



**NORA**

## **NATIONAL OCCUPATIONAL RESEARCH AGENDA (NORA)**

August 14, 2009

### **NATIONAL TRANSPORTATION, WAREHOUSING, AND UTILITIES AGENDA**

FOR OCCUPATIONAL SAFETY AND HEALTH RESEARCH  
AND PRACTICE IN THE U.S. TRANSPORTATION,  
WAREHOUSING, AND UTILITIES (TWU) SECTOR

**Developed by the NORA Transportation, Warehousing, and Utilities Sector  
Council**

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## **ACRONYMS**

<b>BLS</b>	Bureau of Labor Statistics
<b>CFOI</b>	Census of Fatal Occupational Injuries
<b>CVD</b>	Cardiovascular disease
<b>DAFW</b>	Days away from work
<b>NAICS</b>	North American Industry Classification System
<b>NIOSH</b>	National Institute for Occupational Safety and Health
<b>NORA</b>	National Occupational Research Agenda
<b>TWU-SC</b>	Transportation, Warehousing, and Utilities Sector Council
<b>TWU</b>	Transportation, Warehousing, and Utilities
<b>WMSD</b>	Work-related musculoskeletal disorders

## **INTRODUCTION**

### ***What is NORA?***

The National Occupational Research Agenda (NORA) is a partnership program to stimulate innovative research and workplace interventions. In combination with other initiatives, the products of this program are expected to reduce the occurrence of injuries and illnesses at work. Unveiled in 1996, NORA has become a research framework for the National Institute for Occupational Safety and Health (NIOSH) and the nation. Diverse parties collaborate to identify the most critical issues in workplace safety and health and to develop strategic plans for addressing these needs.

NORA entered its second decade in 2006 with a new structure based on the premise that the conceptualization of research and translation of research results to the workplace is best accomplished by those who are knowledgeable about the problems and work environment within specific industry groups. NIOSH is the steward of NORA and facilitates the work of the multi-stakeholder NORA Sector Councils, which are developing and implementing research agendas for the occupational safety and health community over the decade (2006-2016).

The new “sector-based” structure for NORA groups industries into eight sectors using North American Industry Classification System (NAICS) codes. The Transportation, Warehousing, and Utilities (TWU) sector encompasses NAICS code groupings 48, 49, and 22. The Transportation sector (NAICS 48) covers all modes of transporting passengers and cargo: air, rail, water, road, and pipeline. The Warehousing sector (NAICS 49) consists of establishments engaged primarily in warehousing and storage of goods. The Utilities sector (NAICS 22) covers electric power, natural gas, water, sewage, and other systems. Additionally, related support activities in the Transportation sector are included; these support functions often entail different activities and are thus associated with a different set of workplace injury and illness risks.

### ***What is the NORA Transportation, Warehousing, and Utilities Sector Council (TWU-SC)?***

The NORA Transportation, Warehousing, and Utilities Sector Council (TWU-SC) is made up of approximately 25 individuals who represent diverse interests across this wide-ranging sector. The TWU-SC is co-led by one NIOSH representative and another member from outside NIOSH.

The mission of the TWU-SC is: *To implement a focused program of surveillance, research, and the development of interventions that leads to the mitigation and prevention of occupational injuries, illnesses, and fatalities in this broad industry sector.*

The TWU-SC draws on an active group of Corresponding Members who participate in ad hoc working groups and serve as reviewers of Council products. Because the TWU sector is so diverse, the Corresponding Members are valuable sources of specialized knowledge that may not reside within the Council itself.

### ***What does the National Agenda for TWU represent?***

This is the first effort to create a national occupational safety and health agenda for the transportation, warehousing, and utilities industry sector. It is intended to identify the research, information, and actions most urgently needed to prevent occupational injuries and illnesses in

the TWU sector. This National Agenda for TWU provides a vehicle for industry stakeholders to describe the most relevant issues, gaps, and safety and health needs for the sector.

The following National Agenda for TWU reflects the breadth and diversity of the sector. It is the result of a challenging process that set out to identify the issues to be addressed through research and stakeholder actions. Because the Agenda is intended to guide national occupational health and safety efforts for the TWU sector, it cannot at the same time be an *inventory* of all issues worthy of attention. The omission of a topic does not mean that topic was viewed as unimportant. Those who developed this Agenda did, however, believe that the number of topics should be small enough so that resources could be focused on a manageable set of goals, thereby increasing the likelihood of real impact in the workplace. However, once a topic was selected, the group tried to develop sufficient intermediate goals to address key gaps and needs. Finally, it should be noted that the proposed goals are not tied to any specific budget level or anticipated activity level.

### ***Who are the target audiences?***

The National Agenda for TWU will help stakeholders and partners to prioritize their work among the many safety and health issues of interest. Stakeholders and partners include persons, groups, or organizations that have a direct or indirect stake in occupational safety and health in the TWU sector. Stakeholders and partners can affect or be affected by the priorities established and are essential for implementing the TWU Agenda. Stakeholders and partners include industry, labor, safety professionals, academic institutions, insurance carriers, government agencies, and safety-related non-government organizations. The National TWU Agenda is intended to inspire decision makers and program planners to include these topics in their top priorities, and to guide researchers to relevant topic areas for research proposals. Finally, it is intended to encourage dialogue and partnering among stakeholders on a subset of key issues, thereby increasing our collective ability to reduce injuries and illnesses among workers in the TWU industries. Potential users of the Agenda are:

Research funding sources:

- Federal and state agencies
- Research foundations
- Industry-supported research organizations

Public and private researchers:

- Government researchers
- Academic researchers
- Industry and foundation-based researchers

Industry organizations:

- Trade associations
- Vehicle and equipment manufacturers and distributors

Labor organizations and unions

Regulatory agencies at federal, state, and local levels

Public health agencies at federal, state, and local levels

Non-profit and non-government organizations

Safety and health practitioners in public and private sectors:

- Individual safety, industrial hygiene, and engineering practitioners
- Health educators and health promotion coordinators
- Consensus standards groups
- Professional associations
- Other professionals with safety and health interests (e.g., economists, occupational physicians, ergonomists, occupational and physical therapists, and occupational health nurses)

### *How was the research agenda developed?*

The second decade of NORA was launched with a series of town hall meetings around the country. The meeting that focused on the TWU sector was held on December 5, 2005 in College Park, Maryland. Additional comments related to occupational safety and health priorities for the sector were submitted at other town hall meetings held over the next several months. Written comments were collected through a NORA sector docket. The resulting comments, organized by each sector, may be accessed at <http://www2a.cdc.gov/niosh-comments/nora-comments/commentsrch.asp>. Finally, input was solicited at a breakout session dedicated to TWU concerns at the NORA Symposium in April, 2006.

As public input was being collected, potential members for the TWU-SC were being identified and invited to participate. The Council consists of approximately 25 stakeholders representing government, industry, academia, labor, and research organizations. (See <http://www.cdc.gov/niosh/nora/councils/twu/planpart.html> for a list of current and former TWU-SC members). Prior to the Council's first meeting on November 29, 2006, members prepared worksheets on top occupational safety and health problems, and were asked to consider which actions would most appropriately address those problems. At the meeting, members were briefed on the structure and goals for NORA, the comments received through the town hall meetings and other venues, and current injury and illness data for the TWU sector (see Appendix A for examples of injury and illness data used to identify priority areas).

Subsequent meetings and conference calls led to the identification of strategic areas that would form the basis for **strategic goals**, which capture the key improvements in occupational safety and health to be achieved. Eventually, the strategic goals will be linked with a **performance measure**, a metric that allows better focus of the **implementation plan** and tracking of progress toward that goal.

Work groups, formed around each strategic goal and co-chaired by TWU-SC members, were charged with drafting intermediate goals to accompany that strategic goal. **Intermediate goals** delineate the expected efforts of TWU partners and stakeholders that, taken together, contribute to achieving a strategic goal. In turn, **activity/output goals** are specific research or public health prevention activities and outputs relevant to a specific intermediate goal. Other interested

individuals who serve as “corresponding members” of the TWU-SC were brought into the work groups, and participated fully in developing intermediate goals and supporting information.

***What are the primary areas of focus in the National Agenda for TWU?***

There are four strategic areas of focus in this agenda, with further description of the nature of the problems in each area provided in the appendices of this document:

**(1) Traumatic injuries.** Acute trauma at work is a leading cause of death and disability among TWU workers. This section concentrates on preventing and reducing fatal and non-fatal injuries sustained as a result of trauma. Trauma is defined as "an injury or wound to a living body caused by the application of external force or violence." Acute trauma can occur with the sudden, one-time application of force or violence that causes immediate damage to a living body.

See Appendices A and B.

**(2) Musculoskeletal disorders.** This section focuses on prevention and reducing work-related musculoskeletal disorders (WMSDs) among TWU workers. Musculoskeletal disorders are injuries or disorders of the muscles, nerves, tendons, joints, and cartilage, affecting the upper and lower limbs, neck, and back. These disorders are caused, precipitated or exacerbated by sudden exertion or prolonged exposure to physical factors such as repetition, force, vibration, or awkward posture. Low back pain and repetitive strain injuries are two examples that come under WMSDs. (This definition specifically excludes those conditions such as fractures, contusions, abrasions, and lacerations resulting from sudden physical contact of the body with external objects). See Appendix C.

**(3) Health and wellness.** This section addresses the occupational health and wellness of TWU workers, including work-related issues associated with engaging in healthy behaviors, reduction of risk factors, improving work organization practices, reducing psychological stressors, and improving appropriate access to and utilization of healthcare. See Appendix D.

**(4) Exposures.** This section involves anticipating, identifying, characterizing, evaluating, and preventing hazardous workplace exposures among industry sub-sectors within TWU. The selected exposures are classified into three main categories of chemical, biological, and physical. Due to the diversity of the TWU Sector, there is a wide range of potential exposures that can impact worker health. These exposures are subject to change as emerging issues arise and research further defines the nature and effects of various exposures.

In addition to these four areas, economics and the public health burden and the impacts of fatigue were consistently identified as two additional areas of concern as they relate to occupational injuries and illnesses. After much discussion, it was determined by the TWU-SC that these two areas would be best addressed by inclusion in each of the four strategic areas rather than creating an additional strategic area. The TWU-SC felt that this approach would draw attention to the need for economics and fatigue-related issues to be addressed in a diversity of strategic areas.

***What conditions must be in place if these goals are to be achieved?***

In drafting this National Agenda for TWU, the TWU-SC, corresponding members, and other stakeholders noted that goals for prevention of occupational injury and illness require strong organizational commitments, and cannot be met without supportive organizational and collaborative linkages.

- First and foremost, the setting of targets for reduction of occupational injuries, illnesses, and fatalities is not intended to imply that any level of injury or illness is acceptable. The cumulative and long-term efforts of industry, labor, government, the research community, and other interested parties are focused on the elimination of *all* work-related injuries and illnesses.
- The TWU-SC notes the importance of strengthening national capacity to apply rigorous research methodology to the mitigation and prevention of work-related injuries and illnesses in addition to the application of ‘best practices’ when available and appropriate. The majority of the goals that appear in the following section encompass the full range of the research process: identification of problems and risk factors, development of interventions, evaluation of interventions in the workplace, and finally, broad dissemination and implementation of successful interventions. Formal evaluation of interventions in a work setting is a particularly important part of the process; too often, an intervention may be adopted before its effectiveness in preventing injury or illness is demonstrated.
- Multi-disciplinary research teams can provide a breadth of perspective that will enhance credibility and encourage broader applicability of interventions.
- A culture that supports injury and illness prevention programs at the highest level of the organization is crucial to success. Improved techniques to survey and measure attributes of organizational culture will help safety and health professionals identify changes in policies and practices that will improve safety performance.
- Coordination of injury prevention activities within a single industry or group of industries with common concerns will result in more effective use of scarce resources. One area that would benefit from collaborative activity is the development of integrated safety and health performance measures as a means to quantify progress, successes, and failures. Shared knowledge and experience about the predictive value of different outcome measures (e.g., leading, process, and lagging) would further the implementation of industry-appropriate systems for tracking performance.
- Mitigation and prevention activities should be interpreted to consider all aspects of prevention, from primary prevention to secondary and tertiary prevention. The prevention focus taken for a particular goal should be dependent on existing knowledge and research determining the approach of greatest need and benefit.

***What are the next steps in this process?***

The TWU-SC will develop an **implementation plan**, which will detail the actions to be undertaken by partners, including NIOSH, to put the National Agenda for TWU into practice. It is an important premise that the TWU National Agenda represents the Nation’s occupational safety and health goals. Accomplishment of these goals is a shared responsibility that will require the commitment, participation, and effort of all partners. Implementation is dependent upon: the level of interest key partners have in participating in activities that will lead to the achievement of Agenda goals; the extent to which new research partnerships between industry and the research community can be developed; the availability of research funding; and the availability of researchers with the necessary expertise.

