IV. Overview of Traumatic Injuries (TI) Research Program

Background: Traumatic Occupational Injuries

According to U.S. Bureau of Labor Statistics (BLS) data for 2005, there were 5,702 occupational fatalities in the private-sector, an average of 15 per day.[40] In 2005, there were also 4.2 million nonfatal injuries and illnesses in the private-sector.[41] The Liberty Mutual 2005 Workplace Safety Index estimated that employers spent $50.8 billion in 2003 on wage payments and medical care for workers hurt on the job.[42] Although recent decades have exhibited steady reductions in the numbers and rates of traumatic occupational injuries and fatalities (see Figure 4, for example), the toll remains far too high. The NIOSH TI Program is the Federal program with the mission of reducing this toll through research, collaboration, and knowledge transfer.

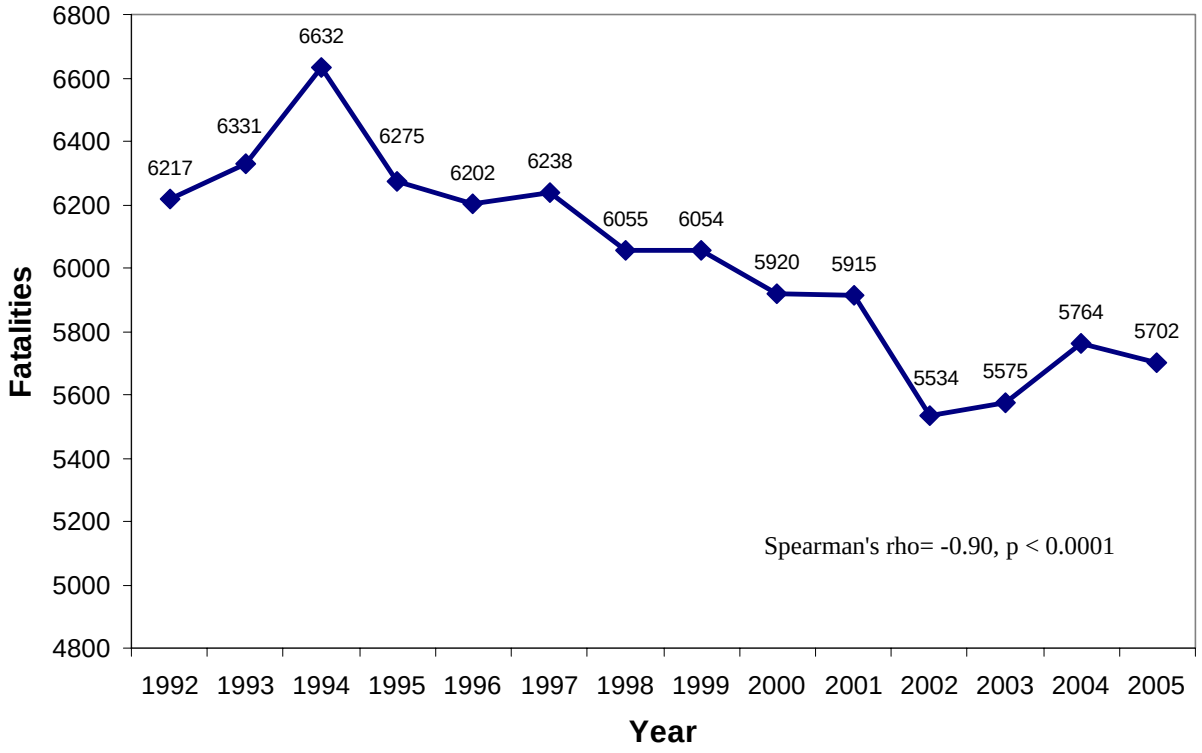

Figure 4. Number of Fatal Work Injuries, United States, 1992-2005.

Brief History of the NIOSH TI Research and Prevention Program

In the 1970s, NIOSH safety research efforts emerged slowly, partly because the Institute was initially organized along the lines of a predecessor—the Bureau of Occupational Safety and Health (BOSH)—that leaned more toward the study and prevention of occupational illnesses.[43]

Early project-level TI prevention research and communication activities were not centrally managed, but dispersed throughout a handful of NIOSH divisions, branches, offices, and laboratories. In 1971, NIOSH hired A.D. Little, Inc. to survey the safety research literature, identify the gaps, and develop a list of safety research priorities. The contractor reported that the status of occupational safety

research was "limited" in the areas that NIOSH considered within its scope (i.e., research into the development of criteria and standards, and research in areas related to psychology, behavior, motivation, engineering, equipment, and education).[44] Substantial research was being done by other agencies in areas that NIOSH had already decided to exclude from consideration—i.e., mine safety and highway traffic safety.[44]

The contractor developed an algorithm for prioritizing research topics, based upon need, potential success, and cost. When contractor staff members tested the algorithm on a sample list of research topics, they concluded that the scheme was "workable, although factual data on incidence and severity is difficult to obtain from available statistics."[44] This lack of data prompted A.D. Little to conclude that one area where additional occupational research was needed could be labeled "accident causative factors, accident investigations and statistical studies."[44] With inadequate injury and fatality data, more weight was given to the opinions of safety professionals in the identification of safety research priorities. Resulting occupational safety research priorities included studies of company incentives and other reinforcement and punishment methods in safety, risk taking behavior of workers, worker motivation regarding the use of protective equipment, management practices, the economics of safety, overexertion injuries (especially related to lifting and moving objects), falls, "struck by" and "caught in" injuries related to machines, and "struck by" vehicle injuries.[44]

Early on, the Institute focused primarily on studying toxic exposures and health concerns, and providing criteria for OSHA health standards.[45] Even in 1973, the NIOSH safety engineering program was described as "a small research effort,"[49] although "initial steps were taken to establish a NIOSH occupational safety research laboratory."[45]

A handful of productive TI-related programs were in operation during the early 1970s, including a program involving the testing of personal protective equipment (PPE). This program originated in the U.S. Department of Interior's (DOI) Bureau of Mines (USBM) in 1919, but a series of legislative actions and governmental reorganizations, including the OSH Act, brought the program, which focused mainly upon respirator performance testing, to NIOSH. Also during the 70s, another NIOSH program incorporated industry-specific hazard, injury prevention, and health information into small, lay-oriented manuals called health and safety guides (HSGs). All told, 56 HSGs were prepared and distributed within the targeted industries during the 1970s. Two other NIOSH groups were organized to: 1) study the contribution of behavioral and motivational factors to occupational TI and health risks, and 2) provide injury prevention technical assistance and consultative services to government and industry.

Here are some "firsts" in the NIOSH TI effort:

- A 1974 gathering entitled Occupational Safety Research Specifically Related to Personal Protection—A Symposium was described as "the very first NIOSH Symposium devoted to occupational safety research."[46]

- In 1975, one of the first published NIOSH technical reports specifically and solely covering a safety topic (machine safety) was "believed to be the first organized effort to assess the relative hazard levels of currently used machines in the United States."[47]

- In 1976, the first Criteria Document focusing strictly on safety—"Criteria for a recommended standard…Logging from Felling to First Haul"[48]—was published by NIOSH. (Other safety-

related CDs were subsequently published,[49,50] but injury topics in general continued to take a back seat to health-related CDs and other types of NIOSH publications throughout the 1970s.)

- Finally, in 1977, the first division-level focus on TI research in NIOSH—the Division of Safety Research (DSR)—was established as part of ALOSH in Morgantown.

Although other divisions and laboratories within NIOSH continued to include some efforts focusing on traumatic injury risks and prevention, particularly the divisions which focused upon surveillance, protective technology (general and personal), and education and communication, DSR became the central location of the NIOSH TI Research Program.

TI Strategic Planning and Program Direction from 1979 through 1995: Laying the Foundation

The first published program plan for DSR was for Federal Fiscal Year 1979.[51] Nearly 70 employees (55 civil servants and 12 commissioned corps officers) staffed the division at that time. The program addressed traditional high priority areas, such as falls from elevation (scaffolding and handrail design), machines (safeguarding metal-cutting lathes and power presses), and low-back injuries (assessing countermeasures), along with a variety of miscellaneous efforts such as studies of warning devices, signs, and labels; explosives and pyrotechnics; the safety functions of occupational health nurses, and so on. A project aimed at development of an accident investigation methodology is noteworthy as a precursor to the Fatal Accident Circumstances and Epidemiology (FACE) Program initiated in 1982. (FACE was later renamed "Fatality Assessment and Control Evaluation," due to the undesirable connotation that "accidents" are random, unpredictable, and therefore unpreventable events.)

In a 1979 article in *Professional Safety*, managers of the Division of Safety Research described the NIOSH Strategy for occupational safety research.[52] The authors pointed out barriers to scientific advances in occupational injury research and recommended the development of a national surveillance database to identify research needs and track progress, increased evaluation of effectiveness (including cost effectiveness) of hazard control strategies and techniques, establishment of technology transfer mechanisms, and increased coordination and collaboration with other agencies. Although the article does not mention epidemiology or public health, it clearly expresses the need for improved surveillance, evaluation, dissemination and technology transfer, and collaboration.

In the program plans for FY 1980, the NIOSH Director outlined a shift of emphasis across the Institute toward more field studies, epidemiology studies, and surveillance studies.[53] Funding was provided for initiating new Institute projects in five areas, including safety hazards. As mentioned previously, the earliest TI research priorities in NIOSH were based not upon injury and fatality data (which was inadequate), but upon the opinions of safety professionals obtained via surveys. Managers of the TI Program in the new division, however, decided to focus their attention and the resources they were allocated upon the "types of accidents that contribute most to workers' compensation costs."[53] This "data-driven" approach prefigured the current TI approach, which relies heavily upon injury and fatality data for identifying problems and setting priorities. The top seven TI Program priorities in 1979 included types of injuries ("falls from elevations," "caught-in injuries," "overexertion injuries," and "struck-by injuries") which were generally very costly due to their

severity and sometimes chronic effects. High priority was also given to both "injury epidemiology" and "technology transfer." [68]

Under the heading of "Injury Epidemiology" was the item "report on feasibility of using death certificate data for safety studies." [53] The idea of using death certificate data for national occupational fatality surveillance became a reality a few years later with the development of the National Traumatic Occupational Fatalities (NTOF) surveillance system.

