (such as cutting brick or block, grinding concrete or grout, mixing mortar, etc.): How frequently is water used to control the dust?*
   Current (baseline) results
   Contractors 44% Always, 23% Most of the time
   Craft workers 23% Always, 32% Most of the time

2) *When your employees engage in tasks that produce dust (such as cutting brick or block, grinding concrete or grout, mixing mortar, etc.): How frequently are vacuums used to capture the dust?*
   Current (baseline) results
   Contractors 19% Always, 14% Most of the time
   Craft workers 14% Always, 13% Most of the time

The Masonry partnership also has plans to re-survey over time so there is an existing mechanism to evaluate progress towards meeting NORA goals.

The SG5 workgroup discussed the 33% reduction figure included as an example in the original performance measure. The workgroup thought that this figure might be overly ambitious. First, the available baseline information is for 2011, not 2006, so there is a reduced time period available to affect change. Secondly, OSHA's silica proposed rule was originally seen as a likely driver to influence awareness, interest, and use of controls by contractors and workers, but external factors are affecting promulgation of the proposed rules[4]. Taken together, these factors suggested that a 25% increase might be ambitious but achievable and it is used in the revised measure.

The resulting baseline uses combined percentages for responses for "always" and "most of the time" resulting in the following levels:

Q1 wet method use	67% contractor use, 55% worker use
Q2 vacuum use	33% contractor use, 27% worker use

A goal of a 25% increase in use will be met if these rates increase to the following upon resurvey in 2016:

Q1 wet method use	83% contractor use, 68% worker use
Q2 vacuum use	41% contractor use, 34% worker use

The workgroup also discussed the open-ended language of the goal itself, which mentions progress on tasks associated with "important" exposures. The workgroup discussed this issue and selected the following 5 important tasks:

[4] OSHA did publish a Notice of Proposed Rule for Silica on September 12, 2013 after these NORA workgroup discussions were held.

- Tuck pointing
- Concrete polishing
- Saw cutting of roads
- Saw cutting of bricks and blocks
- Hand grinding of concrete

Roadmap for additional activities

Intermediate Goal 5.1 – Use existing information supplemented by survey research to develop a baseline on current silica control practices and programs in construction.

Activities	Outputs -Lead and Partners
1) Workgroup reviewed available information and identified a Masonry Partnership survey performed in conjunction with CPWR with masonry contractors and workers on use of wet methods and local exhaust ventilation (LEV) to control silica dust. Obtained approval from Masonry Partnership to use results for NORA Baseline purposes. Workgroup also narrowed scope concept to focus on the "top 5 tasks" with highest silica exposures.	1) Masonry Partnership Survey Results Report -Masonry Partnership (International Council of Employers of Bricklayers and Allied Craftworkers, International Union of Bricklayers and Allied Craftworkers, International Masonry Institute) Preliminary "Top 5 Tasks" list
2) Support additional survey research to evaluate use of controls in 2016	2) A new survey of the Masonry Partnership to revisit the baseline questions -Masonry Partnership

Intermediate Goal 5.2 – Increase awareness about silica hazards and known solutions among construction workers, contractors, owners, and suppliers.

Activities	Outputs -Lead and Partners
1) Collaborate to support a one-stop "Silica Safe" website targeted to contractors and workers. Use site to post relevant silica awareness and guidance materials for contractors.	1) A "Work Safely with Silica" site was developed and was launched in November of 2012. http://www.silica-safe.org/ (There are 16 direct links to the site and there have been numerous successful outreach steps taken to publicize the site Webinar about site with Occupational Health and Safety magazine was held in September 2013

	-CPWR Site has 11 supporters listed representing contractors, workers, and manufacturers
2) Sponsor a 90 minute educational session at annual World of Concrete (WoC) conference. (Meeting attracts 50,000 attendees from masonry and concrete industries – key audiences on silica)	2) Abstract involving 3 partner speakers was submitted on 4/11/12 for 2013 meeting but was not accepted. Will resubmit again for 2014 meeting. Will use developed materials for other sessions such as webinar -NIOSH and CPWR Speaker volunteer partners from the following organizations: -CPWR/UMass -Donley's Construction -Brasfield & Gorrie

Intermediate Goal 5.3 – Increase the availability of engineering and work practice options for preventing and reducing silica exposures

Activities	Outputs -Lead and Partners
Develop "Workplace Solutions" and similar good engineering and work practice materials for engineering control research projects underway (e.g. pavement milling, concrete surface preparation tools, fiber cement siding cutting, dowel pin drills, tuck pointing)	Develop appropriate information products for NIOSH, CPWR, and other research projects nearing completion Posting on silica website in the Planning Tool and section on new research and training materials. -NIOSH, CPWR Various Project Partners such as NAPA, IUOE, LIUNA, AEM and relevant equipment manufacturers

Intermediate Goal 5.4 – Develop model practices and programs and promote their use by construction owners, governmental groups, professional groups, and best practice employers.