Partnerships are important to the success of this national effort. Partners who may be involved in the progress of this Agenda are inclusive of, but not limited to, academic institutions, consensus standard groups, employees, employers, government agencies, individual safety and health practitioners in the public and private sectors, labor, manufacturers, professional associations, public health agencies, regulatory agencies, research foundations and organizations, trade associations, unions, and workers compensation insurance carriers.

During the time established as the second decade of NORA, the goals in this document will be considered dynamic. Goals may be added, deleted or modified based on changes in the availability of resources, the development of new or emerging issues, and/or achievements in injury or illness prevention.

Individuals and organizations with comments on this document or those interested in learning more about volunteering to work with the Council to achieve the goals are encouraged to send an email to [noracoordinator@cdc.gov](mailto:noracoordinator@cdc.gov).

## **TWU SECTOR GOALS**

### ***Strategic Goal 1 - Traumatic Injuries***

**Strategic Goal 1: Reduce lost-workday occupational traumatic injury and fatality rates in the TWU sector.**

*Performance measure:*

Injury and fatality rate reduction of 20% from 2008 baseline levels in the following sub-sectors: air transportation; rail transportation; water transportation; truck transportation; transit and ground passenger transportation; couriers and messengers; warehousing and storage; and utilities.

Note: See Appendix B for data, discussion, and references supporting this goal.

#### ***Air Transportation (NAICS 481)***

**Intermediate Goal 1.1:** Employers (including the self-employed) will incorporate effective interventions into their policies and procedures to prevent work-related injuries and fatalities due to aircraft crashes.

Activity Goal 1.1.1: Identify risk factors for work-related injuries and fatalities due to aircraft crashes.

Activity Goal 1.1.2: Develop and evaluate interventions to reduce risk factors for work-related injuries and fatalities due to aircraft crashes.

Activity Goal 1.1.3: Implement and promote effective interventions to reduce risk factors for work-related injuries and fatalities due to aircraft crashes.

Activity Goal 1.1.4: Develop and coordinate partnerships to disseminate information on methods to prevent work-related injuries and fatalities due to aircraft crashes.

**Intermediate Goal 1.2:** Employers (including the self-employed) will incorporate effective interventions into their policies and procedures to prevent work-related injuries associated with fatigue among air transportation employees.

Activity Goal 1.2.1: Identify risk factors for work-related injuries associated with fatigue among air transportation employees.

Activity Goal 1.2.2: Develop and evaluate interventions to reduce risk factors for work-related injuries associated with fatigue among air transportation employees.

Activity Goal 1.2.3: Implement and promote effective interventions to reduce risk factors for work-related injuries associated with fatigue among air transportation employees.

Activity Goal 1.2.4: Develop and coordinate partnerships to disseminate information on methods to prevent work-related injuries and fatalities associated with fatigue among air transportation employees.

**Intermediate Goal 1.3:** Employers (including the self-employed) will incorporate effective interventions into their policies and procedures to prevent slips, trips, and falls on working surfaces among air transportation employees.

Activity Goal 1.3.1: Identify risk factors for slips, trips, and falls on working surfaces among air transportation employees.

Activity Goal 1.3.2: Develop and evaluate interventions to prevent slips, trips, and falls among air transportation employees.

Activity Goal 1.3.3: Implement and promote effective interventions to prevent slips, trips, and falls among air transportation employees.

Activity Goal 1.3.4: Develop and coordinate partnerships to disseminate information on methods to prevent work-related slips, trips, and falls among air transportation employees.

**Intermediate Goal 1.4:** Employers (including the self-employed) will incorporate effective interventions into their policies and procedures to prevent injuries resulting from contact with objects and equipment in air transportation employee groups.

Activity Goal 1.4.1: Identify risk factors for injuries resulting from contact with objects and equipment among air transportation employees.

Activity Goal 1.4.2: Develop and evaluate interventions to prevent injuries resulting from contact with objects and equipment among air transportation employees.

Activity Goal 1.4.3: Implement and promote effective interventions to prevent injuries resulting from contact with objects and equipment among air transportation employees.

Activity Goal 1.4.4: Develop and coordinate partnerships to disseminate information on methods to prevent work-related injuries resulting from contact with objects and equipment among air transportation employees.

### ***Rail Transportation (NAICS 482)***

**Intermediate Goal 1.5:** Employers will incorporate effective interventions into their policies and procedures to prevent injuries related to switching activities among railroad operating employees.

Activity Goal 1.5.1: Identify risk factors for injuries related to switching activities among railroad operating employees.

Activity Goal 1.5.2: Develop and evaluate interventions to prevent injuries related to switching activities among railroad operating employees.

Activity Goal 1.5.3: Implement and promote effective interventions to prevent injuries related to switching activities among railroad operating employees.

Activity Goal 1.5.4: Develop and coordinate partnerships to disseminate information on methods to prevent work-related injuries related to switching activities among railroad operating employees.

**Intermediate Goal 1.6:** Employers will incorporate effective interventions into their policies and procedures to prevent work-related injuries associated with fatigue among rail transportation employees.

Activity Goal 1.6.1: Identify risk factors for work-related injuries associated with fatigue in employee groups in rail transportation.

Activity Goal 1.6.2: Develop and evaluate interventions to reduce risk factors for work-related injuries associated with fatigue in railroad operations.

Activity Goal 1.6.3: Implement and promote effective interventions to reduce risk factors for work-related injuries associated with fatigue in railroad operations.

Activity Goal 1.6.4: Develop and coordinate partnerships to disseminate information on methods to reduce risk factors for work-related injuries associated with fatigue in railroad operations.

### ***Water Transportation (NAICS 483)***

**Intermediate Goal 1.7:** Employers (including the self-employed) will incorporate effective interventions into their policies and procedures to prevent work-related injuries among water transportation employees.

Activity Goal 1.7.1: Implement a surveillance system within the water transportation industry to capture data on work-related injuries other than those associated with vessel incidents.

Activity Goal 1.7.2: Develop and evaluate interventions to reduce leading injury risk factors among water transportation employees, as identified by surveillance.

Activity Goal 1.7.3: Implement and promote effective interventions to reduce leading injury risk factors among water transportation employees, as identified by surveillance.

Activity Goal 1.7.4: Develop and coordinate partnerships to disseminate information on methods to reduce leading injury risk factors among water transportation employees, as identified by surveillance.

**Intermediate Goal 1.8:** Employers (including the self-employed) will incorporate effective interventions into their policies and procedures to prevent work-related injuries associated with fatigue among water transportation employees.

Activity Goal 1.8.1: Identify risk factors for work-related injuries associated with fatigue among water transportation employees.

Activity Goal 1.8.2: Develop and evaluate interventions to reduce risk factors for work-related injuries associated with fatigue among water transportation employees.

Activity Goal 1.8.3: Implement and promote effective interventions to reduce risk factors for work-related injuries associated with fatigue among water transportation employees.

Activity Goal 1.8.4: Develop and coordinate partnerships to disseminate information on methods to prevent work-related injuries associated with fatigue among water transportation employees.

### ***Truck Transportation (NAICS 484)***

**Intermediate Goal 1.9:** Implement a surveillance system to better ascertain the nature and extent of work-related injuries to truck drivers.

Activity Goal 1.9.1: Develop and coordinate partnerships to identify data gaps on injuries to truck drivers.

Activity Goal 1.9.2: Define methods for collecting, recording, storing, summarizing and disseminating data that describe work-related injuries to truck drivers.

Activity Goal 1.9.3: Implement newly designed or improved surveillance systems for identifying worker injuries among truck drivers.

Activity Goal 1.9.4: Evaluate the effectiveness of surveillance system improvements for capturing injury cause and risk factors among truck drivers.

**Intermediate Goal 1.10:** Employers (including the self-employed) will incorporate effective interventions into their policies and procedures to prevent injuries to truck drivers due to vehicle crashes.

Activity Goal 1.10.1: Identify risk factors for vehicle crashes among truck drivers.

Activity Goal 1.10.2: Increase seat belt/restraint usage among truck drivers through collaboration of truck manufacturers, standard-setting bodies, and other partners.

Activity – Partners will develop, implement, and evaluate a training program to increase seat belt/restraint use among truck drivers.

Activity – Truck manufacturers will complete design specifications for occupant restraint systems that will more closely conform to body dimensions of the truck driver population.

Activity Goal 1.10.3: Develop and coordinate partnerships to disseminate information on methods to increase seat belt/restraint usage among truck drivers

**Intermediate Goal 1.11:** Employers (including the self-employed) will incorporate effective interventions into their policies and procedures to prevent work-related injuries associated with fatigue among truck drivers.

Activity Goal 1.11.1: Identify risk factors for work-related injuries associated with fatigue in truck drivers.

Activity Goal 1.11.2: Develop and evaluate interventions to reduce risk factors for work-related injuries associated with fatigue in truck drivers.

Activity Goal 1.11.3: Implement and promote effective interventions to reduce risk factors for work-related injuries associated with fatigue in truck drivers.

Activity Goal 1.11.4: Develop and coordinate partnerships to disseminate information on methods to reduce risk factors for work-related injuries associated with fatigue in truck drivers.

**Intermediate Goal 1.12:** Truck manufacturers will modify cab designs based on updated anthropometric data, results of ergonomic workspace evaluations, and updated design standards.

Activity Goal 1.12.1: Specify more ergonomically efficient truck cab design through collaboration between standard-setting bodies and other partners to update standards.

Activity Goal 1.12.2: Update anthropometric data for a nationally representative sample of the truck driver population.

Activity Goal 1.12.3: Complete an ergonomic workspace evaluation of the truck cab environment.

Activity Goal 1.12.4: Develop and coordinate partnerships to disseminate information on ergonomic workspace evaluation of the truck cab environment.

**Intermediate Goal 1.13:** Develop, implement, evaluate, and promote interventions into policies and procedures to prevent falls from trucks and trailers through collaboration with partners.

Activity Goal 1.13.1: Develop recommendations for truck cab design and work practices guidelines for safe ingress and egress from large trucks.

Activity Goal 1.13.2: Evaluate and disseminate large-truck ingress and egress design and work practices guidelines to independent truckers and trucking companies through collaboration of partners.

Activity Goal 1.13.3: Develop and coordinate partnerships to disseminate information on large-truck ingress and egress design and work practices guidelines.

**Intermediate Goal 1.14:** Employers (including the self-employed) will incorporate effective interventions into their policies and procedures to prevent slips, trips, and falls on working surfaces (e.g., loading docks, trailer surfaces, cab steps, etc.) in truck transportation.

Activity Goal 1.14.1: Identify risk factors for slips, trips, and falls on working surfaces in truck transportation.

Activity Goal 1.14.2: Develop and evaluate interventions to prevent slips, trips, and falls on working surfaces in truck transportation.

Activity Goal 1.14.3: Implement and promote effective interventions to prevent slips, trips, and falls on working surfaces in truck transportation.

Activity Goal 1.14.4: Develop and coordinate partnerships to disseminate information on methods to prevent work-related slips, trips, and falls on working surfaces in truck transportation.

**Intermediate Goal 1.15:** Employers (including the self-employed) will incorporate effective interventions into their policies and procedures to prevent injuries resulting from falling objects during loading and unloading operations in truck transportation.

Activity Goal 1.15.1: Identify risk factors for injuries resulting from falling objects during loading and unloading operations in truck transportation.

Activity Goal 1.15.2: Develop and evaluate interventions to prevent injuries resulting from falling objects during loading and unloading operations in truck transportation.

Activity Goal 1.15.3: Implement and promote effective interventions to prevent injuries resulting from falling objects during loading and unloading operations in truck transportation.

Activity Goal 1.15.4: Develop and coordinate partnerships to disseminate information on methods to prevent work-related injuries resulting from falling objects during loading and unloading operations in truck transportation.

***Transit and Ground Passenger Transportation (NAICS 485)***

This industry subsector includes the operation of chartered buses, school buses, interurban transport buses, commuter vans, light rail, commuter rail, subways, streetcars, limousines, and taxis.

**Intermediate Goal 1.16:** Implement a surveillance system to better ascertain the nature and extent of work-related injuries among transit workers.

Activity Goal 1.16.1: Develop and coordinate partnerships to identify data gaps on injuries to transit workers.

Activity Goal 1.16.2: Define methods for collecting, recording, storing, summarizing and disseminating data that describe work-related injuries among transit workers.

Activity Goal 1.16.3: Implement newly designed or improved surveillance systems for identifying worker injuries among transit workers.