At the same time the TI Program was changing its focus toward increased surveillance, epidemiology and field studies, some of the in-house, laboratory-based activities were winding down, in particular a portion of the PPE testing and certification program. Due to resource constraints, the TI Program decided to focus its PPE research upon respirators and related technologies alone, and drop the testing of other PPE gear such as industrial and fire fighter helmets; safety glasses, goggles and face shields; gloves; industrial footwear; etc.[54] Fiscal Year 1981 was the last year a project addressing these devices was part of the Institute plan, and that project was designated to "wrap up" activities in this area.[55]

In 1983, NIOSH leadership published a suggested list of "The Ten Leading Work-Related Diseases and Injuries" including "Fractures, amputations, eye losses, and traumatic deaths."[56] An internal working group was established to develop a strategy for the control of these traumatic injuries. The strategy was finalized at a 1985 conference of more than 50 expert panelists and 450 other occupational safety and health professionals co-sponsored by NIOSH and the Associated Schools of Public Health (ASPH). By the time the "Proposed National Strategy…" had been published, the topic area had been broadened to incorporate all "severe occupational traumatic injuries."[21] This publication was the first national-level strategy for addressing TI by means of research and prevention activity. The TI strategy outlined the use of epidemiology methods in "charting the course."[21]

In 1987, TI leadership began developing an internal implementation strategy for the "Proposed National Strategy" for severe occupational traumatic injury. An analysis of the proposed national TI strategy and realignment of existing and creation of new TI Program areas were conducted. The set of program areas identified for the TI Program included: agriculture/pesticides, certification, chemical protective clothing (CPC), construction, dissemination, industrial machine safety, musculoskeletal injuries, personal protective equipment, respirator research, surveillance, and trauma epidemiology.[57]

This list is noteworthy because it identifies major high-risk sectors (agriculture and construction) as a focus for programmatic thinking, for the inclusion of high-risk topics such as machine safety and acute musculoskeletal injury, and a growing awareness that surveillance, trauma epidemiology, and dissemination of risk and prevention information represented major gaps in the existing TI Program. Four of the program areas (certification, respirator research, chemical protective clothing, and personal protective equipment) would be removed from the TI Program in 1996, and eventually form the functional basis for the NIOSH Personal Protective Technology program now housed in the National Personal Protection Technology Laboratory (NPPTL) in Pittsburgh.

Over the course of the next decade, in order to fill crucial shortcomings in its capacity to apply an effective public health approach to TI research, TI management would:

- Design and develop new surveillance systems to address the dearth of useful data on injuries and fatalities
- Develop a fatality investigation program and methodology to address the lack of detailed information on injury causation and prevention
- Create new organizational structures and expertise to strengthen its capacity to conduct analytic epidemiology studies and evaluation research, to study and develop protective technology applications, and to transfer TI risk and prevention knowledge and products
- Develop new approaches to collaboration and communication with the occupational traumatic injury research community.

Surveillance. As the NIOSH TI efforts were ramping up in the late 1970s and early 1980s, no system existed that enabled an actual count of fatal workplace injuries. Estimates of the number of occupational injury fatalities, published by organizations such as the National Safety Council (NSC) and the Federal Bureau of Labor Statistics varied widely. For example, the NSC estimated that there were 13,000 occupational injury deaths in 1980, whereas the BLS estimated that there were only 4,400 that same year. NIOSH concluded that: "While the difference between these two estimates is due partly to different survey populations and differences in estimation procedures, more information is needed to properly assess the true extent of occupational fatalities."[58] In Fiscal Year 1984, the National Traumatic Occupational Fatalities (NTOF) surveillance system was initiated by TI to collect "injury-at-work" death certificates, retrospective to 1980, from the State vital registrars in all 50 States, New York City, and the District of Columbia. The objective was to establish the first accurate national count of work-related deaths.

In a 1987 MMWR article, the Centers for Disease Control reported that about 7,000 workers die on the job annually, and that 42 percent of female workers who die on the job are murdered.[59] These data came from the first five years' data from the NTOF Surveillance System. This first ever count of work-related deaths from traumatic injury, and the new knowledge about the workplace violence as the leading cause of death for female workers, are considered by CDC as significant accomplishments in its 60-year history by virtue of their inclusion on the "CDC Timeline" Website.[60] In September 1989, TI published "National Traumatic Occupational Fatalities: 1980-1985."[61] This report provided data that influenced planning and priority-setting in the TI Program and nationally. For example, the NTOF data showed that fully 13 percent of the worker deaths identified for the six-year period were homicides. NTOF data was instrumental in identifying the importance of homicide as a leading cause of traumatic injury death in the U.S.

When a decades' worth of NTOF data was reported in 1993, homicide was the third leading cause of death (12 percent of total) behind motor-vehicle crashes (23 percent) and machine-related deaths (14 percent).[62]

NTOF also enabled researchers to calculate frequency and rates of TI deaths by State. Not surprisingly, the largest number of occupational TI deaths was seen in large, highly populated States such as Texas and California. However, Alaska (34.2 deaths per 100,000 workers) exhibited the highest rates of TI deaths by far.[63] This finding led to a Congressional initiative to establish the Alaska Field Station in Anchorage, Alaska in 1991 to study high-risk Alaskan industries such as commercial fishing, logging, and aviation.

In the 1990s, the BLS initiated data collection for a new surveillance system for fatal occupational injuries—the Census of Fatal Occupational Injuries (CFOI)—which eventually superseded the NTOF system.[40] CFOI, which includes data from 1992 onward, uses multiple State and Federal sources of case reports, and cross-references source documents to ensure that cases are counted as accurately as possible without duplication. NTOF, which remains the only source of fatal occupational injury data for years prior to 1992, was discontinued by TI management in 2003 after working with BLS to ensure that CFOI could adequately bridge the resultant gap.

Causation Research. Although injury and fatality surveillance systems are useful in identifying cases and provide some basic information that may suggest causation, TI Program management recognized that more detailed information is needed about the circumstances surrounding an event that results in traumatic injury death to a worker. Acquiring information about the factors associated with the victim, the task, the machines/equipment, the work environment, the company, as well as the sequence of events leading to a fatal event can lead investigators to better understand causation and recommend prevention options. The TI Fatality Assessment and Control Evaluation (FACE) Program was begun as a pilot project to fill the gap in knowledge about the causation of traumatic occupational fatalities.[54]

Initial investigations targeted confined space fatalities, electrocutions, and falls from elevation. For each area, a point in time was reached when TI recognized that investigations were not yielding new risk or prevention knowledge. At these times, TI summarized the investigative findings for each area in compendium reports[64-66] and new targets were established. Subsequent targets suggested by NTOF findings included logging, agriculture, and machines. The FACE Program has proven flexible in shifting to new targets in response to emerging issues and this flexibility has increased the responsiveness and relevance of the TI Program. For example, when analysis of surveillance data demonstrated high fatality rates among Hispanic workers, the TI Program added this high-risk population as a FACE target. The 1998 National Research Council report, "Protecting Youth at Work,"[63] as well as input from the Wage and Hour Division of the U.S. Department of Labor, prompted TI Program managers to begin investigating young worker deaths. Stakeholder encouragement to improve highway work zone safety prompted this focus as a current target.

In addition to providing more detailed, circumstantial information about fatal occupational injuries, the FACE Program has enabled researchers to detect and address clusters of similar cases in well-known hazard areas, such as falls and electrocutions in tree trimming, asphyxiation deaths in manure pits on farms, electrocutions from boomed vehicle contact with overhead power lines, and worker deaths from excavation cave-ins. FACE has also served to detect and address emerging problems. Some examples include falls through skylights in building construction and maintenance, falls from telecommunications towers, and caught-in/crushing deaths to operators of skid-steer loaders.

The FACE model is also the basis for cooperative agreements between TI and selected States (currently nine) that enable State investigators to conduct FACE investigations in their States. Additionally, the FACE model has been used as the basis for the Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) that Congress directed NIOSH TI to undertake in 1998.

The FACE Program has been a cornerstone of the TI Program, producing a steady stream of publications providing risk and prevention information. As of November 1, 2006, there were nearly 2,500 fatality investigation reports available on the TI FACE Website (http://www.cdc.gov/niosh/face/).[67] Of total investigation reports, 598 were produced by the internal TI-FACE Program, 1,557 reports were produced by the State FACE Program, and 333 were

produced by the FFFIPP. The FACE and FFFIPP programs have also produced NIOSH Alerts, Workplace Solutions, and other publications that recommend prevention strategies based on findings from multiple investigations.

Analytic and Evaluation Research. In the early 1990s, the TI Program developed a strategic plan that called for the expansion of analytical epidemiology research aimed at identifying the causes of injury.[68] In a realignment of the TI Program, the Analysis and Field Evaluation Branch was created in DSR with a mission defined as "determining causes and risk factors for work-related trauma, and evaluating the efficacy of interventions through epidemiologic field studies."[69] This branch has been the focus of epidemiologic investigations of risk and causal factors associated with homicides in retail establishments. Intervention evaluation studies have included determining the efficacy of back belts and of safe patient lifting programs in nursing homes.

Protective Technology Research. As the program evolved, TI Program managers realized that the public health approach to occupational injury research and prevention would require increasing collaboration between public health researchers and practitioners (epidemiologists, biostatisticians, health information specialists, etc.) and safety analysis researchers and practitioners (engineers, ergonomists, industrial hygienists, safety specialists, etc.). Although the new knowledge generated by surveillance, investigations, and analytic epidemiology was valuable, a critical gap remained in the quest for workplace impact—researchers in the safety analysis disciplines were needed to identify or develop, analyze, and evaluate protective interventions. The TI multidisciplinary approach also involved a focus upon the "hierarchy of controls"—giving higher priority to "engineering out" the hazards through design modification or intervention controls than to approaches that require behavior changes by the workers or reliance upon personal protective equipment.

In 1993, when NIOSH was planning for a new laboratory facility in Morgantown, TI developed a protective technology research plan, which largely focused upon the programs it still managed in respiratory testing, certification, and research; and chemical protective clothing (CPC).[70] In addition to those programs, which were relocated a few years later, the plan proposed addressing traditional traumatic injury hazards with high technology approaches to research and prevention. The plan included concepts such as using virtual reality to study falls from elevation and using 3D scanning technology to collect anthropometric data on worker populations. Many of the current TI laboratories and protective technology research activities have evolved from that plan and the laboratories that were subsequently designed and built within the new and renovated facilities.