Activities	Outputs -Lead and Partners
1) Promote a "Silica Competent Person" concept as developed by AIHA Construction Committee	1) AIHA white paper, "Recommended Skills and Capabilities for Silica Competent Persons", which mentions NORA connection, was issued on March 19, 2013 http://www.aiha.org/news-pubs/newsroom/Documents/SPR-13-0319-01_SilicaWhitePaper.pdf -AIHA, NIOSH

2) Develop and promote a 3-5 step pre-job silica hazard review/plan that can be used by competent persons to estimate and plan for project-specific silica exposure hazards	2) Pre-job planning tool (called "Create a Plan" was developed and integrated into the Silica Safe website. See http://plan.silica-safe.org/ -CPWR
3) Partner with NORA Green Construction Committee (described more fully in the later discussion for SG 13) to develop a LEED pilot credit for "Clean" construction or for "Controlled Disturbance" to encourage owners and planners to request that dust control be used on construction and renovation projects. Alternative is to develop guidance for existing credits to encourage the use of dust controls. Share broadly.	3) Will develop a Pilot Credit and supporting information. -NIOSH NORA Green Coordinating Group, CPWR, AGC, AIHA, others
4) Develop "Model Specification" for tuck pointing and 2 other tasks and work to get them used.	4) Model Specification white paper and supporting information using Veterans Administration Spec as starting point -NIOSH, CPWR, VA, AGC

SG5 Appendix A Listing of additional topics that may be used for future activities

Activities and Opportunities	**Additional information on contacts, outputs or suggested partners for future use**
5.4 Develop standardized sample collection form to encourage sharing of air sample results for common tasks	Short paper describing rationale and suggested form -AGC, AIHA, The Association of Union Contractors (TAUC)
5.4 Explore the value of how lab testing (e.g. German model with Hilti) could be used to provide "objective evidence" for OSHA compliance for silica	Short paper describing rationale, German model, and suggested objective evidence procedure. -AGC, HILTI tools, AIHA, TAUC, CPWR
5.4 Further explore the use of "Portable health testing" for silica medical surveillance and respirator medical evaluations	Short paper describing rationale and suggested options for use by employers, labor management trusts, and other organizations.

STRATEGIC GOAL 8

Increase understanding of factors that comprise both positive and negative construction safety and health cultures; and, expand the availability and use of effective interventions at the policy, organizational, and individual level to maintain safe work practices 100% of the time in the construction industry.

> Performance Measure: This goal will be successfully achieved if by 2016, NIOSH, its stakeholders, and the construction industry as a whole increase their recognition and understanding of the complexity of safety and health culture and strive to use successful measurement and intervention tools to create a positive culture at the worksite.

Revised Goal and Performance Measure

STRATEGIC GOAL 8.0: Increase understanding of factors that contribute to safety culture and climate in the construction industry and improve sector capabilities to evaluate and improve practices at the policy, organizational, and individual level. Promote increased attention to safety culture and climate as a way to improve the effectiveness of safety and health programs and practices.

> Performance Measure: Support safety culture research and organize at least three activities that advance understanding and exchange of knowledge and which can serve to promote good practices to create a more positive safety culture and climate in the construction industry.

Objective Basis for Performance Measure

The performance measure for this goal is activity-based. The roadmap describes the three activities to be tracked for evaluating performance.

Roadmap for additional activities

SG8 workgroup chairs reviewed potential activities and determined that the most valuable action would be to organize a meeting to bring together researchers and practitioners to discuss key safety culture and climate issues. A “Safety Culture/Climate Workshop” was organized and held on June 11-12, 2013 in Washington, DC. NIOSH and CPWR co-sponsored the meeting with the National Institute for Environmental Health Sciences (NIEHS).