Activity Goal 1.16.4: Evaluate the effectiveness of surveillance system improvements for capturing injury cause and risk factors among transit workers.

**Intermediate Goal 1.17:** Employers (including the self-employed) will incorporate effective interventions into their policies and procedures to prevent slips, trips, and falls on working surfaces among transit workers.

Activity Goal 1.17.1: Identify risk factors for slips, trips, and falls on working surfaces among transit workers.

Activity Goal 1.17.2: Develop and evaluate interventions to prevent slips, trips, and falls on working surfaces among transit workers.

Activity Goal 1.17.3: Implement and promote effective interventions to prevent slips, trips, and falls on working surfaces among transit workers.

Activity Goal 1.17.4: Develop and coordinate partnerships to disseminate information on methods to prevent work-related slips, trips, and falls on working surfaces among transit workers.

**Intermediate Goal 1.18:** Employers (including the self-employed) will incorporate effective interventions into their policies and procedures to prevent injuries to taxi drivers resulting from physical violence.

Activity Goal 1.18.1: Identify risk factors for injuries to taxi drivers resulting from physical violence.

Activity Goal 1.18.2: Develop and evaluate interventions to prevent injuries to taxi drivers resulting from physical violence.

Activity Goal 1.18.3: Implement and promote effective interventions to prevent injuries to taxi drivers resulting from physical violence.

Activity Goal 1.18.4: Develop and coordinate partnerships to disseminate information on methods to work-related prevent work-related injuries to taxi drivers resulting from physical violence.

***Couriers and Messengers (NAICS 492)***

This section is inclusive of Postal Service workers (NAICS 491).

**Intermediate Goal 1.19:** Implement a surveillance system to better ascertain the nature and extent of work-related injuries among couriers and messengers.

Activity Goal 1.19.1: Develop and coordinate partnerships to identify data gaps on injuries to couriers and messengers.

Activity Goal 1.19.2: Define methods for collecting, recording, storing, summarizing and disseminating data that describe work-related injuries among couriers and messengers.

Activity Goal 1.19.3: Implement newly designed or improved surveillance systems for identifying worker injuries among couriers and messengers.

Activity Goal 1.19.4: Evaluate the effectiveness of surveillance system improvements for capturing injury cause and risk factors among couriers and messengers.

**Intermediate Goal 1.20:** Employers (including the self-employed) will incorporate effective interventions into their policies and procedures to prevent slips, trips, and falls on working surfaces among couriers and messengers.

Activity Goal 1.20.1: Identify risk factors for slips, trips, and falls on working surfaces among couriers and messengers.

Activity Goal 1.20.2: Develop and evaluate interventions to prevent slips, trips, and falls on working surfaces among couriers and messengers.

Activity Goal 1.20.3: Implement and promote effective interventions to prevent slips, trips, and falls on working surfaces among couriers and messengers.

Activity Goal 1.20.4: Develop and coordinate partnerships to disseminate information on methods to work-related prevent work-related slips, trips, and falls on working surfaces among couriers and messengers.

**Intermediate Goal 1.21:** Employers (including the self-employed) will incorporate effective interventions into their policies and procedures to prevent injuries to couriers and messengers resulting from falling objects during loading and unloading operations.

Activity Goal 1.21.1: Identify risk factors for injuries to couriers and messengers resulting from falling objects during loading and unloading operations.

Activity Goal 1.21.2: Develop and evaluate interventions for couriers and messengers to prevent injuries resulting from falling objects during loading and unloading operations.

Activity Goal 1.21.3: Implement and promote effective interventions for couriers and messengers to prevent injuries resulting from falling objects during loading and unloading operations.

Activity Goal 1.21.4: Develop and coordinate partnerships to disseminate information on methods to work-related prevent work-related injuries resulting from falling objects during loading and unloading operations.

***Warehousing and Storage (NAICS 493)***

**Intermediate Goal 1.22:** Employers (including the self-employed) will incorporate effective interventions into their policies and procedures to prevent slips, trips, and falls on working surfaces in warehousing and storage operations.

Activity Goal 1.22.1: Identify risk factors for slips, trips, and falls on working surfaces in warehousing and storage operations.

Activity Goal 1.22.2: Develop and evaluate interventions to prevent slips, trips, and falls on working surfaces in warehousing and storage operations.

Activity Goal 1.22.3: Implement and promote effective interventions to prevent slips, trips, and falls on working surfaces in warehousing and storage operations.

Activity Goal 1.22.4: Develop and coordinate partnerships to disseminate information on methods to work-related prevent work-related injuries slips, trips, and falls on working surfaces in warehousing and storage operations.

**Intermediate Goal 1.23:** Employers (including the self-employed) will incorporate effective interventions into their policies and procedures to prevent injuries resulting from contact with objects and equipment in warehousing and storage operations.

Activity Goal 1.23.1: Identify risk factors for injuries resulting from contact with objects and equipment in warehousing and storage operations.

Activity Goal 1.23.2: Develop and evaluate interventions to prevent injuries resulting from contact with objects and equipment in warehousing and storage operations.

Activity Goal 1.23.3: Implement and promote effective interventions to prevent injuries resulting from contact with objects and equipment in warehousing and storage operations.

Activity Goal 1.23.4: Develop and coordinate partnerships to disseminate information on methods to work-related prevent work-related injuries resulting from contact with objects and equipment in warehousing and storage operations.

**Intermediate Goal 1.24:** Employers (including the self-employed) will incorporate effective interventions into their policies and procedures to prevent forklift-related injuries in warehousing and storage operations.

Activity Goal 1.24.1: Identify risk factors for forklift-related injuries in warehousing and storage operations.

Activity Goal 1.24.2: Develop and evaluate interventions to prevent forklift-related injuries in warehousing and storage operations.

Activity Goal 1.24.3: Implement and promote effective interventions to prevent forklift-related injuries in warehousing and storage operations

Activity Goal 1.24.4: Develop and coordinate partnerships to disseminate information on methods to work-related prevent work-related forklift-related injuries in warehousing and storage operations

*Utilities (NAICS 22)*

**Intermediate Goal 1.25:** Implement a surveillance system to better ascertain the nature and extent of work-related injuries among utilities workers.

Activity Goal 1.25.1: Develop and coordinate partnerships to identify data gaps on injuries to utilities workers.

Activity Goal 1.25.2: Define methods for collecting, recording, storing, summarizing and disseminating data on work-related injuries to utilities workers.

Activity Goal 1.25.3: Implement newly designed or improved surveillance systems for identifying worker injuries among utilities workers.

Activity Goal 1.25.4: Evaluate the effectiveness of surveillance system improvements for capturing injury cause and risk factors among utilities workers.

**Intermediate Goal 1.26:** Employers (including the self-employed) will incorporate effective interventions into their policies and procedures to prevent injuries to utilities workers resulting from electrical and chemical burns and from working with energized equipment and tools.

Activity Goal 1.26.1: Identify risk factors for injuries to utilities workers resulting in electrical/chemical burns from working with high/low-voltage panel apparatus and conductors.

Activity Goal 1.26.2: Identify risk factors for cut, crush, and amputation injuries to utilities workers from energized equipment and tools.

Activity Goal 1.26.3: Develop and evaluate interventions to prevent injuries to utilities workers resulting in electrical/chemical burns from working with high/low-voltage panel apparatus and conductors.

Activity Goal 1.26.4: Implement and promote effective interventions to prevent injuries to utilities workers resulting in electrical/chemical burns from working with high/low-voltage panel apparatus and conductors.

**Intermediate Goal 1.27:** Employers (including the self-employed) will incorporate effective interventions into their policies and procedures to prevent injuries to utilities workers resulting from slips, trips and falls from walking and working surfaces, and falls from elevations.

Activity Goal 1.27.1: Identify risk factors for injuries to utilities workers resulting from slips, trips and falls on walking and working surfaces.

Activity Goal 1.27.2: Identify risk factors for injuries to utilities workers resulting from falls from elevations while working on poles, towers, elevated platforms, ladders and scaffolding.

Activity Goal 1.27.3: Develop and evaluate interventions to prevent injuries to utilities workers resulting from slips, trips and falls on walking and working surfaces and elevations.

Activity Goal 1.27.4: Implement and promote effective interventions to prevent injuries to utilities workers resulting from slips, trips and falls on walking and working surfaces and elevations.

**Intermediate Goal 1.28:** Employers (including the self-employed) will incorporate effective interventions into their policies and procedures to prevent injuries to utilities workers in crashes involving motor vehicles and service trucks.

Activity Goal 1.28.1: Identify risk factors for crashes among utilities workers involving motor vehicles and service trucks.

Activity Goal 1.28.2: Develop and evaluate effective interventions to prevent injuries to utilities workers from crashes involving motor vehicles and service trucks.

Activity Goal 1.28.3: Implement and promote effective interventions to prevent injuries to utilities workers from crashes involving motor vehicles and service trucks.

**Intermediate Goal 1.29:** Employers (including the self-employed) will incorporate effective interventions into their policies and procedures to prevent injuries to utilities workers resulting from contact with objects and equipment.

Activity Goal 1.29.1: Identify risk factors for injuries to utilities workers resulting from contact with objects and equipment (e.g., binding, moving, storing, and opening).

Activity Goal 1.29.2: Develop and evaluate interventions to prevent injuries to utilities workers resulting from contact with objects and equipment (e.g., binding, moving, storing, and opening).

Activity Goal 1.29.3: Implement and promote effective interventions to prevent injuries to utilities workers resulting from contact with objects and equipment (e.g., binding, moving, storing and opening).

## ***Strategic Goal 2 - Work-related Musculoskeletal Disorders***

**Strategic Goal 2: Reduce the incidence and severity of work-related musculoskeletal disorders (WMSDs) among workers in the TWU sector.**

Note: See Appendix C for data, discussion, and references supporting this goal.

**Intermediate Goal 2.1:** Disseminate, promote, and evaluate a WMSD surveillance system for the TWU sector through the collaboration of partners.

Activity Goal 2.1.1: Develop and coordinate partnerships for WMSD surveillance data collection within the TWU sector.

Activity Goal 2.1.2: Define methods for collecting, recording, storing, summarizing and disseminating WMSD surveillance data for the TWU sector.

Activity Goal 2.1.3: Identify critical data fields for tracking changes in WMSD including specific diagnostic groupings, sub-sector populations at risk, and other key factors that influence statistical analysis of morbidity within the TWU sector.

Activity Goal 2.1.4: Implement improved surveillance systems for identifying WMSDs among the TWU sector.

Activity Goal 2.1.5: Evaluate the effectiveness of surveillance system improvements for capturing WMSDs in the TWU sector.

**Intermediate Goal 2.2:** Quantify the associations between risk factors and neck, upper extremity, back (including lower back), and lower extremity WMSDs in the TWU sector through the collaboration of partners.

Activity Goal 2.2.1: Evaluate results of previous NORA and other research on evidence for putative risk factors contributing to neck, upper extremity, back (including lower back), and lower extremity WMSDs in the TWU sector.

Activity Goal 2.2.2: Identify and fill research gaps and evaluate evidence for inclusion of non-physical risk factors such as fatigue, work organization, individual co-morbidities, and psychosocial metrics as they contribute to neck, upper extremity, back (including lower back), and lower extremity WMSDs in the TWU sector.

Activity Goal 2.2.3: Identify and fill research gaps and evaluate evidence for inclusion of physical risk factors such as biomechanical stressors, vibration, and others as they contribute to neck, upper extremity, back (including lower back), and lower extremity WMSDs in the TWU sector.

Activity Goal 2.2.4: Develop accurate and precise tools for exposure measurement of risk factors contributing to neck, upper extremity, back (including lower back), and lower extremity WMSDs in the TWU sector.

**Intermediate Goal 2.3:** Establish successful WMSD interventions and best practices in the air transportation sub-sector through the collaboration of partners.

Activity Goal 2.3.1: Identify and pilot promising solutions, and implement interventions to reduce injury risk factors in air transportation occupations that require baggage and materials handling.

Activity Goal 2.3.2: Identify and coordinate common strategies for measuring injury risk and morbidity outcomes of WMSD intervention programs for air transportation occupations that require baggage and materials handling.

Activity Goal 2.3.3: Evaluate WMSD interventions and identify successful interventions and best practices for air transportation occupations that require baggage and materials handling.

Activity Goal 2.3.4: Disseminate and promote successful WMSD interventions and best practices for air transportation occupations that require baggage and materials handling.

**Intermediate Goal 2.4:** Establish successful WMSD interventions and best practices in the trucking and courier and messenger sub-sectors through the collaboration of partners.

Activity Goal 2.4.1: Identify and implement interventions and pilot promising solutions for reducing injury risk factors in the trucking and courier and messenger sub-sectors.