Dissemination and Transfer. In the mid-1980s, TI began to take a broader, more proactive, and targeted approach to disseminating program outputs. Strategic dissemination stressed identification and communication with potential constituencies and audiences early in the planning process. TI recognized that publishing research results in peer-reviewed journals should not be the sole output of a project. New knowledge about workplace risk and prevention must be disseminated broadly in products that are useful and meaningful to those who can take preventive actions. Aside from publishing findings in peer-reviewed journals, typical NIOSH dissemination at the time consisted of mailing copies of each new NIOSH publication to a standard list of "Friends of NIOSH," approximately 1,000 individuals and organizations.

The strategic approach to dissemination placed emphasis on identifying target worker and employer audiences and the organizations that represented them, developing custom mailing lists for each publication, and sending customized cover letters that outlined what individuals and specific organizations could do to address and implement prevention recommendations. Certain

comprehensive mailing lists were obtained and used multiple times, such as a list of agricultural extension agents and of professional and volunteer fire departments. The current NIOSH Research-to-Practice initiative[39] originated in a TI proposal to develop even more systematic ways to transfer prevention information and influence its adoption in the workplace.

TI Strategic Planning and Program Direction from 1996 through 2007: Ensuring Relevance and Impact

The TI Program conducts applied public health research to make workplaces safer by identifying, developing, and evaluating strategies for preventing traumatic occupational injuries. As the only Federal program charged with the responsibility of conducting research to prevent occupational injuries, the NIOSH TI Program extends to every industry sector and every working man and woman in the nation. The breadth and complexity of this responsibility, coupled with the resources allocated to it, require a systematic and strategic approach to planning, prioritizing, conducting, and transferring research in order to maximize its relevance and impact. The TI Program Operational Logic Model (Figure 5) depicts the TI Program's systematic approach.

This logic model is based upon the NIOSH Operational Logic Model. The program **inputs** include production inputs (e.g., funding, staffing, physical infrastructure, management structure, and planning and evaluation processes), and planning inputs (e.g., injury and fatality data, the public health framework, strategic plans, legislative mandates, and stakeholder input).

Program efforts run the gamut of public health **activities**—from surveillance to causal research, from prevention strategy development to intervention evaluation, and from dissemination to technology transfer.

Outputs include a range of products such as:

- Peer-reviewed and trade journal articles
- A variety of NIOSH publications
- Presentations and exhibits at conferences and workshops
- Press releases
- New designs for products, practices, and technologies
- Recommendations for improved standards.

TI Program data, findings, recommendations, and direct staff participation have contributed to **end outcomes**, including reductions in specific types of traumatic occupational injuries and fatalities.

Data, findings, recommendations and direct staff participation have also contributed to **intermediate outcomes**, including:

- Promulgation of new standards and guidance issued by various standards-setting agencies
- Direct compliance or inspection activities by agencies with specific jurisdictional authority
- Development of new or modified products featuring improved safety-enhanced design
- Acquisition and use of new equipment and products
- Adoption of safe work procedures
- Increased awareness of TI risks and prevention options

- Increased research and subsequent research publication by other researchers and research organizations

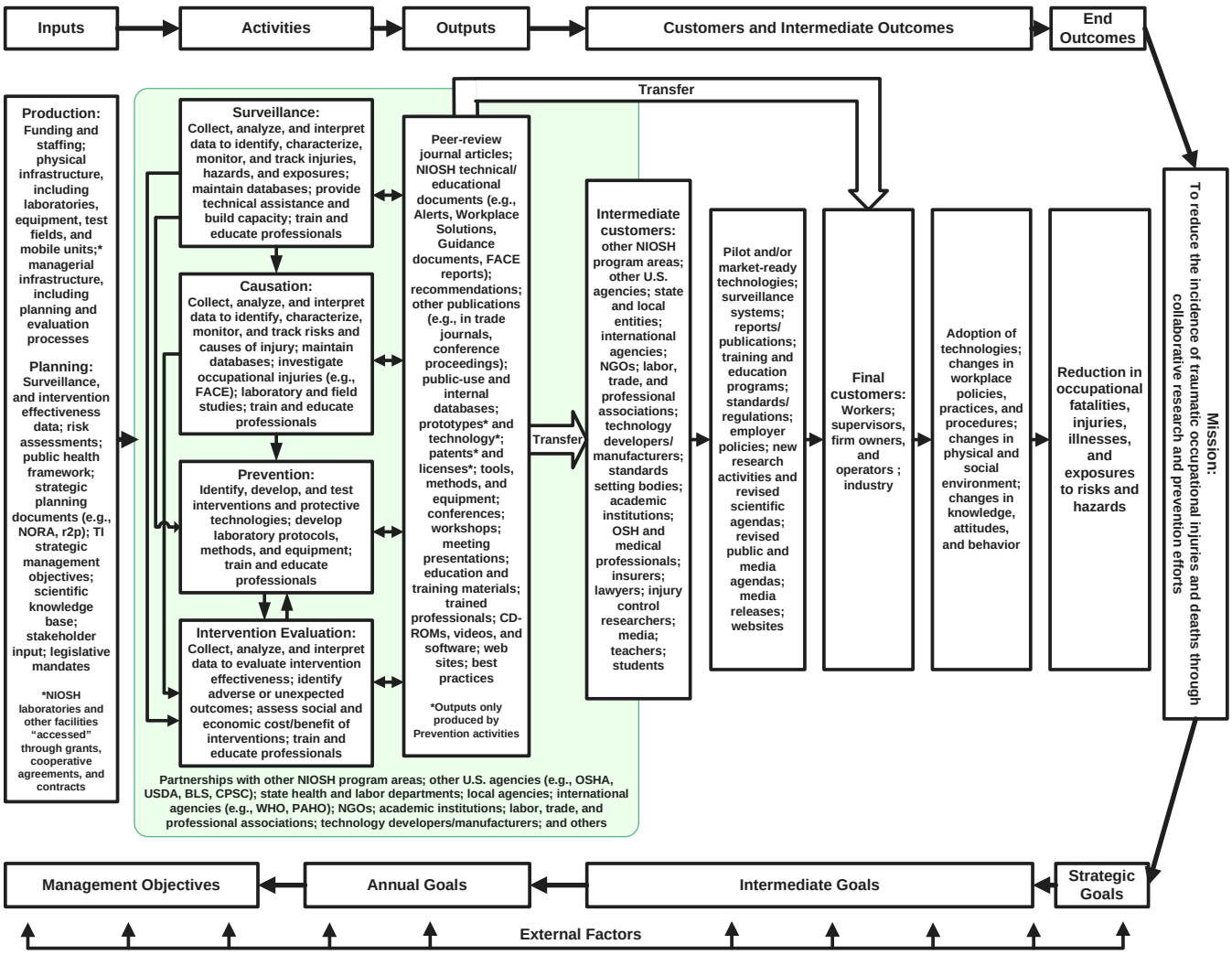

Figure 5. The TI Program Logic Model

Production inputs

Funding. Figure 6 shows the intramural and extramural funding for the TI Program. Over the course of the evaluation period (1997 to 2005), funding allocated to the eight goals increased from $8.7 million in Fiscal Year 1997 to $17.4 million in FY 2005, peaking at $18.8 million in 2002. Table 3 presents the TI budget for each of the eight research goals for each year from 1997 through 2005. The table also shows the relationship between intramural and extramural spending for TI research and the intramural Full-Time Equivalent (FTE) staff allocations.

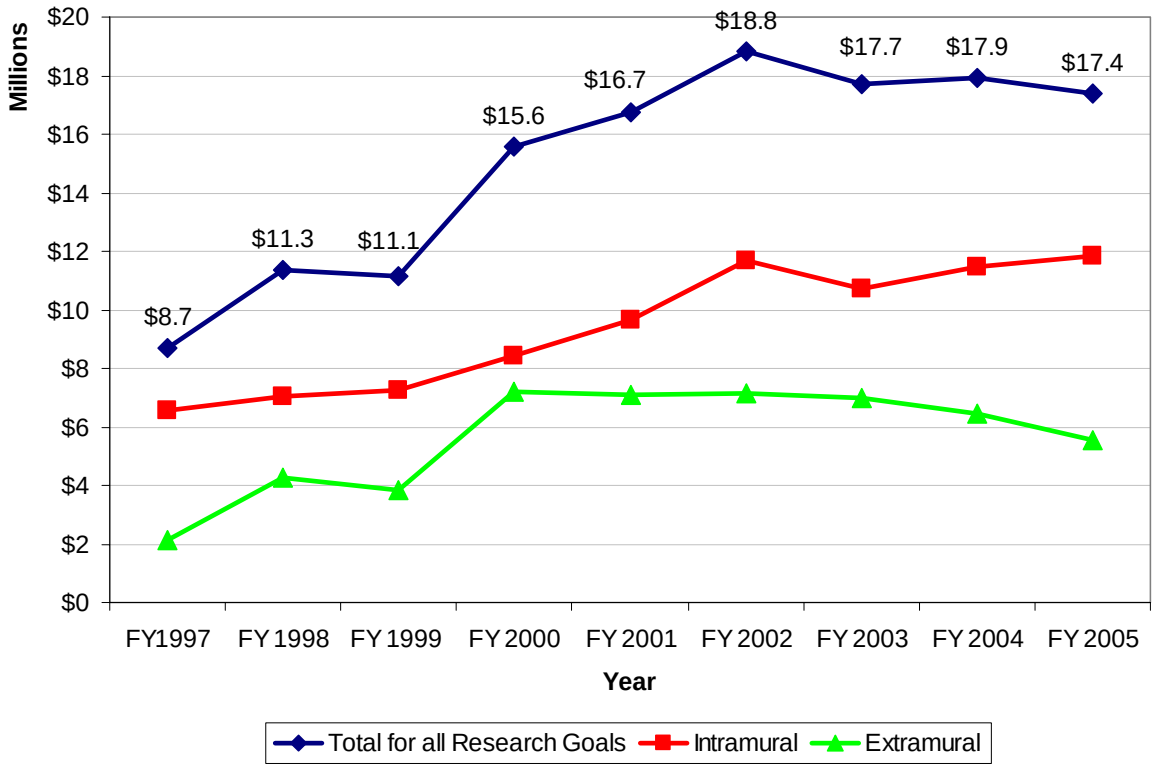

Figure 6. Total, Intramural, and Extramural Funds for the 8 TI Research Goals, 1997-2005

Staffing. The core group of research scientists, engineers, and technical support staff for the TI Program resides within the Division of Safety Research. This research cadre represents a balance between the public health and the safety science fields (see Figure 7). Seventy-five current FTE research and research support positions are filled by individuals in a variety of disciplines, including epidemiology (17), safety engineering (12), safety management (11), statistics (10), general engineering (7), and health science (4). Other current staff disciplines include industrial hygiene, economics, kinesiology, and physiology. Technical support is provided by four information technology (IT) specialists, two physical science technicians, an engineering technician, a project specialist, and a technical writer-editor. Nine staff members provide administrative support. TI research staff CVs are included in Appendix 3.