The resulting meeting used shared plenary sessions combined with separate NIEHS and NORA tracks for more detailed discussions. The construction track was titled: “Safety Culture and Climate in Construction: Bridging the Gap between Research and Practice”. The plenary speakers included OSHA Assistant Secretary David Michaels, NIOSH Director John Howard,

and U.S. Chemical Safety Board Chair Rafael Moure-Eraso. The workshop and additional follow-up activities addressed all three of the intermediate goals listed below:

8.1: Create a working definition and framework for construction industry safety and health culture and improve understanding of the factors that contribute to a positive or negative safety and health culture in the construction industry.

8.2: Develop and expand the use of validated measurement methods for evaluating safety culture and safety climate in the construction industry.

8.3: Partner with construction stakeholders to develop and disseminate effective intervention measures for improving safety and health culture in the construction industry.

Activities	Outputs -Lead and Partners
1) Organize and sponsor a June 2013 Workshop: "Research and Practice in the Construction Industry" to be held in the Washington, DC area. Breakout session #1 to address IG 8.1. It will discuss safety culture and safety climate definition issues and will identify factors that contribute to construction safety culture in the construction setting Breakout session #2 to address IG 8.2. It will discuss safety culture and safety climate measurement and evaluation issues. Breakout session #3 to address IG8.3. It will address interventions to improve safety culture and climate. **COMPLETED**	1) Conference presentations and handouts available at: http://www.cpwr.com/safety-culture Plenary presentations available at http://tools.niehs.nih.gov/wetp/events.cfm?id=2527 2) Literature Review Paper on peer-reviewed research most relevant for Construction Safety Culture/Climate was produced and was provided at the Workshop. It was used to frame issues and inform the workshop discussions. A version is being prepared for publication. 3) A Workshop Report is being prepared to capture and summarize information such as: • Preferred definitions and factors most relevant for construction • Guiding principles for evaluation: Why, What, How, and When? • Guiding principles for interventions -CPWR/NIOSH/OSHA ASSE, LHSFNA, and additional partners to be identified during workshop

2) Encourage additional spin-off and follow-up activities to communicate key findings of 2013 workshop to wider audiences.	2) Suggested follow-up outputs to include a webinar, website topic pages, safety culture/climate roundtables at construction and professional organization meetings, and regional and local meetings. -CPWR/NIOSH/OSHA ASSE, AIHA, and others to be identified during workshop
3) Promote Safety Climate training for front line construction supervisors	3) Disseminate products from NIOSH project titled: "Safety Climate Training for Construction Foremen" Follow-up outputs include a webinar and presentation on products at construction and organizational meetings -NIOSH Additional partners to be identified during workshop

STRATEGIC GOAL 12

Reduce injury and illness among groups of construction workers through improved understanding of why groups of workers experience disproportionate risks in construction work and expanding the availability and use of effective interventions.

> Performance Measure: This goal will be successfully achieved if by 2016, there is improvement in the understanding of what contributes to health disparities in construction; expansion of the existing knowledge base of injury, illness, and exposure of at-risk worker populations; and increased distribution of effective interventions.

Revised Goal and Performance Measure

STRATEGIC GOAL 12.0: Reduce injury and illness among groups of construction workers through improved understanding of why groups of workers experience disproportionate risks in construction work and expanding the availability and use of effective interventions.

> Performance Measure: This goal will be successfully achieved if by 2016, progress is demonstrable in three areas:

1) Support research to expand the existing knowledge base of injury, illness, exposure, and risk factors for at-risk construction worker populations by 50% over a 2006 baseline.

2) Support research and collaboration to identify, evaluate, and inventory interventions relevant for construction. Develop and maintain an accessible resource list of research, reports, interventions, researchers, practitioners and other key contacts, groups and other resources relevant to construction safety and health disparities.

3) Support exchange and dissemination of construction disparities-related information between researchers, practitioners, and at-risk worker groups. Engage groups via at least 5 activities or outputs such as workshops, webinars, training materials, publications, or development of social media approaches.

Objective Basis for Performance Measures

The SG12 workgroup first described the various activities that could improve understanding of disproportionate risks in construction. The group then developed three separate measures that reflect each of the three underlying intermediate goals.

The objective basis for performance measure 1 is a baseline literature review to be repeated in 2016.

The objective basis for performance measure 2 is the creation and maintenance of a resource list. Growth and use of the list through 2016 will be tracked.