Activity Goal 2.4.2: Identify and coordinate common strategies for measuring injury risk and morbidity outcomes of WMSD intervention programs in the trucking and courier and messenger sub-sectors.

Activity Goal 2.4.3: Evaluate WMSD interventions and identify successful interventions and best practices in the trucking and courier and messenger sub-sectors.

Activity Goal 2.4.4: Disseminate and promote successful WMSD interventions and best practices in the trucking and courier and messenger sub-sectors.

**Intermediate Goal 2.5:** Establish successful WMSD interventions and best practices in the transit and ground passenger transportation sub-sector through the collaboration of partners.

This industry sub-sector is inclusive of light and commuter rail that had a rate of 96.3 WMSDs per 10,000 workers [BLS 2007b].

Activity Goal 2.5.1: Identify and implement interventions and pilot promising solutions for reducing injury risk factors in the transit and ground passenger transportation sub-sector.

Activity Goal 2.5.2: Identify and coordinate common strategies for measuring injury risk and morbidity outcomes of WMSD intervention programs in the transit and ground passenger transportation sub-sector.

Activity Goal 2.5.3: Evaluate WMSD interventions and identify successful interventions and best practices in the transit and ground passenger transportation sub-sector.

Activity Goal 2.5.4: Disseminate and promote successful WMSD interventions and best practices in the transit and ground passenger transportation sub-sector.

**Intermediate Goal 2.6:** Establish successful WMSD interventions and best practices in the warehousing sub-sector through the collaboration of partners.

Activity Goal 2.6.1: Identify and implement interventions and pilot promising solutions for reducing injury risk factors in the warehousing sub-sector.

Activity Goal 2.6.2: Identify and coordinate common strategies for measuring injury risk and morbidity outcomes of WMSD intervention programs in the warehousing sub-sector.

Activity Goal 2.6.3: Evaluate WMSD interventions and identify successful interventions and best practices in the warehousing sub-sector.

Activity Goal 2.6.4: Disseminate and promote successful WMSD interventions and best practices in the warehousing sub-sector.

**Intermediate Goal 2.7:** Establish successful WMSD interventions and best practices in the utilities sub-sector through the collaboration of partners.

Activity Goal 2.7.1: Identify and implement interventions and pilot promising solutions for reducing injury risk factors in the utilities sub-sector.

Activity Goal 2.7.2: Identify and coordinate common strategies for measuring injury risk and morbidity outcomes of WMSD intervention programs in the utilities sub-sector.

Activity Goal 2.7.3: Evaluate WMSD interventions and identify successful interventions and best practices in the utilities sub-sector.

Activity Goal 2.7.4: Disseminate and promote successful WMSD interventions and best practices in the utilities sub-sector.

**Intermediate Goal 2.8:** Disseminate and promote findings on successful practices and partnerships within the TWU sector that reduce WMSD costs and yield economic benefit through the collaboration of partners.

Activity Goal 2.8.1: Review and synopsise previous work on cost-benefit research for reducing WMSDs within the TWU sector.

Activity Goal 2.8.2: Assess the impact of health and safety investments on the incidence, severity and costs associated with WMSDs in the TWU sector.

Activity Goal 2.8.3: Identify and evaluate critical and practically-obtained cost-benefit model inputs to determine applicability to the TWU sector.

Activity Goal 2.8.4: Develop and test models for measuring cost-benefit in the TWU sector.

Activity Goal 2.8.5: Develop media resources (e.g., print, electronic, video) on successful, effective interventions to employees, employers, and safety professionals.

### ***Strategic Goal 3 – Health and Wellness***

**Strategic Goal 3: Improve health and reduce premature mortality among TWU workers through workplace programs and practices that (1) enable workers to engage in healthy behaviors, (2) reduce work-related physiological and psychological stressors, and (3) improve healthcare utilization.**

Note: See Appendix D for data, discussion, and references supporting this goal.

**Intermediate Goal 3.1:** Partners will use TWU worker health and wellness knowledge syntheses to support development and improvement of research and prevention activities.

Activity Goal 3.1.1: Produce a knowledge synthesis document to describe major work-related health concerns, identify knowledge gaps, and delineate existing industry practices that may affect the health and wellness of workers in the warehousing sub-sector.

Note: Knowledge synthesis is an evaluation or analysis of research evidence and expert opinion on a specific topic to aid in decision-making or help decision makers in the development of policies. It can help place the results of a single study in context by providing the overall body of research evidence. In this case, the synthesis will help identify gaps in knowledge and describe the existing industry practices that may affect worker health.

Activity Goal 3.1.2: Produce a knowledge synthesis document to describe major work-related health concerns, identify knowledge gaps, and delineate existing industry practices that may affect the health and wellness of workers in the utilities sub-sector.

Activity Goal 3.1.3: Produce a knowledge synthesis document to describe major work-related health concerns, identify knowledge gaps, and delineate existing industry practices that may affect the health and wellness of workers in the transportation sub-sector.

Activity Goal 3.1.4: Disseminate knowledge syntheses to partners who may conduct research and activities related to TWU worker health and wellness.

**Intermediate Goal 3.2:** Through partnerships, quantify health risk factors to support research and prevention activities, and measure the impact of prevention and reduction of risk factors among commercial drivers.

Note: Risk factors related to economic issues should also be considered.

Activity Goal 3.2.1: Use survey research methods to establish prevalence of health risk factors and work-related illnesses among commercial drivers.

Activity Goal 3.2.2: Use medical surveillance, laboratory studies, economic data, and biomedical measures to collect objective measures of commercial driver health status that will validate and complement data collected via self-report.

Activity Goal 3.2.3: Quantify and report the prevalence of health risk factors and work-related illnesses among commercial drivers.

Activity Goal 3.2.4: Disseminate and promote the findings describing the prevalence of health risk factors and work-related illnesses among commercial drivers to expand awareness of the issues and provide a baseline for measuring the effectiveness of prevention activities.

**Intermediate Goal 3.3:** Through partnerships, establish workplace programs, policies, and practices that will enable commercial drivers to engage in healthy behaviors that will help them achieve and maintain a healthy weight.

Note: Economic forces that may impact these conditions or activities should be considered.

Activity Goal 3.3.1: Establish prevalence and identify risk factors, including work environment, associated with obesity among commercial drivers.

Note: Work environment factors related to obesity include stress, social isolation, opportunities for physical activity, nutritional support, and fatigue.

Activity Goal 3.3.2: Evaluate the relationship between commercial driver's work environment and obesity.

Activity Goal 3.3.3: Develop and evaluate interventions and programs to reduce obesity related risk factors among commercial drivers.

Activity Goal 3.3.4: Develop knowledge and methods to calculate benefit/cost ratio of reducing obesity among commercial drivers.

Activity Goal 3.3.5: Develop, implement, and evaluate a healthy weight management program targeted at the commercial driving population.

Activity Goal 3.3.6: Implement and promote effective interventions and programs to reduce obesity related risk factors among commercial drivers.

**Intermediate Goal 3.4:** Through partnerships, establish workplace programs, policies, and practices that enable workers to engage in healthy behaviors to reduce cardiovascular disease (CVD) in the TWU sector.

Note: Economic forces that may impact these conditions or activities should be considered.

Activity Goal 3.4.1: Establish prevalence and identify risk factors, including work environment, associated with CVD in the TWU sector.

Activity Goal 3.4.2: Evaluate the relationship between commercial driver's work environment and CVD.

Note: Work environment factors related to CVD include shift work, stress, lack of work recovery time, use of stimulant medications, toxic exposures, and fatigue.

Activity Goal 3.4.3: Develop and evaluate interventions and programs to reduce CVD related risk factors in the TWU sector.

Activity Goal 3.4.4: Develop knowledge and methods to calculate benefit/cost ratio of reducing CVD related risk factors in the TWU sector.

Activity Goal 3.4.5: Implement and promote effective interventions and programs to reduce CVD related risk factors in the TWU sector.

**Intermediate Goal 3.5:** Through partnerships, establish workplace programs, policies, and practices that will reduce TWU worker smoking and exposure to tobacco smoke.

Activity Goal 3.5.1: Establish prevalence and identify risk factors associated with smoking and exposure to tobacco smoke in the TWU sector.

Activity Goal 3.5.2: Develop and evaluate interventions and programs to reduce smoking and exposure to tobacco smoke in the TWU sector.

Activity Goal 3.5.3: Implement and promote effective interventions and programs to reduce smoking and exposure to tobacco smoke in the TWU sector.

**Intermediate Goal 3.6:** Partners will use evidence-based knowledge of the existence and impact of psychological stressors in TWU to support development and improvement of research and prevention activities. See Table 1 for examples of psychological stressors specific to TWU sub-sectors.

Activity Goal 3.6.1: Identify work-related psychological stressors that exist within the TWU sector, including the diversity, extent, magnitude, and the worker populations affected. See Table 1 for a partial list of work-related psychological stressors.

Activity Goal 3.6.2: Develop knowledge and methods needed to calculate the true benefit/cost ratio of reducing work-related stress among TWU workers.

Note: Currently, benefit/cost ratio calculations cannot accurately incorporate the deleterious effects of many work practices, since the health and safety "cost" of these practices is not known. This is especially true for work practices where the negative health and safety impacts may not be apparent for several years, or where the employee has been exposed to deleterious work practices across multiple employers. For example work practices that result in circadian disruption, sleep deprivation, chronic stress from excessive work, or physical inactivity have an undetermined cumulative impact on the worker. Therefore, we must (1) gain an understanding of the long-term consequences of specific work practices (long and irregular hours, shift work, unpaid labor time, etc.) on stress and fatigue, and (2) develop methods that will allow regulators, business owners,

and researchers to calculate the health costs associated with specific work practices.

Activity Goal 3.6.3: Disseminate knowledge of how psychological stressors may affect TWU sector worker health through collaboration of partners.

**Intermediate Goal 3.7:** Through collaboration of partners, controls, communication tools, and administrative programs will be incorporated into workplace policies and procedures to reduce or eliminate psychological stressors in the TWU.

Activity Goal 3.7.1: Develop, pilot, and evaluate control solutions and mitigation strategies in the TWU sector to prevent and/or reduce psychological stressors.

Activity Goal 3.7.2: Identify effective administrative controls, communicate to stakeholders, and implement corporate administrative programs in the TWU sector to reduce occupational psychological hazards.

Activity Goal 3.7.3: Implement control solutions and mitigation strategies in the TWU sector to prevent and/or reduce psychological stressors.

Activity Goal 3.7.4: Develop and implement state and national prospective and retrospective evaluation strategies to monitor and continuously improve interventions that reduce psychological stressors in the TWU sector.

Note: Important measures include the availability and utilization of psychological support, e.g., employee assistance programs, occupational health professionals, and mental health care providers in the TWU sector, absenteeism, presenteeism (being present at work, but not fully ready for work, as for example, when the worker actually should be home on sick leave), productivity, physical activity, workplace violence and the incidence of sleep disorders in the TWU sector workforce.

**Intermediate Goal 3.8:** Through partnerships, increase access to, and appropriate utilization of, healthcare and promote preventative services among commercial drivers.

Activity Goal 3.8.1: Establish utilization rates for health care services and preventive screening services among commercial drivers.

Activity Goal 3.8.2: Develop a national guide that lists healthcare facilities that are accessible to commercial drivers when they are operating large vehicles such as buses and tractor trailers.

Activity Goal 3.8.3: Identify methods and means to increase the number of clinics housed at truck stops.

Activity Goal 3.8.4: Promote preventive health care screening among commercial drivers as outlined by the U.S. Preventive Services Task Force (e.g., screening for cholesterol, diabetes, prostate cancer, colon cancer, immunizations, and sleep disorders).

Activity Goal 3.8.5: Explore development of a medical record system allowing health care providers in various geographical locations to access health information about commercial drivers in transit.

Activity Goal 3.8.6: Conduct an independent review of the workers' compensation system and its impact on commercial drivers.

Activity Goal 3.8.7: Increase commercial drivers' knowledge of their benefits under the workers' compensation system.

Activity Goal 3.8.8: For commercial drivers, identify barriers to filing for workers' compensation and evaluate methods to remove those barriers.

Activity Goal 3.8.9: Analyze conditions that have a high frequency of denial by workers' compensation due to not being work-related and determine causal relationships, including attribution of work-relatedness where scientific data support this finding.