Physical infrastructure. TI Program research facilities include laboratories and associated equipment that provide unique tools for injury prevention research. Specialized facilities include

Table 3. NIOSH Traumatic Injury Research Program Budget by Research Goals, 1997-2005

Goal	FY1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	Total
1. Reduce injuries and fatalities due to motor-vehicles										
FTEs	5.44	4.27	7.99	4.93	7.90	9.95	10.80	14.18	14.79	80.25
Intramural $	$318,528	$364,968	$497,628	$669,190	$855,111	$1,318,354	$1,229,997	$1,606,772	$1,907,736	$8,768,284
Extramural $	$253,962	$244,912	$229,942	$69,679	$927,921	$984,331	$877,727	$299,919	$1,250	$3,889,643
Total	$572,490	$609,880	$727,570	$738,869	$1,783,032	$2,302,685	$2,107,724	$1,906,691	$1,908,986	$12,657,927
2. Reduce injuries and fatalities due to falls from elevations										
FTEs	8.31	8.03	13.42	15.43	13.56	9.39	14.03	10.79	15.25	108.21
Intramural $	$1,276,334	$922,468	$907,054	$1,459,034	$1,315,445	$1,237,968	$1,568,049	$1,693,086	$1,769,344	$12,148,782
Extramural $	$253,962	$463,061	$229,942	$225,879	$289,011	$278,004	$285,319	$275,532	$250	$2,300,960
Total	$1,530,296	$1,385,529	$1,136,996	$1,684,913	$1,604,456	$1,515,972	$1,853,368	$1,968,618	$1,769,594	$14,449,742
3. Reduce injuries and fatalities due to workplace violence										
FTEs	8.02	4.51	7.28	6.98	6.66	7.75	7.56	9.48	8.61	66.85
Intramural $	$602,689	$482,026	$509,517	$653,934	$839,148	$1,490,096	$1,063,828	$1,273,771	$1,102,187	$8,017,196
Extramural $	$253,962	$511,907	$229,942	$225,879	$289,011	$281,754	$333,389	$275,532	$250	$2,401,626
Total	$856,651	$993,933	$739,459	$879,813	$1,128,159	$1,771,850	$1,397,217	$1,549,303	$1,102,437	$10,418,822
4. Reduce injuries and fatalities due to machines										
FTEs	11.21	9.63	12.77	14.43	12.81	14.78	10.48	13.13	12.09	111.33
Intramural $	$993,113	$1,044,805	$941,902	$1,283,376	$1,160,389	$1,593,009	$1,169,991	$1,514,190	$1,479,104	$11,179,879
Extramural $	$253,962	$235,037	$365,826	$365,942	$289,011	$278,004	$933,245	$890,920	$1,033,342	$4,645,289
Total	$1,247,075	$1,279,842	$1,307,728	$1,649,318	$1,449,400	$1,871,013	$2,103,236	$2,405,110	$2,512,446	$15,825,168
5. Reduce acute back injury										
FTEs	13.54	15.74	14.72	6.00	5.16	4.46	5.05	4.83	3.60	73.10
Intramural $	$1,196,364	$1,356,204	$1,150,931	$597,615	$615,257	$625,395	$647,926	$618,559	$521,036	$7,329,287
Extramural $	$620,369	$654,095	$628,253	$392,677	$194,526	$99,990	$107,222	$0	$231,250	$2,928,382
Total	$1,816,733	$2,010,299	$1,779,184	$990,292	$809,783	$725,385	$755,148	$618,559	$752,286	$10,257,669

Table 3. NIOSH Traumatic Injury Research Program Budget by Research Goals, 1997-2005 (continued)

Goal	FY1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	Total
6. Reduce injuries and fatalities among workers in Alaska										
FTE's	10.58	9.74	6.56	6.58	12.04	12.80	11.09	11.49	11.81	92.69
Intramural $	$1,023,592	$1,109,425	$405,931	$757,099	$1,493,700	$1,546,891	$1,494,324	$1,400,061	$1,701,203	$10,932,226
Extramural $	$253,962	$228,024	$229,942	$575,870	$729,000	$568,419	$296,425	$275,532	$0	$3,157,174
Total	$1,277,554	$1,337,449	$635,873	$1,332,969	$2,222,700	$2,115,310	$1,790,749	$1,675,593	$1,701,203	$14,089,400
7. Reduce injuries and fatalities to emergency responders										
FTEs	2.60	2.45	15.03	13.77	12.32	12.49	18.49	15.02	13.84	106.01
Intramural $	$154,230	$187,711	$1,074,781	$1,284,491	$1,521,576	$2,305,996	$1,932,990	$1,780,148	$1,848,856	$12,090,779
Extramural $	$12,450	$390,299	$480,565	$494,238	$300,972	$376,491	$101,250	$726,364	$806,938	$3,689,567
Total	$166,680	$578,010	$1,555,346	$1,778,729	$1,822,548	$2,682,487	$2,034,240	$2,506,512	$2,655,794	$15,780,346
8. Reduce injuries and fatalities to working youth										
FTEs	11.92	9.71	13.28	12.63	12.71	8.16	8.14	8.29	7.72	92.56
Intramural $	$978,455	$1,586,394	$1,778,041	$1,697,255	$1,839,280	$1,561,840	$1,607,812	$1,597,210	$1,507,439	$14,153,726
Extramural $	$253,962	$1,559,694	$1,470,082	$3,896,916	$4,297,638	$3,192,059	$2,832,167	$2,373,118	$1,984,038	$21,859,674
Total	$1,232,417	$3,146,088	$3,248,123	$5,594,171	$6,136,918	$4,753,899	$4,439,979	$3,970,328	$3,491,477	$36,013,400
Total FTEs for All Research Goals	71.62	64.08	91.05	80.75	83.16	79.78	85.64	87.21	87.71	731.00
Total Intramural $	$6,543,305	$7,054,001	$7,265,785	$8,401,994	$9,639,906	$11,679,549	$10,714,917	$11,483,797	$11,836,905	$84,620,159
Total Extramural $	$2,156,591	$4,287,029	$4,678,518	$7,250,406	$8,025,685	$8,002,147	$7,666,934	$7,271,602	$5,369,171	$54,708,083
Total $ for all Research Goals	$8,699,896	$11,341,030	$11,944,303	$15,652,400	$17,665,591	$19,681,696	$18,381,851	$18,755,399	$17,206,076	$139,328,242

Note: FTE's are totaled for all projects within each Research Goal. The Intramural $ row includes intramural contract funds, interagency agreements, and CRADA's. The Extramural $ row includes all grants and extramural contracts.

an anthropometry scanning lab, a virtual reality simulations lab, and a high bay lab (for research requiring a 37-foot ceiling, overhead crane, and overhead catwalk). Other laboratories feature research oriented toward human factors, protective systems, and safety engineering. Special mobile research units have been designed to support studies of emergency medical service (EMS) workers' safety in ambulance patient compartments and safety in highway construction work zones. Descriptions of TI research laboratory facilities and associated equipment, with examples of related research efforts, are included in Appendix 5.

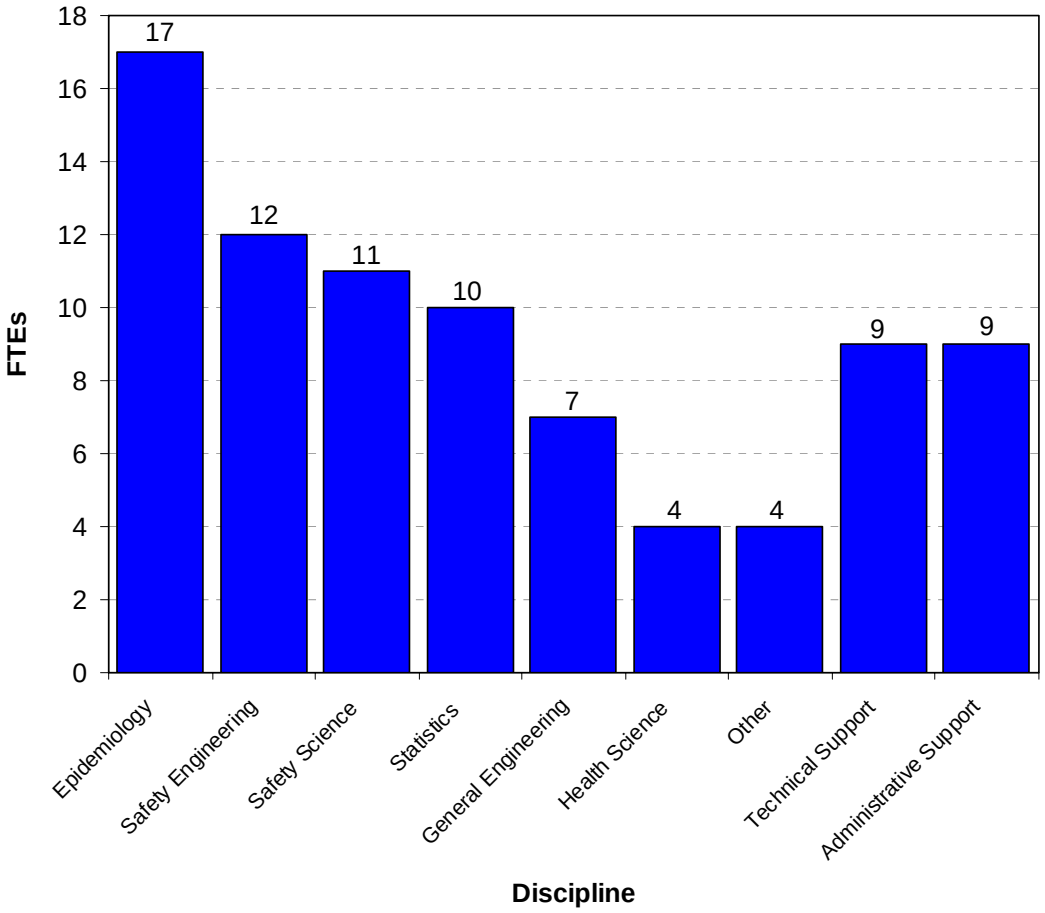

Figure 7. TI Research and Support Staff by Discipline

Planning Inputs

Strategies to ensure relevance of the TI Program include the program planning process, external input and partnerships, and transfer activities.