The objective basis for performance measure 3 is development and documentation of at least five activities or outputs such as: development of a publication on safety for temporary workers in construction, co-sponsorship of a disparities training intervention session with OSHA Harwood grantees, or co-sponsorship of a session or publication with ASSE or other groups.)

Roadmap for additional activities

Intermediate Goal 12.1 – Improve the surveillance of work-related injuries, illnesses, hazards, and related costs among workers at disproportionate risk of injury in construction in order to set intervention priorities, guide future research, and evaluate progress in reaching prevention goals.

Activities	Outputs -Lead and Partners
1) Prepare reports utilizing the best available surveillance information to describe labor force characteristics and risks relevant to disproportionate risks	1) Construction Chart Book sections developed for • Foreign born workers in Construction • Hispanic workers in Construction • Racial minority workers in Construction • Women workers in Construction • Worker age in Construction • Displaced workers in Construction See http://www.cpwr.com/rp-chartbook10-20.html -CPWR
2) Explore how leading safety and health indicators are used on construction sites and how this affects safety and health for high risk workers/workers who are likely to experience safety and health disparities.	2) Create 3-4 case studies to answer questions such as: How effective is a safety and health program for high risk workers when you replace lagging indicators with leading? What are the appropriate leading indicators and how does this affect what we know about high risk workers? Is an industry shift from lagging to leading indicators occurring? Can we quantify it? -Virginia Tech – may have some case studies people can use as leading indicators to vulnerable workers and disparities. Construction Industry Institute (CII), NIOSH, Voluntary Protection Program (VPP), CPWR, others

Intermediate Goal 12.2 – Improve our understanding of conditions and factors that contribute to disproportionate risk and the mechanisms through which vulnerability places workers at increased risk for work-related injury (or illness) in the construction trades, and their longitudinal effects.

Activities	Outputs -Lead and Partners
1) Support new research projects	1) New research proposals and projects
2) 'State of the research' for disparities in construction	2) Reference list of disparities in construction research -NIOSH
3) Hold a one-day disparities in construction workshop bringing key researchers and practitioners together. Plan for 2014.	3) One-day disparities in construction workshop. White paper and additional materials -NIOSH/CPWR NORA Construction Sector Council, NORA Disparities workgroup

Intermediate Goal 12.3 – Develop and disseminate materials on risk and effective interventions to raise awareness and increase the utilization of these methods by construction stakeholders and to influence policy-makers. Based on existing information, Hispanic workers should be an important target group, but efforts should not neglect other groups, including non-Hispanic immigrants and inexperienced workers

Activities	Outputs -Lead and Partners
1) Adapt Education & Training white paper from NIOSH Occupational Health Disparities Conference into a secondary product for construction trainers	1) Communication product outlining best practices for training and education in construction safety and health for trainers—need proven training techniques /education methods, adult education principles etc. -WVU/Umass Lowell OSHA Ed Centers/Training Institute, NIOSH organizers from the NIOSH sponsored Conference "Eliminating Health and Safety Disparities at Work"
2) Develop Spanish-language occupational safety and health (OSH) brochure for immigrant workers in the construction industry. Work with the Mexican Consulates to integrate OSH into the health and legal components.	2) Spanish-language construction brochure to include occupational safety and health information; distribute throughout the Mexican Consulates (50 consulates throughout the U.S., 4 million people a year visit). Through training, integrate OSH into legal departments of Mexican Consulates to assist in providing seamless array

	of services around OSH. Also work to train promotores de salud (community health workers) to ensure they have the OSH training to best serve the health needs of the Consulate community. -NIOSH Mexican Consulates
3) To better address low literacy among construction workers, develop a wordless safety manual to educate workers on safety and health practices	3) Wordless safety manual (manual of pictograms) for the construction practice specialty -ASSE
4) Develop disparities training targeted towards OSHA Harwood grantees, NIEHS, ASSE, AGC including how best to train low literacy Hispanic workers	4) Disparities training intervention session with OSHA Harwood grantees, NIEHS, ASSE, AGC -WVU hosting the next OSHA education center meeting in Baltimore, Workgroup co-chair to see if he can get some time to discuss disparities and will check on engaging NIEHS grantees -Co-chair to check with AGC to see if they have any avenues to discuss disparities -WVU OSHA, NORA Construction Sector Council, Disparities WG
5) Cull Falls Fatalities Campaign focus groups summary for relevant information	5) Information/recommendations about how to disseminate effective interventions -NIOSH NORA Sector Council Contributing Factors Work Group #2, CPWR, The Hannon Group

STRATEGIC GOAL 13

Increase the use of "prevention through design (PtD)" approaches to prevent or reduce safety and health hazards in construction.