**Table 1. Examples of Psychological Stressors of Concern in the TWU Sector (not prioritized)<sup>1</sup>**

Aviation	Rail	Trucking	Utilities	Warehousing	Water transport
<ul style="list-style-type: none"> <li>• Aggressive passengers</li> <li>• Workload</li> <li>• Work schedules</li> <li>• Disincentives to report illness and injury</li> <li>• Shift work</li> </ul>	<ul style="list-style-type: none"> <li>• PTSD (rail collisions)</li> <li>• Stress from potential workplace violence (transit)</li> <li>• Shift work</li> <li>• Work schedules</li> <li>• Solitary work environment</li> </ul>	<ul style="list-style-type: none"> <li>• Shift work</li> <li>• Work schedules</li> <li>• Solitary work environment</li> </ul>	<ul style="list-style-type: none"> <li>• Overtime</li> <li>• Shift work</li> <li>• Solitary work environment</li> </ul>	<ul style="list-style-type: none"> <li>• Shift work</li> <li>• Solitary work environment</li> </ul>	<ul style="list-style-type: none"> <li>• Shift work</li> <li>• Work schedules</li> </ul>

<sup>1</sup> This table is not comprehensive and only includes select psychological stressors of concern.

## ***Strategic Goal 4 - Exposures***

**Strategic Goal 4: Identify, evaluate, and reduce chemical, biological, and physical occupational hazards and exposures that results in a reduction of occupational injuries, illnesses, and fatalities in the TWU sector.**

Note: See Appendix E for data, discussion, and references supporting this goal.

**Intermediate Goal 4.1:** Determine baseline hazard identification and exposure characterization data for occupational exposures to priority **chemical hazards and exposures** within the TWU sector, including the diversity, extent, and magnitude of exposures, and the worker populations affected. Table 2 contains examples of potential exposures by subsector, is not all inclusive, and will be revised as new information is available.

Activity Goal 4.1.1: Identify priority chemical exposures of concern for the TWU sector, based on existing or planned use, magnitude of user population, toxicity, and potential for exposure.

Activity Goal 4.1.2: Research, survey, conduct field assessments where existing data is lacking, and characterize occupational exposure to the identified priority chemicals within the TWU sector.

Activity Goal 4.1.3: Utilizing the identified priority chemicals, create Job Exposure Matrices for TWU that establishes a scientific basis for characterizing risk, prioritizing engineering and other control strategies, and determines long term research needs.

**Intermediate Goal 4.2:** Utilizing activity and sub-sector specific exposure characterizations and the hierarchy of controls for prioritization, develop and implement substitution programs, engineering controls, PPE improvements, communication tools, and administrative programs in the TWU sector to reduce and eliminate priority **chemical hazards and exposures** through collaboration of partners.

Activity Goal 4.2.1: Identify and characterize prevalence of diseases and injuries resulting from exposure to priority chemical hazards among TWU employees.

Activity Goal 4.2.2: Identify, develop and pilot substitutions in the TWU sector for priority chemical agents where less hazardous alternatives are available.

Activity Goal 4.2.3: Evaluate Personal Protective Equipment practices (use, provisions, appropriateness, training, maintenance and care) in the TWU sector

Activity Goal 4.2.4: Develop and pilot engineering control solutions and mitigation strategies in the TWU sector to prevent and/or reduce identified exposures to priority chemical agents

Activity Goal 4.2.5: Identify effective administrative controls, communicate to stakeholders, and implement corporate administrative programs in the TWU sector to reduce occupational exposures to priority chemicals.

Activity Goal 4.2.6: Develop and pilot real-time detection technologies and biomonitoring techniques for applicable priority chemicals to evaluate potential exposures and provide early detection of hazardous conditions in the TWU sector.

Activity Goal 4.2.7: Develop and pilot training programs in the TWU sector which result in improved work practices and adherence to PPE requirements, and a reduction in exposures to priority chemical hazards.

Activity Goal 4.2.8: Develop and implement state and national prospective and retrospective evaluation strategies (surveillance) to monitor exposures to priority chemicals, associated disease, and continuously improve interventions in the TWU sector.

Activity Goal 4.2.9: Develop a business case methodology for the TWU sector to illustrate economic benefits of reducing and eliminating priority chemical occupational exposures and improving training programs.

Activity – Identify and evaluate benchmarking models for application in the TWU sector industries.

Note: Benchmarking is a technique in which a company measures its performance against that of best in class companies, determines how those companies achieved their performance levels and uses this information to improve its own performance. It can serve as mechanism to create a market for safety by using a “continuous improvement” benchmarking model and method that allows development of an appropriate safety rating.

Activity – Validate benchmarking for application in the TWU industries.

Activity – Disseminate economic models to stakeholders and partners within TWU sector.

Activity – Initiate and promote improved training programs (e.g., training for management and employees to raise awareness, and eliminate/reduce hazards and exposures).

**Intermediate Goal 4.3:** Determine baseline hazard identification and exposure characterization data for occupational exposures to **biological hazards** within the TWU sector, including the diversity, extent, and magnitude of exposures, and the worker populations affected.

Activity Goal 4.3.1: Identify biological exposures of concern for the TWU sector.

Activity Goal 4.3.2: Research, survey, conduct field assessments where existing data is lacking, and characterize occupational exposures to biological hazards of concern within the TWU sector.

Activity Goal 4.3.3: Utilizing the identified biological hazards, create Job Exposure Matrices for TWU that establishes a scientific basis for characterizing risk, prioritizing engineering and other control strategies, and determines long term research needs.

**Intermediate Goal 4.4:** Utilizing activity and sub-sector specific exposure characterizations and information on disease, develop and implement controls (in accordance with the established hierarchy of controls), communication tools, and administrative programs to reduce and eliminate occupational **biological hazards** in the TWU sector through collaboration of partners.

Activity Goal 4.4.1: Identify and characterize prevalence of disease and injuries resulting from exposure to biological hazards of concern in the TWU sector.

Activity Goal 4.4.2: Evaluate Personal Protective Equipment practices (use, provisions, appropriateness, training, maintenance and care) in the TWU sector

Activity Goal 4.4.3: Develop and pilot control solutions and mitigation strategies in the TWU sector to prevent and/or reduce identified exposures to biological hazards of concern.

Activity Goal 4.4.4: Identify effective administrative controls, communicate to stakeholders, and implement corporate administrative programs in the TWU sector to reduce occupational exposure to biological hazards of concern.

Activity Goal 4.4.5: Develop and pilot training programs in the TWU sector which result in improved work practices, adherence to PPE requirements, and a reduction in exposure to biological hazards of concern.

Activity Goal 4.4.6: Develop and implement state and national prospective and retrospective evaluation strategies (surveillance) to monitor exposures to biological hazards of concern, associated disease, and to continuously improve interventions in the TWU sector.

**Intermediate Goal 4.5:** Determine baseline hazard identification and exposure characterization data for occupational exposures to **physical hazards** in the TWU sector, including the diversity, extent, and magnitude of exposures, and the worker populations affected.

Note: Physical hazards include: temperature and pressure extremes, noise, vibration, and radiation (ionizing, non-ionizing)

Activity Goal 4.5.1: Identify priority physical hazards and exposures of concern for the TWU sector based on magnitude of the hazard and population exposed

Activity Goal 4.5.2: Research, survey, conduct field assessments where existing data is lacking, and characterize occupational exposures to priority physical hazards within the TWU sector.

Activity Goal 4.5.3: Utilizing the identified priority physical hazards, create Job Exposure Matrices for TWU that establishes a scientific basis for characterizing risk, prioritizing engineering and other control strategies, and determines long term research needs.

**Intermediate Goal 4.6:** Utilizing activity and sub-sector specific exposure characterizations, develop and implement controls (in accordance with the established hierarchy of controls), communication tools, and administrative programs to reduce and eliminate **physical hazards** in the TWU sector through collaboration of partners.

Activity Goal 4.6.1: Identify and characterize prevalence of disease and injuries resulting from exposure to priority physical hazards and exposures in the TWU sector.

Activity Goal 4.6.2: Develop and pilot control solutions and mitigation strategies in the TWU sector to prevent and/or reduce identified exposures to priority physical hazards

Activity Goal 4.6.3: Evaluate Personal Protective Equipment practices (use, provisions, appropriateness, training, maintenance and care) for protecting workers from priority physical hazards in the TWU sector

Activity Goal 4.6.4: Identify effective administrative controls, communicate to stakeholders, and implement corporate administrative programs in the TWU sector to reduce occupational exposure to physical hazards.

Activity Goal 4.6.5: Develop and pilot training programs in the TWU sector which result in improved work practices, adherence to PPE requirements, and a reduction in exposure to priority physical hazards.

Activity Goal 4.6.6: Develop and implement state and national prospective and retrospective evaluation strategies (surveillance) to monitor priority physical hazard exposures and associated health effects, and continuously improve interventions in the TWU sector.

Activity Goal 4.6.7: Develop a business case methodology for the TWU sector to illustrate economic benefits of reducing and eliminating priority physical hazards and exposures, and improving training programs.

Activity – Identify and evaluate benchmarking models for application in the TWU industries.

Activity – Validate benchmarking for application in the TWU industries.

Activity – Disseminate economic models to stakeholders and partners within TWU.

Activity – Initiate and improve training programs (e.g., training for management) to improve awareness of health issues and techniques to reduce and eliminate physical hazards and exposure in the TWU sector)

**Table 2. Examples of Exposures of Concern in the TWU Sector (not prioritized)<sup>1</sup>**

	<b>Aviation</b>	<b>Rail</b>	<b>Trucking</b>	<b>Utilities</b>	<b>Warehousing</b>	<b>Water transport</b>
<b>Chemical</b>	<ul style="list-style-type: none"> <li>Pyrolyzed oil and hydraulic fluid contaminants in engine and APU bleed air supply</li> <li>Pesticides</li> <li>Deicing fluid contaminants</li> </ul>	<ul style="list-style-type: none"> <li>Diesel exposure</li> <li>PCBs</li> <li>Machine shop chemicals</li> <li>Container leaks</li> </ul>	<ul style="list-style-type: none"> <li>Diesel exposure (liquid)</li> <li>Exhaust exposure (particulates, CO, NOx) in truck and in parking, sleeping, and dock areas</li> <li>Maintenance worker exposure to solvents, asbestos, paint, etc.</li> </ul>	<ul style="list-style-type: none"> <li>Solvents, acids, degreasers</li> <li>Wood preservatives</li> <li>Heavy metals</li> <li>Pesticides and herbicides</li> <li>Chlorine (water treatment plants)</li> <li>Fly ash</li> </ul>	<ul style="list-style-type: none"> <li>Engine bleed air</li> <li>CO2</li> <li>Particulate</li> <li>CO</li> <li>Fumigants</li> </ul>	<ul style="list-style-type: none"> <li>Diesel</li> <li>Cargo fumigants</li> <li>Asbestos</li> </ul>
<b>Biological</b>	<ul style="list-style-type: none"> <li>Bioaerosol</li> <li>Infectious agents</li> <li>Dermal contacts</li> <li>Blood borne pathogens</li> </ul>	<ul style="list-style-type: none"> <li>Blood borne pathogens</li> </ul>	<ul style="list-style-type: none"> <li>Cargo exposure (livestock, waste, other agricultural products)</li> <li>Off-duty (truck stop showers, STDs)</li> <li>Blood borne pathogens</li> </ul>	<ul style="list-style-type: none"> <li>Animal bites</li> <li>Hepatitis A</li> <li>Blood borne pathogens</li> </ul>	<ul style="list-style-type: none"> <li>Blood borne pathogens</li> <li>Endotoxins</li> </ul>	<ul style="list-style-type: none"> <li>Blood borne pathogens</li> </ul>
<b>Physical</b>	<ul style="list-style-type: none"> <li>Noise</li> <li>Vibration</li> <li>Heat/cold</li> <li>Cosmic and solar radiation</li> </ul>	<ul style="list-style-type: none"> <li>Heat/cold</li> <li>Noise</li> <li>Vibration</li> </ul>	<ul style="list-style-type: none"> <li>Noise (in-truck; parking, sleeping, fueling, loading areas)</li> <li>Temperature (parking, sleeping, fueling, loading areas)</li> <li>Vibration</li> </ul>	<ul style="list-style-type: none"> <li>Noise</li> <li>Heat</li> <li>Confined space</li> <li>Ionizing and non-ionizing radiation</li> <li>Vibration</li> </ul>	<ul style="list-style-type: none"> <li>Heat/cold</li> <li>Noise</li> <li>Combustible dust</li> <li>Vibration</li> </ul>	<ul style="list-style-type: none"> <li>Heat/cold</li> <li>Vibration</li> </ul>

<sup>1</sup> This table is not comprehensive and only includes select exposures of concern. Additional exposures will be refined/added as appropriate, including but not limited to, exposures related to new energy source technology.