The primary planning drivers of the TI Research Program are:

- The occupational injury and fatality data indicating the leading causes of occupational injuries and deaths and highest-risk industries and worker populations

- The public health model as research framework, to ensure a multidisciplinary approach and commitment to follow-through from data-driven conceptualization to workplace implementation

- The recommendations described in the NORA Traumatic Injury Team document, "Traumatic Occupational Injury Research Needs and Priorities"[71] (http://www.cdc.gov/niosh/traumado.html)

- The NIOSH priorities of Research-to-Practice (r2p) and impact of results, which must be a critical component of every research project.

Injury and fatality data. Data on the frequency, severity, and rates of traumatic occupational injuries and deaths comprise a principal driver of TI Program priority-setting, decision making, tracking, and evaluation. Prior to 1985 and the development of the NTOF, TI relied primarily on the Bureau of Labor Statistics' Annual Survey of Occupational Injuries and Illnesses and Supplemental Data System[72] and the Consumer Product Safety Commission's National Electronic Injury Surveillance System (NEISS)[73] for data on nonfatal traumatic occupational injuries. As previously stated, prior to 1985 there were no national data that provided accurate counts of traumatic injury deaths, although a number of organizations (e.g., BLS, National Safety Council, and NIOSH) provided estimates. Since the development of the TI NTOF system, and subsequently the BLS Census of Fatal Occupational Injuries (CFOI), frequency, rate, and causal information have helped to guide TI Program activities. Both the numbers of deaths (magnitude) and the fatality rates (risk) are important considerations in prioritizing problems to address.

A brief presentation of recent BLS CFOI[40] and Annual Survey[41] data will show the statistical basis of the current TI Program direction. Figure 8 shows the ranking of major industry sectors by numbers and rates of traumatic injury deaths for 2005.

The construction sector experienced 1,186 fatalities in 2005, followed by transportation and warehousing (881), and agriculture, forestry, fishing and hunting (714). The highest rates of TI deaths (deaths per 100,000 workers) in 2005 occurred in agriculture, forestry, fishing and hunting (32.5) and mining (25.6). Transportation and warehousing, and construction followed, with rates of 17.6 and 11.0, respectively. Comparing these rates to the overall rate across all sectors (4.0), the high-risk nature of these sectors is evident. In Figure 8, the major industry sector services are broken out by sub-sectors (e.g., professional and business services, educational and health services, other services, etc.). In the 2004 data from BLS that follow, note that the services sector is presented in aggregate.

Table 4 shows that the highest number of fatal traumatic occupational injuries in 2004 resulted from transportation incidents (2,480) which accounted for 43.5 percent of the total. Contact with objects and equipment (1,004, 17.6 percent), falls (815, 14.3 percent), and assaults and violent acts (795, 13.9 percent) caused most of the remaining fatalities.

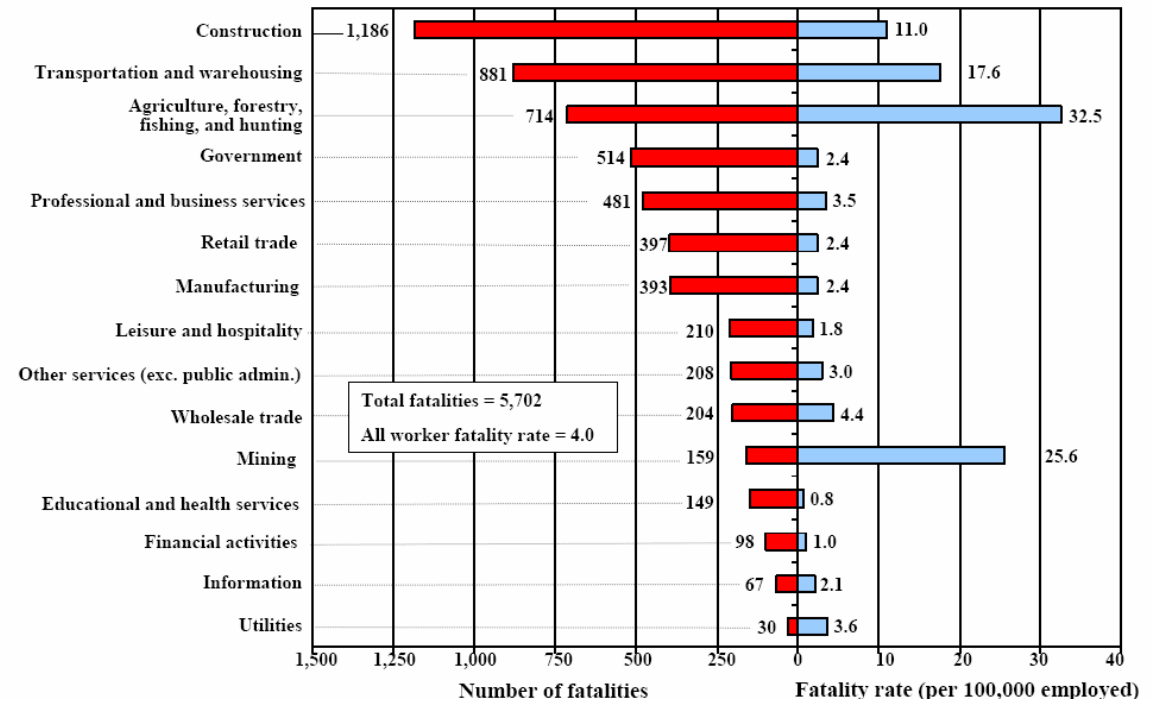

Figure 8. Numbers and Rates of Fatal Work Injuries by Industry Sector, United States, 2005
Source: US Department of Labor, Bureau of Labor Statistics, Census of Fatal Occupational Injuries, Preliminary Data for 2005

Table 4. Number of Fatal Occupational Injuries by Type of Event/Exposure, 2004

Type of Event/Exposure	Number of Fatal Injuries
Transportation Incidents	2460
Contact with Objects & Equipment	1004
Falls	815
Assaults & Violent Acts	795
Exposure to Harmful Substances or Environment	459
Fires & Explosions	159
Total	**5692**

Source: US Department of Labor, Bureau of Labor Statistics, Census of Fatal Occupational Injuries, 2004 data http://www.bls.gov/iif/oshcfoi1.htm. Notes: Fatalities associated with events or exposures of bodily reaction and exertion (8) and other events or exposures (3) were excluded from the event categories. Government workers are distributed across the sectors according to the industry of the agency.

The services sector also had the highest overall frequency of nonfatal injuries (nearly 1 million injuries), as well as the highest number of cases requiring the injured worker to miss work (more

than a quarter million–See Table 5). Manufacturing and wholesale and retail trade also had high numbers of nonfatal injuries, followed by construction and transportation, warehousing and utilities. Tables 6 and 7 summarize the 2004 data for fatal injuries; Tables 8 and 9 summarize the 2004 data for nonfatal injuries.

Table 5. Number of Nonfatal Injuries and illnesses by Industry Sector, 2004

NORA Industry Sector	Total Reportable Injuries/Illnesses	Total Cases with Days Away from Work
Services	971,800	283,380
Manufacturing	941,900	226,090
Wholesale and Retail Trade	867,600	259,900
Healthcare and Social Assistance	684,000	179,910
Construction	401,000	153,200
Transportation, Warehousing and Utilities	314,600	127,750
Agriculture, Forestry, and Fishing	54,700	19,750
Mining	21,600	9,350
Totals	**4,257,200**	**1,259,330**

Source: US Department of Labor, Bureau of Labor Statistics, Industry Illness and Injury Data, 2004 data (http://www.bls.gov/iif/oshsum.htm) Note: Cases with days away from work with an event of Other Events or Exposures were excluded (150). NORA Services sector estimate for nonfatal injuries and illnesses excludes public administration workers. All sector estimates exclude self-employed, household workers, workers on farms with <11 employees, and volunteers. Values may not match BLS News Release values.

The public health framework. Using a public health approach as a framework allows TI to structure research activities systematically and sequentially from data-driven priorities to identifying risk factors, developing prevention strategies, evaluating promising interventions, and facilitating the transfer and adoption of our science into the workplace. This allows the TI Program to identify, prioritize, and determine the appropriate research stage and activities needed to address new issues as they emerge. For instance, when the issue of child agricultural injuries emerged, it was clear that data on such injuries were insufficient to accurately characterize the child agricultural injury problem and determine and direct appropriate additional research activity. Therefore, surveillance capability had to be developed. If surveillance is adequate, but knowledge of causal and risk factors is lacking (as in problem areas such as violence and highway work zones), then causation research studies must be designed and conducted. If prevention options are known, but products or technologies are not available, then protective technology research and development efforts are needed (e.g., for tractor safety and fall protection). If effective prevention is known (safe lifting programs to prevent back injury), then interventions and programs, and business cases demonstrating their feasibility and cost effectiveness must be communicated. The process is an iterative one requiring continuous monitoring to ensure that strategies implemented actually reduce or eliminate the exposure or outcome as the intervention progresses and do not create unacceptable new risks. Components of the public health model have been incorporated into the "activities" component of the TI Research Program Logic Model (See Figure 5).

Table 6. Number of Fatal Occupational Injuries by Industry Sector and Event or Exposure, United States, 2004

NORA Sectors	Total	Transportation Incidents	Contact with Objects & Equipment	Falls	Assaults & Violent Acts	Exposure to Harmful Substances or Environment	Fires & Explosions
Agriculture, Forestry, and Fishing (11)	663	333	204	30	47	34	14
Mining (21)	152	61	56	13	*****	9	12
Construction (23)	1268	317	270	444	32	171	34
Manufacturing (31-33)	459	139	164	47	42	36	28
Wholesale and Retail Trade (42, 44-45)	576	223	57	50	203	22	20
Transportation, Warehousing, and Utilities (48-49, 22)	931	665	92	49	66	44	14
Services (51-56, 61, 71-72, 81, 92)	1518	650	157	170	374	127	34
Healthcare and Social Assistance (62)	131	70	3	10	30	16	*****
Total	5703	2460	1004	815	795	459	159

Source: BLS Census of Fatal Occupational Injuries (www.bls.gov/iif) Notes: Industry was unknown for 5 fatalities. Fatalities associated with events or exposures of bodily reaction and exertion (8) and other events or exposures (3) were excluded from the event categories. Government workers are distributed across the sectors according to the industry of the agency. Events are listed in rank order from left to right. Values may not match BLS News Release values.