Performance Measure: Increase the use of CHPtD by 33% over the next 10 years.

Revised Goal and Performance Measure

STRATEGIC GOAL 13.0: Increase awareness about and use of "prevention through design (PtD)" approaches to prevent or reduce safety and health hazards in construction.

Performance Measure: Increase awareness about and use of PtD in Construction and Maintenance by 33% over the next 10 years.

Objective Basis for Performance Measure

The SG13 workgroup reviewed existing sources that could be used as a baseline. The best available survey information was from a study performed by former NORA Construction Sector Council member Mike Toole at Bucknell University. The 2008 survey results were available as a final report to CPWR[5] and publication of a paper to describe the results is expected. The survey was a convenience sample of national construction owner organizations, including federal agencies, two state transportation departments, owner associations, and the Construction Industry Institute and American Society of Civil Engineers. The survey found that an average of 71% of 182 survey participants had never heard of the Design for Construction Safety concept (equivalent to the PtD concept in construction) meaning that 29% had heard of it. A 33% improvement to meet the NORA performance measure would require awareness to rise to 39% by 2016.

One important facet of PtD relates to green construction. Green rating systems such as the US Green Building Council's LEED (Leadership in Energy and Environmental Design) utilize design and represent an opportunity for PtD. This is especially true as green evolves towards sustainability, where social equity and worker safety have a more clear cut role. Integrating safety and health into green construction was the other focus area (besides the falls campaign) selected by the NORA Construction Sector Council for emphasis during 2011-2013. A NORA Green Construction Coordinating Committee was developed consisting of NORA Construction Sector Council members combined with other subject matter experts to focus on this issue.

[5] Toole, M, Gambatese, J, Abowitz, D. [2012] Owners' Role in Facilitating Designing for Construction Safety. Final Research Report submitted to CPWR. January 12, 2012.

Another topic targeted for action under this goal was to explore the use of BIM – Building Information Modeling – as a promising means to facilitate PtD. A successful meeting was held on August 6, 2013, co-sponsored by NIOSH, CPWR, AGC, and BIMForum.

Roadmap for additional activities

Intermediate Goal 13.1 – Characterize the current use of "Construction Hazard Prevention through Design" (CHPtD) and coordinate efforts to promote its use and to fill key information gaps.

Activities	Outputs -Lead and Partners
1) Develop and disseminate undergraduate PtD modules that include construction-related topics. **COMPLETED** 2) Develop a PtD awareness course for architects	1) Four Education modules for construction have been developed and were released in August of 2013. See Architectural Design and Construction http://www.cdc.gov/niosh/docs/2013-133/ Reinforced Concrete Design http://www.cdc.gov/niosh/docs/2013-135/ Structural Steel Design Education http://www.cdc.gov/niosh/docs/2013-136/ Mechanical-Electrical Systems http://www.cdc.gov/niosh/docs/2013-134/ -NIOSH Academic partners contributed content
2) Develop a PtD awareness course for architects	2) A 1 credit continuing education course titled: "Overview of Construction Prevention through Design" was developed Course at http://cpeprograms.ecu.edu/CourseStatus.awp?&course=ARCH001 -Co-Chair, East Carolina University and Virginia Tech

Intermediate Goal 13.2 – Evaluate, clarify, and address the most prevalent obstacles to acceptance and implementation of CHPtD:

- fear of liability;
- lack of expertise in safety and in designing for safety; and,
- uncertainty about costs associated with CHPtD.

Activities	Outputs -Lead and Partners
Support research to re-survey owners, architects, engineers, and safety and health professionals to evaluate any increase in awareness about and use of PtD along with information about ongoing obstacles hindering adoption of PtD.	Research proposal or practitioner partnership leading to survey report. -CPWR/NIOSH Academic partners

Intermediate Goal 13.3 – Evaluate opportunities to develop potential incentives for encouraging architects and engineers to embrace CHPtD.