## Appendix A

### TWU Fatal and Nonfatal Data

**Table A-1. Fatal and nonfatal occupational injuries and illnesses in the TWU sector, 2006**

Industry	Number of employees <sup>1</sup>	Fatalities <sup>2</sup>	Fatalities per 100,000 workers	Nonfatal injuries and illnesses with DAFW <sup>3,4</sup>	Nonfatal injuries and illnesses with DAFW per 10,000 workers <sup>3</sup>
<b>All TWU</b>	7,455,000	967	13.0	116,010	---
<b>Utilities (NAICS 22)</b>	1,186,000	73	6.2	6,210	115.0
<b>Air transportation (NAICS 481)</b>	536,000	51	9.5	20,800	541.4
<b>Rail transportation (NAICS 482)</b>	266,000	19	7.1	3,530	146.2
<b>Water transportation (NAICS 483)</b>	68,000	21	30.9	1,210	191.8
<b>Truck transportation (NAICS 484)</b>	2,034,000	555	27.3	40,090	271.4
<b>Transit and ground passenger transportation (NAICS 485)</b>	781,000	70	9.0	6,320	216.7
<b>Bus service and urban transit (NAICS 4851-4859, exc. 4853)</b>	578,000	21	3.6	5,360	---
<b>Taxi/limousine service (NAICS 4853)</b>	223,000	49	22.0	960	177.6
<b>Pipeline transportation (NAICS 486)</b>	36,000	---		230	60.0
<b>Scenic and sightseeing transportation (NAICS 487)</b>	27,000	8	29.6	410	212.6
<b>Support activities for transportation (NAICS 488)</b>	673,000	84	12.5	9,310	175.5
<b>Postal Service (NAICS 491)</b>	799,000	21	2.6		
<b>Couriers and messengers (NAICS 492)</b>	680,000	41	6.0	15,210	345.9
<b>Warehousing (NAICS 493)</b>	349,000	17	4.9	12,700	220.6
<b>All industries</b>	144,427,000	5,840	4.0	1,183,500	127.8

<sup>1</sup> These employment estimates were taken from BLS, Current Population Survey electronic files. Available at: <http://www.bls.census.gov/cpsftp.html#cpsbasic>. These numbers are different from those published in the BLS, Annual Survey of Occupational Injuries and Illnesses as they include both public and private sector employees.

<sup>2</sup> Source: BLS, Census of Fatal Occupational Injuries, 2006. Available at: <http://data.bls.gov/GQT/servlet/InitialPage>.

<sup>3</sup> Source: BLS, Annual Survey of Occupational Injuries and Illnesses, 2006. Available at: <http://www.bls.gov/iif/oshsum.htm>. These estimates are for private industry only.

<sup>4</sup> DAFW = Days away from work

**Table A-2. Nonfatal occupational injuries and illnesses involving days away from work by private industry and selected events or exposures; transportation, warehousing, and utilities sector, United States, 2006.**

Private Industry	Total	Event					
		Transportation incidents	Assaults & violent acts	Contact with objects & equipment	Fall to lower level; fall on same level; slips or trips without fall	Overexertion	Harmful substance or environment
Air transportation	20,800	1,190	70	3,990	3,790	8,730	730
Rail transportation†	3,530	500	40	570	700	520	150
Water transportation	1,210	110	--	340	210	280	90
Truck transportation	40,090	5,440	290	8,280	10,670	9,270	940
Transit and ground passenger transportation (including Taxi/limo)	6,320	2,020	230	860	1,270	1,080	150
Taxi/limousine service	960	450	70	90	100	160	20
Pipeline transportation	230	30	--	60	40	20	--
Scenic and sightseeing transportation	410	60	--	60	160	40	30
Support activities for transportation	9,310	1,070	60	2,670	1,960	2,090	290
Marine cargo handling	1,900	330	---	430	480	300	---
Couriers and messengers	15,210	940	150	3,080	2,740	5,200	150
Warehousing and storage	12,700	1,100	70	3,360	1,990	4,230	150
Utilities	6,210	350	140	1,140	1,350	1,250	450

Source: BLS, Annual Survey of Occupational Injuries and Illnesses, 2006. Available at: <http://www.bls.gov/iif/oshwc/osh/case/ostb1796.pdf>.

† Data for railroad transportation were provided to BLS by the Federal Railroad Administration of the U.S. Department of Transportation, therefore estimates for this industry are not comparable to estimates in other industries.

**Table A-3. Rates of nonfatal occupational injuries and illnesses involving days away from work by private industry and selected events or exposures; transportation, warehousing, and utilities sector, United States, 2006.**

Private Industry	Rate per 10,000 full-time workers	Event				
		Transportation incidents	Assaults & violent acts	Contact with objects & equipment	Overexertion	Fall to lower level
All private industry	127.8	6.1	2.4	36.2	30.8	8.0
Air transportation	541.4	30.9	1.7	104.0	227.2	17.5
Rail transportation†	146.2	20.6	1.7	23.6	21.4	24.1
Water transportation	191.8	17.8	--	54.5	44.2	13.2
Truck transportation	271.4	36.8	2.0	56.1	62.7	35.8
Transit and ground passenger transportation (including Taxi/limo)	216.7	69.2	7.9	29.3	36.9	12.1
Taxi/limousine service	177.6	84.3	27.8	17.4	28.9	---
Pipeline transportation	60.0	8.4	--	15.3	5.5	---
Scenic and sightseeing transportation	212.6	29.0	--	33.4	18.4	18.0
Support activities for transportation	175.5	20.2	1.1	50.3	39.3	10.7
Marine cargo handling	494.5	86.4	---	113.2	77.1	36.1
Couriers and messengers	345.9	21.5	3.5	70.1	118.3	15.4
Warehousing and storage	220.6	19.1	1.2	58.3	73.6	8.8
Utilities	115.0	6.5	2.5	21.1	23.2	9.8

Source: BLS, Annual Survey of Occupational Injuries and Illnesses, 2006. Available at: <http://stats.bls.gov/iif/oshwc/osh/case/ostb1800.pdf>.

† Data for railroad transportation were provided to BLS by the Federal Railroad Administration of the U.S. Department of Transportation, therefore estimates for this industry are not comparable to estimates in other industries.

## Appendix B

### Strategic Goal 1 Discussion and References

#### **Background/Support for Strategic Goal 1: Reduce lost-workday occupational traumatic injury and fatality rates in the TWU sector.**

##### *Air Transportation (NAICS 481)*

In 2006, the incidence rate of nonfatal occupational injuries and illnesses involving days away from work for the air transportation sub-sector (NAICS 481) was 5.4 per 100 full-time workers [BLS, 2007a]. This rate was 4.2 times the national rate for all private industry (1.3 injuries and illnesses per 100 full-time workers). Since the mid-1990's, the year-by-year trends for these most serious injury and illness cases have been mixed: In 2004 and 2005, the rate was actually slightly lower, at 5.3, which was an improvement from the 2003 rate of 5.8. Prior to 2003, Bureau of Labor Statistics (BLS) data were tabulated using the Standard Industrial Classification (SIC) system, which is slightly different from the NAICS categories in use today. For SIC 45 Transportation by air, incidence rates for days away from work injury/illness cases have drifted up and down since the mid-1990's, with a high of 8.4 in 1995 to a low of 5.2 in 2002.

For 2006, the injuries and illnesses involving days away from work within the air transportation sub-sector were most frequently due to overexertion (227.2 injuries and illnesses per 10,000 full-time workers), contact with objects and equipment (104.0 injuries and illnesses per 10,000 full-time workers), and slips, trips and falls (98.6 per 10,000 full-time workers) [BLS, 2007b]. The hazards that contribute to the occurrence of these incidents should receive particular attention when developing annual goals for injury/illness mitigation strategies. In terms of severity, for all of private industry the median number of days away from work for lost work day injury/illness cases in 2006 was 7 days; for the air transportation sub-sector, the median was 16 days [BLS, 2007c]. This difference indicates the high relative severity of injuries and illnesses that occur to workers in the air transportation sub-sector.

Certain occupations specific to the air transportation industry have occupational injury or fatality rates that are among the highest for all occupations. For example, in 2006, there were 104 work-related fatalities involving aircraft pilots and flight engineers reported by the Census of Fatal Occupational Injuries (CFOI), with a U.S. fatality rate of 90.4 per 100,000 employed workers. This rate is more than three times higher than the work-related fatality rate for driver/sales workers and truck drivers (27.5 per 100,000 employed workers) for 2006, and more than 22 times higher than the fatality rate for all workers (4.0 per 100,000 employed workers) for 2006 [BLS, 2007d]. Further, in 2006, the rate of nonfatal injuries involving days away from work for flight attendants was 7.3 per 100 full-time workers, well above the rate of 5.4 for the air transportation sub-sector as a whole [BLS, 2007e].

### **Rail Transportation (NAICS 482)**

Between 1998 and 2007 human factors related incidents accounted for 38% of railway incidents leading to injuries [FRA 2005]. The Federal Rail Administration (FRA) identified the following factors as most frequent contributors to these incidents between 2001 and 2004:

- Improper line switches (track switches not fully aligned during car movement) (16%) [FRA 2005]. In 2003 the FRA determined that 63% of employees fatally injured in struck-by incidents were involved in switching activities [FRA 2006].
- Shoving movement (pushing rail cars with the engine)(15%).
- Rail cars left in places that obstruct train movements on an adjacent track (4%) [FRA 2005].

Like many other transportation sub-sectors, rail operations place workers at risk of fatigue-related incidents. The laws related to hours-of-service allow employees to work 12 hours and have 10 hours off-duty. A 2006 FRA study examined approximately 1,400 train accidents and found a strong statistical correlation between the crew's estimated level of alertness and the likelihood that they would be involved in an accident caused by human factors [FRA 2005].

The FRA reports that 31.7% of the fatalities that occurred between 2004 and 2006 were struck-by, 63% of which occurred during switching activities. In 2003 the FRA found that 19% were fatally injured maintaining track [FRA 2006]. BLS reports that the rate per 10,000 workers for nonfatal injuries caused by struck-by ranged from 15.6-10.7 from 2003 to 2006 [BLS, 2007f]. The FRA reports that 25.3% of the fatalities that occurred between 2004 and 2006 were collisions [FRA 2008].

### **Water Transportation (NAICS 483)**

The Water Transportation industry sub-sector employs approximately 67,700 people in the U.S [BLS 2007m] and consists of approximately 1700 businesses [NAICS 2007]. These businesses are primarily engaged in water transportation of passengers and cargo using water craft, such as ships, barges, and boats. The two industry groups in this subsector are based primarily on the different equipment used; (1) Deep Sea Coastal, and Great Lakes; and (2) Inland Water Transportation [NAICS 2007].

Among six main components of the Transportation, Warehousing, and Utilities Sector (i.e., ground, air, rail, water, warehousing, utilities) the Water Transportation sub-sector had the second highest fatality rate, with 31.0 fatalities per 100,000 in 2006 [BLS 2007k]. The injury rate for non-fatal injuries involving days away from work (DAFW) in 2006 was 1.9 injuries per 100 full time workers [BLS 2007i].

BLS data indicated that contact with objects and overexertion, are the two leading nonfatal injury and illness events resulting in DAFW. Of the 1210 water transportation injuries and illnesses resulting in DAFW in 2006, 28% are from contact with objects (n=340) and 23% are from overexertion (n=280) [BLS 2007j]. Nonfatal injuries and illnesses due to contact with objects and overexertion had rates of 54.5 and 44.2 per 10,000 full-time workers, respectively [BLS 2007b].

The United State Coast Guard (USCG) reported that fatigue contributed to 16% of the fatalities and 33% of the injuries reported in 1996 [NTSB 1999]. The USCG implemented the Crew

Endurance Management program in 2003 to attempt to address the issue of fatigue in the sub-sector, although fatigue continues to be a concern and remain on The National Transportation Safety Board Most Wanted List for Marine [NTSB 2009].

***Truck Transportation (NAICS 484)***

In 2006, 5,840 fatal work-related injuries were reported by the CFOI with a U.S. fatality rate of 4.0/100,000 [BLS 2007d]. The estimated total cost for fatal and nonfatal work-related unintentional injuries in 2006 was \$164.7 billion dollars [National Safety Council 2008]. Included in that amount were wage and productivity losses of \$80.0 billion, medical expenses of \$31.3 billion, and motor-vehicle damage costs of \$1.7 billion. Truck transportation fatalities accounted for 10% (n= 555) of all worker fatalities in 2006 [BLS 2007k].

The nonfatal occupational injury and illness incidence rate for the truck transportation industry was 5.8 injuries and illness/ 100 full-time workers, which was 32% higher than the national rate for all private industries (4.4 injuries and illnesses/ 100 full-time workers) [BLS 2007a].