Table 7. Rate of Fatal Occupational Injuries by Industry Sector and Event or Exposure, United States, 2004

NORA Sectors	Total	Transportation Incidents	Contact with Objects & Equipment	Falls	Assaults & Violent Acts	Exposure to Harmful Substances or Environment	Fires & Explosions
Agriculture, Forestry, and Fishing (11)	28.0	14.1	8.6	1.3	2.0	1.4	0.6
Mining (21)	23.4	9.4	8.6	2.0	*****	1.4	1.8
Construction (23)	11.8	2.9	2.5	4.1	0.3	1.6	0.3
Manufacturing (31-33)	2.6	0.8	0.9	0.3	0.2	0.2	0.2
Wholesale and Retail Trade (42, 44-45)	2.9	1.1	0.3	0.3	1.0	0.1	0.1
Transportation, Warehousing, and Utilities (48-49, 22)	12.8	9.2	1.3	0.7	0.9	0.6	0.2
Services (51-56, 61, 71-72, 81, 92)	2.5	1.1	0.3	0.3	0.6	0.2	0.1
Healthcare and Social Assistance (62)	0.9	0.5	0.0	0.1	0.2	0.1	*****
Total	4.3	1.8	0.8	0.6	0.6	0.3	0.1

Source: BLS Census of Fatal Occupational Injuries (www.bls.gov/iif) Notes: Rates are fatalities per 100,000 full-time equivalent workers. Population estimates are based on the Current Population Survey hours for the primary job worked (2000 hrs = 1 FTE) for workers 15 years of age and older. Fatalities and population estimates were not corrected for 12 fatalities to youth less than 16 years of age. Government workers are distributed across the sectors according to the industry of the agency. Events are listed in rank order from left to right. Values may not match BLS News Release values.

Table 8. Number of Nonfatal Occupational Injuries and Illnesses by NORA Industry Sector and Event or Exposure in Private Industry, United States, 2004

NORA Sectors	Total Reportable Cases	Cases with Days Away from Work								
		Total Cases with Days Away from Work	Contact with Objects & Equipment	Falls	Bodily Reaction & Exertion	Exposure to Harmful Substances or Environment	Transportation Incidents	Fires & Explosions	Assaults & Violent Acts	Nonclassifiable
Agriculture, Forestry, and Fishing (11)	54,700	19,750	7,080	4,410	5,190	650	890	60	960	500
Mining (21)	21,600	9,350	3,700	2,010	2,920	300	250	40	*****	130
Construction (23)	401,000	153,200	51,830	35,480	52,330	5,220	5,670	470	500	1,680
Manufacturing (31-33)	941,900	226,090	**80,620**	31,230	95,260	10,590	4,980	**750**	620	2,020
Wholesale and Retail Trade (42, 44-45)	867,600	259,900	72,940	49,840	**112,050**	7,480	12,220	370	2,360	**2,620**
Transportation, Warehousing, and Utilities (48-49, 22)	314,600	127,750	27,900	22,400	55,360	2,890	15,660	190	950	2,370
Services (51-56, 61, 71-72, 81)	**971,800**	**283,380**	67,870	**72,650**	97,580	**17,290**	**17,810**	480	7,170	2,460
Healthcare and Social Assistance (62)	684,000	179,910	23,220	37,590	91,070	8,400	5,380	50	**12,320**	1,880
Total	4,257,300	1,259,320	335,160	255,600	511,750	52,830	62,860	2,420	24,880	13,660

Source: BLS Survey of Occupational Injuries and Illnesses (www.bls.gov/iif) Notes: Cases with days away from work with an event of Other Events or Exposures were excluded (150). Rows and columns may not sum to totals because of rounding error. NORA Services sector estimate for nonfatal injuries and illnesses excludes public administration workers. All sector estimates exclude self-employed, household workers, workers on farms with <11 employees, and volunteers. Values may not match BLS News Release values.

Table 9. Rate of Nonfatal Occupational Injuries and Illnesses by NORA Industry Sector and Event or Exposure in Private Industry, United States, 2004

NORA Sectors	Total Reportable Cases (cases per 100 FTE)	Cases with Days Away from Work (cases per 10,000 FTE)								
		Total Cases with Days Away from Work	Contact with Objects & Equipment	Falls	Bodily Reaction & Exertion	Exposure to Harmful Substances or Environment	Transportation Incidents	Fires & Explosions	Assaults & Violent Acts	Nonclassifiable
Agriculture, Forestry, and Fishing (11)	6.4	230.4	82.6	51.4	60.5	7.6	10.4	**0.7**	**11.2**	**5.8**
Mining (21)	3.8	163.2	64.6	35.1	51.0	5.2	4.4	**0.7**	*****	2.3
Construction (23)	6.4	243.7	**82.4**	**56.4**	83.2	**8.3**	9.0	**0.7**	0.8	2.7
Manufacturing (31-33)	6.6	158.6	56.6	21.9	66.8	7.4	3.5	0.5	0.4	1.4
Wholesale and Retail Trade (42, 44-45)	5.0	151.1	42.4	29.0	65.2	4.3	7.1	0.2	1.4	1.5
Transportation, Warehousing, and Utilities (48-49, 22)	**7.0**	**285.4**	62.3	50.0	**123.7**	6.5	**35.0**	0.4	2.1	5.3
Services (51-56, 61, 71-72, 81)	2.8	82.2	19.7	21.1	28.3	5.0	5.2	0.1	2.1	0.7
Healthcare and Social Assistance (62)	6.2	163.3	21.1	34.1	82.6	7.6	4.9	*****	**11.2**	1.7
Total	4.8	141.3	37.6	28.7	57.4	5.9	7.1	0.3	2.8	1.5

Source: BLS Survey of Occupational Injuries and Illnesses (www.bls.gov/iif) Notes: Cases with days away from work with an event of Other Events or Exposures were excluded (150). BLS does not report the FTE estimates used to calculate rates among private industries. To determine FTE for estimation of NORA industry sector rates the FTE estimates for individual industry sectors were back-calculated from the BLS number and rate data; then the FTE estimate used was the average of estimated values for Total DAFW, Contact with Objects, Falls, and Bodily Reaction categories. FTE in thousands were: Agriculture, Forestry, Fishing and Hunting 857; Mining 573; Construction 6,287; Manufacturing14,255; Wholesale and Retail Trade17,197; Transportation, Warehousing, and Utilities 4,476; Services 34,461; Healthcare and Social Assistance 11,019; and Total average FTE 89,119. All sector estimates exclude self-employed, household workers, workers on farms with <11 employees, volunteers, and government workers. Values may not match BLS News Release values.

The NORA Traumatic Injury (NORA-TI) Team Report. The National Occupational Research Agenda (NORA), unveiled by NIOSH in April 1996 on the occasion of the 25th Anniversary of the OSH Act of 1970, represented an "effort to guide and coordinate research nationally—not only for NIOSH, but for the entire occupational safety and health community."[71] NORA, which was developed collaboratively by NIOSH and approximately 500 of its partners, focused upon 21 priority areas, including traumatic occupational injuries. In order to develop strategies for these 21 priority areas, partnership teams were formed, composed of NIOSH specialists and individuals representing multiple sectors—i.e., industry, labor, academia, and other government agencies—and multiple disciplines. For the NORA TI Team, members came from varied backgrounds and disciplines associated with traumatic injury research and practice, including public health, safety sciences, engineering, and communication. A major accomplishment of the NORA TI Team was the publication of "Traumatic Occupational Injury Research Needs and Priorities: A Report by the NORA Traumatic Injury Team."[71]

The NORA-TI report describes a broad framework of the objectives and research needed to begin filling the gaps in knowledge and furthering progress toward safer workplaces and practices. In addition to wide peer-review, a draft of the document was presented at the NOIRS conference in Morgantown in October 1997 and at the Safe America Conference in Washington, D.C. in November 1997. Copies of the draft were made available for public review and comment at both of these national conferences. Revised per comments and input received, the document was published by NIOSH in 1998.

In the 1999 Institute of Medicine Report, "Reducing the Burden of Injury: Advancing Prevention and Treatment,"[74] the authoring committee recommended "…that NIOSH, working in collaboration with other Federal partners, implement the NORA research priorities for traumatic and other injury-related occupational injuries, and give higher priority to injury research." The committee went on to say that "Traumatic injury research priorities recently developed by the multidisciplinary NORA team assigned to this topic also warrant special consideration by Congress."[74]

This document not only serves as a driver of the NIOSH TI Program, but is also used by other organizations and academia to prioritize research in this area. For example, The University of Iowa School of Public Health requires that occupational injury epidemiology students, in selecting thesis and dissertation topics, be responsive to the priorities presented in this document.[75]

Research Project Planning and Resource Allocation

Traditionally, NIOSH research project planning has been conducted at the Division/Laboratory level based on an annual allocation ceiling determined by the NIOSH Office of the Director. With the advent of new Congressional funding for NORA, an additional project planning process was initiated at the Institute level to compete for NORA funds. NIOSH is in the process of transitioning the entire NIOSH research program into a sector-based, strategic goal-oriented planning process, as discussed previously. Currently there are two separate, complementary processes for research project planning and resource allocation: at the Division level and at the Institute level.

Because administration of mining TI research remains independent of non-mining TI research due to external factors, the following describes the planning process for non-mining TI research conducted in the Division of Safety Research. A few TI-related projects are also conducted by other NIOSH Divisions/Labs, and most employ a similar planning process.

At the research project level, planning is primarily a bottom-up approach with investigators proposing research projects within the context of the program drivers. Rather than allocating annual discretionary funding systematically by organizational unit (e.g., branch), the TI Program employs a process that aims to ensure that resources are focused on the greatest programmatic relevance and need, scientific quality, and expected impact of results. The vast majority of projects are designed to accomplish specific goals within finite time frames. The relatively few ongoing TI projects primarily address surveillance, field investigation programs, or Congressionally mandated projects. “Emerging issues” projects are also maintained to support pilot efforts or partnership opportunities that arise mid-planning cycle.