Activities	Outputs -Lead and Partners
1) Green Construction, given its reliance on design and mention as NORA subgoal 13.3.2, was identified as a major opportunity for encouraging PtD. A NORA Green Construction Coordinating Committee was created to evaluate US Green Building Council (USGBC) LEED (Leadership in Energy and Environmental Design) credits to identify potential hazards, benefits, and design interventions. **COMPLETED**	1) Committee performed a "Credit by Credit" review of potential hazards related to the 2009 LEED New Construction credits and prepared a July, 2011 report titled: "Integrating Occupational Safety and Health into the US Green Building Council LEED New Construction Credits: A Preliminary Report" prepared and submitted to USGBC. Included development of pilot credit and reference guide materials.
Engage the USGBC via ongoing meetings to raise awareness about construction and maintenance issues and to identify areas for collaboration.	Various outreach materials prepared such as: NIOSH Blog piece: "Going Green: Safe and Healthy Jobs" January 4, 2010 http://blogs.cdc.gov/niosh-science-blog/2010/01/green-2/
Perform outreach about the need to integrate safety and health into green construction to various construction stakeholder groups	Over 10 presentations given about integrating safety and health into green construction
Develop a "Life Cycle Safety" approach to provide green practitioners with a PtD-based methodology that fits with green rating system thinking. **COMPLETED**	Presentation describing Life Cycle Safety prepared
Develop additional pilot credits	Safe Roof Plan Pilot credit developed
Evaluate international green rating systems to determine if any are integrating safety and health	Report on international green rating systems and safety and health to be prepared

	-NIOSH with East Carolina University and Virginia Tech as Committee Co-Chairs Coordinating Committee members from CPWR, Construction Safety Council, National Asphalt Pavement Association, West Virginia University, American Contractors Insurance Group, Safety Council of Texas City, Blue Green Alliance, University of Colorado, Oregon State University, Hoffman Construction, EMS Environmental.
2) Organize and sponsor an August 2013 Workshop: "Using BIM (Building Information Modeling) to Eliminate Construction Site Hazards" The meeting will include discussion of how BIM features can be used to improve PtD efforts and pre-job planning. **COMPLETED**	2) August 6, 2013 workshop held. Agenda and presentations at http://bimforum.org/resources/safety/ -NIOSH, CPWR, AGC, BIMFORUM

Intermediate Goal 13.4 – Develop tangible products and methods to address identified CHPtD obstacles and challenges.

Activities	Outputs -Lead and Partners
1) Partner with the NORA Falls Campaign and Strategic Goal 1 (Falls) Workgroup to develop a "Safe Roof Design Guide" to promote best practices for preventing falls by construction and maintenance workers by proper design. Disseminate to architects, engineers, and safety and health professionals	1) A 10-20 page NIOSH or NORA web publication with photos and diagrams to describe roof-related fall hazards and design solutions. Can also be used as reference for USGBC LEED reference guide. -NIOSH, Green Construction Coordinating Committee, and NORA Falls workgroup OSHA, ASSE, NSC, Workers Comp carriers, NRCA, Roofers Union, and subject matter experts such as Nigel Ellis
2) Partner with the NORA Falls Campaign and the Strategic Goal 1 (Falls) Workgroup to Develop PtD factsheets related to falls. Disseminate to architects, engineers, and safety and health professionals	2) Six 2-3 page fact sheets were developed with NIOSH and stakeholder input for the OSHA Construction Alliance. Discussions are underway to convert these into OSHA products. NIOSH is also considering developing Workplace Design Solution products. Once finalized, these will be disseminated to key design audiences. -OSHA, ASSE, NSC, Workers Comp carriers, NRCA, Roofers Union, and subject matter experts such as Nigel Ellis

3) Partner with the NORA Silica Workgroup to develop pilot credits for “Clean” or “Controlled Disturbance” construction	3) Short white paper describing the need for use of local exhaust ventilation to capture dust at the source on green construction and maintenance jobs along with pilot credit language. -NIOSH, CPWR, AIHA, AGC

Intermediate Goal 13.5 – Expand the use and evaluation of CHPtD practices.

Activities	Outputs -Lead and Partners
Coordinate a “Train the Trainer” webinar with Australian colleagues who created CHAIR (Construction Hazard Assessment Implication Review) to support the use of the CHAIR approach in the U.S.	Webinar Follow-up training at various locations. - Virginia Tech/East Carolina - University/NIOSH/CPWR - University of Washington - University of Colorado