National workers' compensation premium rates correspond with injury rates and are a burden to employers (\$2.48 per \$100 of payroll in the year 2006 [Oregon Department of Consumer & Business Services 2007]. Employer costs for workers' compensation per hour worked in the trade, transportation and utilities industry were estimated to be \$0.50 per hour in March 2008. Workers' compensation costs were higher in the trade, transportation, and warehousing industry than in all service-producing industries (\$0.38 per hour) but lower relative to all goods-producing industries (\$0.83 per hour) [BLS 2007l].

Most of the injuries within the truck transportation industry were due to events involving overexertion (62.7 injuries and illness per 100 full-time workers), transportation accidents (36.8 injuries and illnesses per 100 full-time workers), falls to a lower level (35.8/ 100 full-time workers), and being struck by an object (30.2 per 100 full-time workers) due primarily to falling objects [BLS 2007b]. Injury sources accounting for the highest truck transportation injury incidence rates were floors, walkways or ground surfaces (65.1 injuries and illnesses per 10,000 full-time workers) and vehicles (68.4 injuries and illnesses per 10,000 full-time workers) [BLS 2007g].

***Transit and Ground Passenger Transportation (NAICS 485)***

The Transit and Ground Passenger Transportation subsector employs approximately 801,600 people in the U.S [BLS 2007m] and consists of an estimated 25,500 businesses [NAICS 2007]. These businesses are primarily engaged in a variety of passenger transportation activities, such as urban transit systems; chartered bus, school bus, and interurban bus transportation, and taxis. Factors such as vehicle types, routes, and schedules are components used to differentiate these activities. The subsector is composed of scheduled transportation and nonscheduled transportation [NAICS 2007].

The Transit and Ground Passenger Transportation subsector ranks third among the Transportation, Warehousing, and Utilities Sector (i.e., ground, air, rail, water, warehousing, utilities), with fatality rate of 8.7 fatalities per 100,000 in 2007 [BLS 2007k]. In addition, the Transit and Ground Passenger Transportation sub-sector had the fifth highest nonfatal injury rate

in the sector in 2006 of 2.2 injuries resulting in days away from work (DAFW) per 100 full time workers [BLS 2007i].

BLS data indicated that transportation incidents, slips, trips or falls, followed closely by overexertion are the three leading nonfatal injury and illness events resulting in DAFW. Of the 6320 transit and ground transportation injuries and illnesses resulting in DAFW in 2006, over 30% are from transportation incidents (n=2020), 20% are from slips, trips, or falls (n=1270), and 17% are from overexertion (n=1080) [BLS 2007j]. Nonfatal injuries and illnesses due to contact with objects and overexertion had rates of 29.3 and 36.9 per 10,000 full-time workers respectively [BLS 2007b]. Compared to the rate of 2.4 per 10,000 workers for assaults and violent acts on all private industry workers, the taxi service industry had a notably higher rate of assault and violent acts at 27.8 per 10,000 workers.

### ***Postal Service (NAICS 491)***

The Postal Service subsector includes the activities of the National Post Office and its subcontractors in delivering letters and small parcels, normally without pick-up at the sender's location. These articles can be described as those that can be handled by one person without special equipment. This allows the collection, pick-up, and delivery operations to be done with limited labor costs and minimal equipment. Sorting and transportation activities, where necessary, are generally mechanized. The restriction to small parcels distinguishes these establishments from those in transportation industries.

The traditional activity of the National Postal Service is described in this subsector. Subcontractors include rural Post Offices on contract to the Postal Service.

Bulk transportation of mail on contract to the Postal Service is not included here, because it is usually done by transportation establishments that also carry other customers' cargo.

### ***Couriers and Messengers (NAICS 492)***

The Couriers and Messengers subsector employs approximately 680,200 people in the U.S. [BLS 2007m] and consists of an estimated 5200 businesses [NAICS 2007]. These businesses are primarily engaged in intercity and/or local delivery of parcels. These articles can be described as those that may be handled by one person without special equipment. The restriction to small parcels is one of the primary factors differentiating these establishments from those in transportation industries [NAICS 2007].

The Couriers and Messengers subsector ranks last in the TWU Sector (i.e., ground, air, rail, water, warehousing, utilities), with fatality rate of 6.0 fatalities per 100,000 in 2007 [BLS 2007k]. Conversely, the Couriers and Messengers subsector had the second highest nonfatal injury rate in the sector in 2006 of 3.3 injuries resulting in days away from work (DAFW) per 100 full time workers [BLS 2007i].

BLS data indicated that overexertion, contact with objects, and slips, trips or falls, are the three leading nonfatal injury and illness events resulting in DAFW. Of the 15,210 courier and messenger industry injuries and illnesses resulting in DAFW in 2006, over 34% are from overexertion (n=5200), 20% are from contact with objects (n=3080), and 18% are from slips, trips, or falls (n=2740) [BLS 2007j]. Nonfatal injuries and illnesses resultant of overexertion

and contact with objects had rates of 118.3 and 70.1 per 10,000 full-time workers respectively [BLS 2007b].

### ***Warehousing and Storage (NAICS 493)***

The Warehousing and Storage industry sub-sector employs approximately 600,000 people in the U.S. [BLS 2007a] and consists of an estimated 28,000 businesses [NAICS 2007]. These businesses are primarily engaged in handling goods in containers (e.g., boxes, barrels, or drums) and using equipment (e.g., forklifts, pallets, and racks) [NAICS 2007]. The sub-sector includes refrigerated storage, farm product warehousing, and other miscellaneous warehousing such as bulk petroleum and lumber storage. It does not include leased self-storage or hazardous materials storage for treatment and disposal.

Among six main components of the TWU Sector (i.e., ground, air, rail, water, warehousing, utilities), the Warehousing and Storage sub-sector had one of the lowest fatality rates, with 2.8-3.8 fatalities per 100,000 from 2004-2006 [BLS 2007h]. In contrast, the Warehousing and Storage sub-sector had the third highest nonfatal injury rate from 2003-2006, with 220-300 injuries per 10,000 full-time workers [BLS 2007i]. In 2006 specifically, the overall nonfatal injury incidence rate was 220.6 per 10,000 full-time workers [BLS 2007e].

BLS data indicated that contact with objects and equipment and slips, trips, and falls are two of the leading nonfatal injury and illness events resulting in days away from work (DAFW). Of the 12,700 warehousing and storage industry injuries and illnesses resulting in DAFW in 2006, more than a quarter are from contact with objects and equipment (n = 3360) and 16% are from slips, trip, and falls (n = 1990) [BLS 2007j]. Nonfatal injuries and illnesses resultant of contact with objects and equipment and falls on the same level had rates of 58.3 and 20.3 per 10,000 full-time workers, respectively [BLS 2007b].

Injuries and illnesses involving forklifts are of particular concern in the warehousing and storage industry. In 2006, one-fifth (n = 2,440) of all injuries and illnesses involving forklifts and resulting in DAFW were in the transportation and warehousing industries [BLS 2007k]. In addition, the rate for forklift injuries and illnesses in transportation and warehousing is notably higher at 6.0 per 10,000 full-time workers compared to 1.3 per 10,000 full-time workers in all private industry.

### ***Utilities (NAICS 22)***

The Utilities sector is made up of establishments that provide the following services:

- Electric power and supply: generation, transmission, and distribution (629,200 workers)
- Natural gas: Distribution (134,500 workers);
- Combination: Electric and gas, and other combinations (70,900 workers);
- Water, sewage, and other systems: Provision and/or distribution of steam; water treatment and distribution; and collection, treatment, and disposal of waste through sewer systems and sewage treatment facilities (330,300 workers); and
- Unspecified utilities (20,900 workers) [BLS 2007m].

The CFOI reported 73 workplace fatalities within the utilities industries in 2006. The leading causes of fatalities were transportation incidents (25 deaths, 34%), exposure to harmful substances or environments (20 deaths, 28%), contact with objects and equipment, and falls (10 and 11 deaths respectively, 14% and 15%). The majority of fatalities (n=47) occurred within the electric power generation, transmission, and distribution sub-sector [BLS 2007k].

Estimates for 2006 from the BLS Survey of Occupational Injury and Illness show that there were 6,210 nonfatal injuries resulting in DAFW among utilities industry employees. The rate of 115 lost-workday injuries per 10,000 full-time workers in the utilities sector was slightly below the rate of 127.8 for all workers in private industry. Workers in water, sewage, and other systems had a somewhat higher rate, at 162.2 lost workday injuries per 10,000 full-time workers [BLS 2007k].

### **Additional TWU Industry Subsectors**

Descriptions of additional industry subsectors within the TWU sector are provided below. While there are no developed goals specifically targeting the employees of these subsectors, it is believed that interventions developed to prevent injuries and fatalities in other TWU subsectors will be transferrable to these subsectors with adaptations as needed.

#### ***Pipeline Transportation (NAICS 486)***

Industries in Pipeline Transportation subsector use transmission pipelines to transport products, such as crude oil, natural gas, refined petroleum products, and slurry. Industries are identified based on the products transported (i.e., pipeline transportation of crude oil, natural gas, refined petroleum products, and other products).

The Pipeline Transportation of Natural Gas industry includes the storage of natural gas because the storage is usually done by the pipeline establishment and because a pipeline is inherently a network in which all nodes are interdependent.

#### ***Support Activities for Transportation (NAICS 488)***

The Support Activities for Transportation subsector employs approximately 673,300 people in the U.S. [BLS 2007m] and consists of an estimated 62,000 businesses [NAICS 2007]. These businesses are primarily engaged in support services in transportation. These services may be provided to transportation carrier establishments or the general public. This subsector is separated by mode of transportation and includes businesses, such as air traffic control services, marine cargo handling, and motor vehicle towing.

The Support Activities for Transportation subsector ranks in the middle in the Transportation, Warehousing, and Utilities Sector (i.e., ground, air, rail, water, warehousing, utilities), with fatality rate of 12.5 fatalities per 100,000 in 2007 [BLS 2007k]. The Support Activities for the Transportation subsector has a nonfatal injury rate of 1.8 injuries resulting in days away from work (DAFW) per 100 full-time workers [BLS 2007i].

BLS data indicated that contact with objects, overexertion, and slips, trips or falls, are the three leading nonfatal injury and illness events resulting in days away from work (DAFW). Of the 9,310 support activities injuries and illnesses resulting in DAFW in 2006, 29% are from contact with objects (n=2670), 22% are from overexertion (n=2090), and 21% are from slips, trips, or falls (n=1960) [BLS 2007j]. Nonfatal injuries and illnesses resultant of overexertion and contact

with objects had rates of 50.3 and 39.3 per 10,000 full-time workers, for contact with objects and overexertion respectively [BLS 2007b]. Within the sub-divisions of this sub-sector the marine cargo handling has the highest injury rate for contact with objects, and slips, trips and falls, while navigational services to shipping has the highest rate for overexertion.

### ***Scenic and Sightseeing Transportation (NAICS 497)***

Industries in the Scenic and Sightseeing Transportation subsector utilize transportation equipment to provide recreation and entertainment. These activities have a production process distinct from passenger transportation carried out for the purpose of other types of for-hire transportation. This process does not emphasize efficient transportation; in fact, such activities often use obsolete vehicles such steam trains, to provide some extra ambience. The activity is local in nature, usually involving a same-day return to the point of departure. The Scenic and Sightseeing Transportation subsector is separated into three industries based on the mode: land, water, and other.

### **References**

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BLS (Bureau of Labor Statistics) [2007b]. Table R8. Incidence rates for nonfatal occupational injuries and illnesses involving days away from work per 10,000 full-time workers by industry and selected events or exposures leading to injury or illness, 2006. Available at: <http://stats.bls.gov/iif/oshwc/osh/case/ostb1800.txt>. Date accessed: June 6, 2008.

BLS (Bureau of Labor Statistics) [2007c]. Table R65. Number of nonfatal occupational injuries and illnesses involving days away from work by industry and number of days away from work, 2006. Available at: <http://stats.bls.gov/iif/oshwc/osh/case/ostb1857.txt>. Date accessed: June 6, 2008.

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## Appendix C

### Strategic Goal 2 Discussion and References

#### **Background/Support for Strategic Goal 2: Reduce incidence and severity of work-related musculoskeletal disorders among workers in the TWU industries.**

Work-related musculoskeletal disorders (WMSDs) are defined as “non-traumatic disorders of the soft tissues of the musculoskeletal system that can be caused or aggravated by work activities such as repetitive forceful motions, awkward postures, use of vibrating tools or equipment, or by manual handling of heavy, awkward loads” [WA DOH 2003]. Risk factors associated with WMSDs that occur in the TWU industries include repetitive motion, heavy lifting, forceful exertion, vibration exposure (including whole-body vibration), prolonged sitting, and poor postures.