When projects end (due to completion or discontinuation), the funding returns to a pool for competition for new project concepts. Concepts are developed by staff, often by interdisciplinary, cross-branch teams, and presented to the entire staff. The DSR Leadership Team, with input from staff, rates and ranks the concepts based on the criteria of project need, soundness of approach/methods, and expected impact. The top-ranked concepts are then further developed for a second round of rating and ranking. The highest-ranked concepts are approved for implementation based on available funding. (The NORA proposal process and criteria were adapted from the TI Program process and criteria.) Research protocols are then developed for approved projects, reviewed by scientific peers, and modified based on this feedback. In addition, public meetings are held to seek stakeholder input and assess interest on most research project protocols. By including stakeholders, this review process also provides insight into the interest and potential impact of the research, and establishes and leverages relationships with partners who can provide guidance and assistance in ensuring marketability or adoption/use of results.

At the Institute level, there is an annual opportunity for NIOSH researchers to compete for project funding from a set-aside of intramural NORA funds. The process is similar to the competition for extramural R01 funding: submission of responsive letters of intent (LOIs) followed by full proposals which are externally peer-reviewed and scored. Funding decisions based largely on peer-review scores and available funding are made by the Director of NIOSH. While the Director may call for proposals in specific emphasis areas, proposals compete across program areas. Upon project completion, funds return to the NORA “pot” for renewed intramural competition and distribution across programs.

Extramural TI research is funded by NIOSH through several mechanisms. Investigators complete research proposals in response to the NIOSH general program announcement, in response to targeted RFAs developed by the TI Program and aimed at filling specific program gaps, and to a lesser extent, through cooperative agreements. The State FACE cooperative agreement is an example of a successful and interactive collaboration between TI staff and State Health and Labor Departments to conduct fatality investigations and prevention efforts using a systematic and cooperative approach.

Project assessment and adjustment, including refocusing and discontinuing projects when appropriate, is an ongoing process in the TI Program. Quarterly progress reports for each project are posted on a shared drive for information sharing, progress assessment, and input, and an

annual review of programs and projects occurs at mid-year. This ongoing reassessment, including discontinuation of projects that lack anticipated progress or value, has been critical in assuring and maximizing the quality and relevance of the TI research.

Although project administration and management remains a Division-level responsibility, NIOSH is also implementing a governance structure for the NIOSH Program Portfolio that provides for Program and Division/Labs management in a matrix style approach. The goals of this approach are to continue to improve the internal management and coordination, and the coordination between intramural and extramural research and planning, and to increase the relevance and impact of the NIOSH programs.

External input and partnerships

While the TI Program strives to maintain data-driven research priorities, the program also responds to externally driven priorities such as Congressional initiatives and mandates. The TI Program currently has four research programs directed by Congressional initiatives: agricultural injuries among children, fire fighter safety, workplace violence, and workers in Alaska's high-risk industries. At the inception of each of these initiatives, we held stakeholder meetings to seek external input to guide the development of the research strategy. For two of these initiatives—children in agriculture and fire fighters—TI also held mid-course review meetings with stakeholders for input to assess and adjust program direction.

Recognizing the need for a national forum to facilitate information sharing and research collaboration among the nation's occupational injury researchers and practitioners, the TI Program organized and hosted the National Occupational Injury Research Symposia (NOIRS).[76] This forum, the first and only national meeting in the United States focusing on occupational injury research, facilitates discussion and input among researchers on works in progress, and builds research and prevention collaborations. The first NOIRS was held in October 1997 in Morgantown, West Virginia. NOIRS 2000 convened in Pittsburgh, Pennsylvania in October 2000. The third symposium (NOIRS 2003) was held in Pittsburgh, Pennsylvania on October 28 to 30, 2003. The fourth NOIRS is tentatively planned for October 2008.

External input and partnerships are important strategies for ensuring the relevance of both our research approach and our outcomes. Every research protocol in the TI Program undergoes external peer-review. Frequently this peer-review includes a public meeting announced in the Federal Register, and openly seeking input on the development of programs in new areas. TI staff members also serve on numerous standards-setting and professional association committees.

This connection with relevant stakeholders not only facilitates moving our research results towards workplace implementation, but also keeps us informed and aware of emerging safety issues and potential solutions.

Outputs and transfer

During the years 1996 through 2006, the TI Program has produced and disseminated 55 numbered NIOSH publications with more than 1.7 million copies distributed to date. This figure includes copies that have been proactively distributed by direct mail through the TI targeted dissemination approach as well as copies that have been distributed at various conferences and exhibits. However, a substantial proportion—42.5 percent of all copies distributed—have been sent out in response to customer requests. TI outputs have been reprinted, redistributed and incorporated into training courses, campaigns, and informational products by others. More

information on TI outputs, the distribution of TI-related NIOSH publications, and the citations of TI peer-reviewed articles in other research publications is contained in Appendix 9.

The TI Program also ensures relevance through strategies to ensure widespread dissemination of our research. In 2003, TI launched the NIOSH "Traumatic Injury Topic Page," a Website containing all available TI Program information on traumatic injuries, including publications, data, FACE and fire fighter investigative reports, research summaries, information on NOIRS meetings, and relevant external occupational injury related links.[77] Immediately, the TI Topic Page became one of the most popular NIOSH Websites. Subtopic pages, including a page on Workplace Violence, the Fire Fighter Fatality Investigation and Prevention Program Website, and the FACE Website, ranked in the top pages in number of visits on the entire NIOSH Website. Specific subtopic pages were developed addressing Agricultural Safety (http://www.cdc.gov/niosh/injury/traumaagric.html), Child Agricultural Injury Prevention Initiative (http://www.cdc.gov/niosh/childag/default.html), Commercial Aviation (Alaska), Commercial Fishing (Alaska), Confined Spaces (http://www.cdc.gov/niosh/injury/traumaconf.html), Construction Safety (http://www.cdc.gov/niosh/injury/traumastruct.html), Electrical Safety (http://www.cdc.gov/niosh/injury/traumaelec.html), the Fatality Assessment and Control Evaluation (FACE) Program (http://www.cdc.gov/niosh/face/), Falls (http://www.cdc.gov/niosh/injury/traumafall.html), the Fire Fighter Fatality Investigation and Prevention Program (http://www.cdc.gov/niosh/fire/), Highway Work Zones (http://www.cdc.gov/niosh/injury/traumazone.html), Logging Safety (http://www.cdc.gov/niosh/injury/traumalog.html), Machine Safety (http://www.cdc.gov/niosh/injury/traumamc.html), Motor Vehicle (http://www.cdc.gov/niosh/injury/traumamv.html), and Occupational Violence (http://www.cdc.gov/niosh/injury/traumaviolence.html). This marked the first time all NIOSH TI information had been organized and presented on the Web in one site. The TI Topic Page can be accessed at: http://www.cdc.gov/niosh/injury/.

The TI Program also undertakes proactive strategies to transfer research results to the workplace or to the next step towards workplace implementation. For each research area, TI identifies at least one "recipient" of the findings. TI involves the recipient(s) from the conceptual phase of the research onward and attends to their input. This not only helps to ensure that the outputs will be relevant and acceptable, but also promotes shared ownership or buy-in by the recipients. At the conclusion of the research, TI facilitates the recipient in carrying out the next step in moving the research results towards workplace implementation.

Examples of the various types of recipients include:

- Translators of scientific information to worker-friendly guidance or training
- Materials manufacturers to develop and market safety technologies
- Regulators and employers to promulgate new safety policy
- Organizations to promote new health and safety practices
- Companies to implement new technologies, processes and practices to prevent injuries among their workforce

Emerging Issues

Maintaining optimal relevance and impact of any research program depends in part on the ability to detect and address current and emerging problems. The TI Program uses several strategies to identify and respond to emerging issues.

Surveillance data on fatal and nonfatal injuries are reviewed routinely. Annual trends of injuries and deaths provided primarily by BLS Surveillance Systems[40],[41] drive the annual program planning. The TI also maintains real-time surveillance of injuries reported to a national sample of hospital emergency departments (NEISS)[73] and fatal injuries in selected States (FACE)[34] that allow more immediate detection of injury clusters or spikes. Moreover, the strong engagement with stakeholders and partners in the TI Program, as well as the National Occupational Injury Research Symposia, provide opportunities not only to learn of emerging issues, but to adapt partnership efforts to address them.

The TI Program drivers and planning process promote annual realignment of research priorities. The TI Program also maintains dedicated projects that are specifically designed to respond to emerging issues in the areas of surveillance, causality, and evaluation. Resources are allocated to these projects annually to fund pilot efforts in newly detected areas of concern or serendipitous partnership opportunities.

Finally, the FACE Program with its cooperative intramural and State-based components is designed to be flexible and adaptable to emerging hazards and changing priorities. For example, with the explosion of the telecommunication industry, we began to see a spike in deaths due to falls from towers during construction and maintenance. The FACE Program not only adapted to investigate these incidents, but also collaborated with industry to develop prevention efforts. When surveillance data showed high fatality rates among Hispanic workers, the FACE Program shifted priorities to begin investigating these incidents. Also, each State cooperating in the FACE Program has the flexibility to address high-risk issues specific to the State in addition to the current program investigation targets.

These strategies–attention to surveillance trends, the program planning process, connectivity with stakeholders, maintenance of projects designed to respond to emerging issues, and a flexible investigation program—allow the TI Program to adapt and respond to changes and emerging issues in workplace safety.

External Factors

Due to limited resources to address all work injuries in all sectors, it has been necessary to focus the TI Research Program towards worker groups with the greatest numbers and risk of serious injury or death. While the NIOSH TI Program has been largely data-driven, there have been some exceptions. Although the mining industry and motor-vehicle-related incidents are among the highest risk for occupational injury or death, the TI Program historically has not focused on this sector or cause of death. This conscious decision was based on the existence of other Federal agencies with responsibility and resources to conduct prevention research in these areas (USBM, DOT). Only recently has TI begun a concerted effort to address occupational motor-vehicle safety.

In addition, Congressionally mandated initiatives in several specific areas (i.e., children in agriculture, workers in Alaska, fire fighters, violence) ensured sustained research funding in these areas.

In 1997 the two research laboratories of the USBM (Pittsburgh and Spokane) were merged into NIOSH and NIOSH assumed responsibility for mining injury prevention research. There were a number of successful efforts to integrate research activities between the new mining laboratories and other Divisions. During the late 1990s, a special fund was set aside for collaborative projects between Divisions/Labs that focused on applying mining-related research to agriculture or construction industry sectors. The TI Program engaged in several interdivisional collaborations in response to this opportunity. Drawing from that experience, in 2001 a suite of research projects focusing on "closing the loop from science to prevention" was proposed by an interdivisional team including DSR, PRL, and SRL staff. This research program successfully competed for NORA funding and was conducted collaboratively from FY01 to FY06. Although these were successful collaborations and helped integrate the former USBM labs into NIOSH, the budget and function of these two laboratories have remained relatively independent of other NIOSH research divisions and programs, due largely to stakeholder interest and Congressional oversight.