In 2006 WMSDs<sup>1</sup> in the TWU industries accounted for 33% of all occupational injuries and illnesses resulting in days away from work [BLS 2007a]; the same distribution was reported in 2005 [BLS 2006a]. A total of 38,290 WMSDs were reported in the TWU industries during 2006. The combined rate for WMSDs in transportation and warehousing was 89.7 per 10,000 workers. This is markedly higher than the rate for all private industries of 38.6 per 10,000 [BLS 2007a]. Within TWU, industries with the highest rates of WMSDs were air transportation (245.7 per 10,000) and couriers and messengers (137.4 per 10,000). The industry with the highest number of WMSDs was truck transportation (10,870) [BLS 2007b].

Freight, stock and material movers reported the most WMSDs of all occupations in 2006 (28,860) and truck drivers, heavy and tractor trailer reported the third highest number (17,400). The WMSD rates for these occupations were among the highest at 158 per 10,000 and 108 per 10,000 respectively [BLS 2007c].

From 1993 to 2002 the Transportation and Public Utility Sector, inclusive of warehousing, experienced a 36% reduction in the combined fatal and non-fatal occupational injury and illness incidence rate. This reduction is estimated to have decreased the injury cost for this sector by a total of \$2.8 billion over that time frame [Zaloshnja et al. 2006]. Considering the cost-per-employee for occupational injuries and illnesses, transportation and manual moving occupations ranked third highest for non-fatal injuries (\$1,641) and second highest for fatalities (\$849) [Leigh et al. 2006].

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<sup>1</sup> BLS defines WMSDs to include “cases where the nature of injury is: sprains, strains, tears; back pain, hurt back; soreness, pain, hurt, except back; carpal tunnel syndrome; hernia; or musculoskeletal system and connective tissue diseases and disorders and when the event or exposure leading to the injury or illness is: bodily reaction/bending, climbing, crawling, reaching, twisting; overexertion; or repetition. Cases of Raynaud's phenomenon, tarsal tunnel syndrome, and herniated spinal discs are not included. Although these cases may be considered MSD's, the survey classifies these cases in categories that also include non-MSD cases.”

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## Appendix D

### Strategic Goal 3 Discussion and References

**Background/Support for Strategic Goal 3: Improve health and reduce premature mortality among TWU workers through workplace programs and practices that (1) enable workers to engage in healthy behaviors, (2) reduce work-related physiological and psychological stressors, and (3) improve healthcare utilization.**

Aside from physical hazards such as whole body vibration and chemical vapors (which are addressed in Strategic Goal 4) and safety (which is addressed in Strategic Goal 1) there are specific threats to health that result from work organization; psychological stress; and the physical stress of chronic sleep deprivation, disruption of circadian rhythm, and long periods of immobility. These threats are the health risks that Strategic Goal 3 addresses.

Undoubtedly many of the occupational health-related problems identifiable for workers in the TWU sector are also concerns for the nation's work force in general. For example, health risks associated with individual conditions of obesity, cardiovascular disease, hypertension, diabetes, tobacco use, lack of good nutrition, and poor physical fitness likely affect large swaths of the U.S. population of workers. Therefore, advances made within the TWU sector may benefit workers in every NORA sector.

#### *Workforce Issues*

Among the barriers to improving worker safety and health and the utilization of healthcare services in the TWU sector are the increasingly common nontraditional employer-employee relationships collectively referred to as "contingent" work. Contingent workers are persons who do not have an implicit or explicit contract for ongoing employment; who do not expect their jobs to last; or who report that their jobs are temporary. Included in this definition are persons employed as independent contractors, on-call workers, temporary help agency workers, and workers provided by contract firms. Within TWU, self-employed workers account for approximately 14% of truck transportation employees and 25% of taxi and limo employees [BLS 2008]. Therefore, the challenges faced by the contingent worker population must be considered in research and interventions to prevent injury and illness and in efforts to improve the utilization of healthcare services in these industries.

The expanding use of contingent workers has occupational safety and health implications and can manifest in a higher occurrence of injury, illness, and mortality. Contingent workers are more likely to have lower incomes and fewer benefits [BLS 2009]. Contingent workers are much less likely to have employer-provided health insurance; in 2005, less than one-fifth of contingent workers (18 percent) were covered by health insurance provided by their employer, compared with slightly more than half of non-contingent workers (52 percent)[BLS 2005].

Additionally, some contingent workers (self employed, independent contractors) are excluded from laws designed to protect workers. It has been hypothesized that in some cases outsourcing of more hazardous jobs may go to contingent workers. Contingent workers may have less experience and training, and are thus potentially placed at higher risk for injury or illness [Cummings and Kreiss 2008]. The use of contingent workers can also result in confusion

regarding employer responsibilities for protecting workers (personal protective equipment provisions, training, access to screening programs, etc.) between the contracting agency and work site company. These ambiguities can result in decreased protections [Cummings and Kreiss 2008].

### ***Building TWU sector knowledge synthesis***

Work-related health concerns are not adequately tracked by surveys conducted through the Bureau of Labor Statistics. To fill this void, a series of knowledge syntheses should be conducted to provide in-depth information on health-related topics for the entire TWU sector.

The goal of the program is to provide a rapid assessment of baseline worker health and occupational hazards within the sector. One relatively short synthesis document (50-100 pages) for each of the three major sub-sectors (i.e., Transportation, Warehousing, and Utilities) should summarize the nature and extent of worker health concerns and problems and identify existing industry practices that may affect worker health. Each synthesis should include a critical literature review, an examination of relevant organizations and practices (e.g. employer practices, rules, existing model programs, worker concerns, health insurance related issues, etc.) and analyses of existing data (for example, National Health Interview Survey, National Occupational Mortality Surveillance System). Additionally, each synthesis will provide a list of recommended research topics and actionable programs aimed at improving worker health and reducing premature mortality in the TWU sector.

These syntheses will use multiple sources of information, and will be similar in nature to those produced by the National Research Council's Transportation Research Board (see [www.trb.org](http://www.trb.org) for more information and synthesis publications).

### ***Reducing obesity***

Obesity is a physical condition that contributes to diabetes, cardiovascular disease, osteoarthritis, obstructive sleep apnea, and numerous other preventable conditions. These conditions not only affect quality of life, but may also interfere with the ability to operate a vehicle safely. Many factors influence obesity, including physical activity, stress, eating behavior, sleep quality and quantity, and certain medications.

Although obesity is a national problem – and is likely to be prevalent in a variety of occupational groups in the TWU sector – for two reasons, commercial drivers are targeted initially. First, more than 88% of the truck drivers participating in two recent studies were either overweight or obese, far above the national prevalence of 64%. [Pack et al. 2006; FMCSA 2006] Second, the work demands of commercial drivers create special challenges for this group: the driving task is sedentary in nature, they have limited options for where and when to eat while working or resting away from home, and daily continuous off-duty periods can be as short as 10 hours (team drivers may have even fewer options and shorter continuous off-duty periods). The lessons learned from working to reduce obesity in commercial drivers are expected to ultimately benefit all workers in the TWU and other sectors, particularly those with similar working conditions.

### ***Reducing the incidence of cardiovascular disease (CVD)***

Cardiovascular disease (CVD) is the most common cause of death in the United States [Kung et al. 2008]. CVD is also a leading contributor to premature mortality in a variety of TWU sector

occupational groups. Much of this body of research has focused on truck drivers, for whom several studies have revealed excess heart disease mortality among truck drivers. An examination of the BLS Supplementary Data System for 1985 and 1986 found that among all occupations, heavy truck drivers contributed 29 deaths due to “heart conditions, including heart attack” – more than any other occupation. Truck drivers accounted for 7.6% of all deaths from heart conditions; this was 4 times the expected number, since they represented only 1.9% of the civilian workforce [Leigh and Miller 1998]. Analysis of the National Occupational Mortality Surveillance system (NOMS) from 1979 through 1990 revealed that long-haul, but not short-haul, drivers had elevated proportionate mortality ratios (PMRs) for heart disease. For acute myocardial infarction specifically, the PMR for white long-haul drivers was 112 (95% CI 108-116) and for black long-haul drivers it was 114 (95% CI 101-128) [Robinson and Burnett 2005].

Another study suggested linkages between lifestyle factors and risk of CVD among truck drivers. Bigert et al. (2003) conducted a study of myocardial infarction (MI) among professional drivers involving 1,067 cases (defined as first MI event) and 1,482 population controls. They reported an MI odds ratio of 1.66 (95% CI 1.22-2.26) for truck drivers who had driven for at least one year compared to people who had never driven a truck, bus, or taxi, after adjusting for age, year of selection, and hospital catchment area. When other individual risk factors were added to the model, such as socioeconomic status, tobacco use, alcohol use, sedentary lifestyle, and being overweight, the odds ratio fell to 1.10 (95% CI 0.79-1.53). The researchers concluded that lifestyle factors explain most of the truck driver risk for MI, but acknowledged that since “... an occupational factor such as stress may exert its effect through mechanisms such as hypertension or metabolic changes, the adjustment for hypertension, diabetes and BMI may introduce ‘overadjustment’ if the purpose is to evaluate the influence of occupational factors alone.”

Two Japanese studies [Sato et al. 1999; Koda et al. 2000] examined hypertension in truck drivers. Koda et al. surveyed 134 local drivers, 199 long distance drivers, and 71 clerical workers, and found that truck drivers had significantly higher prevalence of both hypertension and ulcers than did the clerical workers. Sato et al. reported a mean systolic reading of over 140 mmHg for the eight drivers they monitored, and discovered that their blood pressure was higher when driving or loading than it was during a day off.

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## Appendix E

### Strategic Goal 4 Discussion and References

**Background/Support for Strategic Goal 4: By 2016, Identify, evaluate, and reduce chemical, biological, physical, and psychosocial occupational hazards and exposures that results in a reduction of occupational injuries, illnesses, and fatalities in the TWU sector.**

Modern industries and the transportation infrastructure which serve them are growing more complex. As a result, occupational exposures to chemical, biological, and physical stressors in the TWU sector are more diverse and varied. Although some occupational exposures have been characterized in TWU workers previously, data is generally sparse, other known exposures remain largely unstudied, and there are likely unrecognized or unanticipated exposures yet to be identified [Green 2002, Headapohl, 2004]. Unlike fatalities and injuries, occupational hazards, exposures, and associated illness are not captured in existing national surveillance systems such as the BLS surveys. The purpose of this strategic goal is to first more fully identify and evaluate chemical, biological, and physical hazards and exposures in the TWU sector. Given the size, number of employees, [BLS 2007], and the diversity of the sector, this task is especially daunting. The second purpose of this goal is to identify effective controls for identified hazards and implement changes that will ultimately reduce exposures and hazards for TWU workers.

The value of comprehensive occupational safety and health programs to prevent occupational deaths, injuries, and illnesses has long been recognized [Sorenson 2006, Mulhausen 2003, Pelletier 2001]. A major element of an effective program is exposure monitoring to recognize, evaluate and control occupational hazards. When implemented appropriately, exposure monitoring can determine what, when, where, and how unacceptable exposures are occurring, determine the effectiveness of engineering controls, identify necessary administrative programs, improve work practices, aid in the selection of appropriate personal protective equipment, help ensure regulatory compliance, address employee concerns, and provide risk management guidance to employers. The overall goal of exposure assessment is to ensure a more healthful work environment where worker exposures are low and in accordance with applicable recommended occupational exposure limits and/or other predetermined criteria. These criteria can be based on a review of current chemical, toxicological or health data by recognized professional agencies or organizations or internally proposed limits established by an employer or group of employers (such as a trade organization).

After a careful review of peer reviewed literature and consultation with subject matter experts from TWU steering and corresponding membership, SG4 was created to highlight the need for exposure monitoring for TWU workers and their diverse workplaces. Although it is not all inclusive and will be revised as new information becomes available, Table 4 contains examples of potential exposures by subsector. This table is intended to provide initial guidance and serve as a springboard to foster and promote exposure assessments across the TWU sector. Given the magnitude of the exposure assessments necessary and the potential health outcomes, collaboration will be necessary with additional NORA cross sector programs including but not limited to Exposure Assessment, Cancer, Reproductive and Cardiovascular Diseases, Immune and Dermal Diseases, and Respiratory Diseases [NIOSH, 2009] .

Strategic Goal 4 is separated into specific chemical, biological, and physical agent Intermediate and Activity goals. This separation of agent classes into specific goals will help facilitate the implementation of research solutions by agent class, regardless of industry. For example, engineering intervention programs for forklift operators exposed to diesel exhaust or carbon monoxide can be employed in warehousing, utilities and some transportation sectors universally. Engineering intervention programs, health communication products, medical surveillance systems, and economic benchmarking aspects are other examples of programs which could translate into exposure reductions across industries.

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