Impact

It is a major challenge for TI to both directly impact prevention and to demonstrate a cause-effect relationship between TI work and injury metrics. However, from 1996 to 2005, the TI Program has contributed to a 39 percent decline in traumatic occupational fatalities among the U.S. workforce. While efforts of many external entities have also influenced the reduction in worker deaths, the TI contribution to this decrease is reinforced by decreases in specific goal areas where TI has concentrated efforts (e.g., homicides, workers in Alaska, back injuries in nursing homes, injuries to young workers). The following section (V) describes these efforts.

References

1. National Academies Framework Committee [2005]. Framework for the Review of Research Programs of the National Institute for Occupational Safety and Health, Version of 12/19/05. Available on the Web at: http://www.cdc.gov/niosh/nas/pdfs/Framework121905.pdf. Last accessed January 8, 2007.
2. Webster's Third New International Unabridged Dictionary [2002]. Merriam-Webster, 2,816 pages.
3. Hagberg M, Christiani D, Courtney TK, et al. [1997]. Conceptual and Definitional Issues in Occupational Injury Epidemiology. American Journal of Industrial Medicine 32:106-115.
4. NIOSH [2006]. National Academy Review Briefing Documents: The Mining Program, Strategic Goal 4 - Traumatic injuries: Reduce traumatic injuries in the mining workplace. Available on the Web at: http://www.cdc.gov/niosh/nas/mining/whatdoes-randdportfolio.htm#Traumatic percent20injuries. Last accessed on January 8, 2007.
5. Occupational Safety and Health Act [1970]. Public Law 91-596, 91st Congress, December 29, 1970.

6. Unpublished timeline. Chronological History of Occupational Safety and Health Programs: History of administrative changes in Occupational Safety and Health Programs—U.S. Public Health Service, 1910-1985.
7. MSHA [2006]. The Federal Mine Safety & Health Act of 1977, Public Law 91-173, as amended by Public Law 95-164 (signed into law on June 15, 2006). Available on the Web at: http://www.msha.gov/REGS/ACT/ACT1.HTM. Last accessed January 8, 2007.
8. MSHA [1996]. History of Mine Safety and Health Legislation. Available on the Web at: http://www.msha.gov/MSHAINFO/MSHAINF2.HTM. Last accessed on January 9, 2007.
9. NIOSH [2006]. About NIOSH: NIOSH Origins and Mission. Available on the Web at: http://www.cdc.gov/niosh/about.html. Last accessed on January 9, 2007.
10. NIOSH [2006]. NIOSH Strategic Plan Outline: 2004-2009. Available on the Web at: http://www.cdc.gov/niosh/docs/strategic/default.html#values. Last accessed on January 9, 2007.
11. NIOSH [2005]. NIOSH Program Portfolio. Available on the Web at: http://www.cdc.gov/niosh/programs/. Last accessed on January 9, 2007.
12. Office of Management and Budget [1993]. Government Performance and Results Act of 1993 (GPRA). Available on the Web at: http://www.whitehouse.gov/omb/mgmt-gpra/gplaw2m.html. Last accessed on January 9, 2007.
13. Office of Management and Budget [2006]. Program Assessment Rating Tool (PART). Available on the Web at: http://www.whitehouse.gov/omb/part/. Last accessed on January 9, 2007.
14. NIOSH [2005]. NIOSH Board of Scientific Counselors. Available on the Web at: http://www.cdc.gov/niosh/BSC/. Last accessed on January 9, 2007.
15. OSHA [2006]. National Advisory Committee on Occupational Safety & Health. Available on the Web at: http://www.osha.gov/dop/nacosh/nacosh.html. Last accessed on January 9, 2007.
16. Executive Office of the President, Office of Management and Budget [2001]. The President's Management Agenda. Available on the Web at: http://www.whitehouse.gov/omb/budget/fy2002/mgmt.pdf. Last accessed on January 9, 2007.
17. National Institutes of Health [2006]. Biomedical Research and Development Price Index (BRDPI), Updated July 24, 2006. Available on the Web at: http://officeofbudget.od.nih.gov/UI/GDP_FromGenBudget.htm. Last accessed on January 9, 2007.
18. NIOSH [1989]. NIOSH Proposed National Strategies for the Prevention of Leading Work-Related Diseases and Injuries-Occupational Lung Diseases, NIOSH (DHHS) Publication No. 89-128. Cincinnati, OH: National Institute for Occupational Safety and Health.
19. NIOSH [1989]. NIOSH Proposed National Strategies for the Prevention of Leading Work-Related Diseases and Injuries-Musculoskeletal Injuries, NIOSH (DHHS) Publication No. 89-129. Cincinnati, OH: National Institute for Occupational Safety and Health.
20. NIOSH [1989]. NIOSH Proposed National Strategies for the Prevention of Leading Work-Related Diseases and Injuries-Occupational Cancers, NIOSH (DHHS) Publication No. 89-130. Cincinnati, OH: National Institute for Occupational Safety and Health.

21. NIOSH [1989]. NIOSH Proposed National Strategies for the Prevention of Leading Work-Related Diseases and Injuries-Severe Occupational Traumatic Injuries, NIOSH (DHHS) Publication No. 89-131. Cincinnati, OH: National Institute for Occupational Safety and Health.
22. NIOSH [1989]. NIOSH Proposed National Strategies for the Prevention of Leading Work-Related Diseases and Injuries-Cardiovascular Diseases, NIOSH (DHHS) Publication No. 89-132. Cincinnati, OH: National Institute for Occupational Safety and Health.
23. NIOSH [1989]. NIOSH Proposed National Strategies for the Prevention of Leading Work-Related Diseases and Injuries-Disorders of Reproduction, NIOSH (DHHS) Publication No. 89-133. Cincinnati, OH: National Institute for Occupational Safety and Health.
24. NIOSH [1989]. NIOSH Proposed National Strategies for the Prevention of Leading Work-Related Diseases and Injuries-Neurotoxic Disorders, NIOSH (DHHS) Publication No. 89-134. Cincinnati, OH: National Institute for Occupational Safety and Health.
25. NIOSH [1989]. NIOSH Proposed National Strategies for the Prevention of Leading Work-Related Diseases and Injuries-Noise-Induced Hearing Loss, NIOSH (DHHS) Publication No. 89-135. Cincinnati, OH: National Institute for Occupational Safety and Health.
26. NIOSH [1989]. NIOSH Proposed National Strategies for the Prevention of Leading Work-Related Diseases and Injuries-Dermatological Conditions, NIOSH (DHHS) Publication No. 89-136. Cincinnati, OH: National Institute for Occupational Safety and Health.
27. NIOSH [1989]. NIOSH Proposed National Strategies for the Prevention of Leading Work-Related Diseases and Injuries-Psychological Disorders, NIOSH (DHHS) Publication No. 89-137. Cincinnati, OH: National Institute for Occupational Safety and Health.
28. NIOSH [1996]. The National Occupational Research Agenda, DHHS (NIOSH) Publication No. 96-115. Cincinnati, OH: National Institute for Occupational Safety and Health. Available on the Web at: http://www.cdc.gov/niosh/docs/96-115/. Last accessed on January 9, 2007.
29. NIOSH [2002]. NORA 1 Website: NORA Priority Research Areas. Available on the Web at: http://www2a.cdc.gov/nora/nora-1.html. Last accessed on January 9, 2007.
30. NIOSH [1997]. NIOSH Strategic Plan, 1997-2002. Available on the Web at: http://www.cdc.gov/niosh/gpran1a.html. Last accessed on January 8, 2007.
31. NIOSH [2006]. The National Occupational Research Agenda. Available on the Web at: http://www.cdc.gov/niosh/nora/. Last accessed on January 9, 2007.
32. NIOSH [2004]. Worker Health Chartbook, NIOSH (DHHS) Publication Number 2004-146. Cincinnati, OH: National Institute for Occupational Safety and Health, 354 pages. Available on the Web at: http://www.cdc.gov/niosh/docs/chartbook/pdfs/Chartbook_2004_NIOSH.pdf. Last accessed on January 9, 2007.
33. NIOSH [2003]. NIOSH Website: Health Hazard Evaluations. Available on the Web at: http://www.cdc.gov/niosh/hhe/. Last accessed on January 9, 2007.
34. NIOSH [2003]. NIOSH Website: FACEWeb, the NIOSH Fatality Assessment and Control Evaluation (FACE) Program. Available on the Web at: http://www.cdc.gov/niosh/face/. Last accessed on January 9, 2007.

35. NIOSH [2006]. NIOSH Website: Fire Fighter Fatality Investigation and Prevention Program. Available on the Web at: http://www.cdc.gov/niosh/fire/. Last accessed on January 8, 2007.
36. NIOSH [2004]. NIOSH Website: Education and Resource Centers (ERCs). Available on the Web at: http://www.cdc.gov/niosh/oep/centers.html. Last accessed on January 9, 2007.
37. NIOSH [2005]. NIOSH Website. Available on the Web at: http://www.cdc.gov/niosh/homepage.html. Last accessed on January 9, 2007.
38. NIOSH [2004]. NIOSH 800-NUMBER—Information Inquiry Service. Available on the Web at: http://www.cdc.gov/niosh/inquiry.html. Last accessed on January 9, 2007.
39. NIOSH [2004]. r2p: Research-to-Practice at NIOSH. Available on the Web at: http://www.cdc.gov/niosh/r2p/. Last accessed January 9, 2007.
40. BLS [2006a]. Census of Fatal Occupational Injuries. (http://www.bls.gov/iif/oshcfoi1.htm) Website last accessed on October 17, 2006.
41. BLS [2006b]. Industry Illness and Injury Data. (http://www.bls.gov/iif/oshsum.htm) Website last accessed on November 16, 2006.
42. Liberty Mutual [2006]. Despite 6.2 percent Fall In The Number Of Serious Workplace Injuries, Their Financial Impact On Employers Remains Huge, Liberty Mutual Press Release, September 20, 2005. Accessed on-line at: http://www.libertymutual.com/omapps/ContentServer?cid=1003349317278&year=2005&prid=1078447725811&pagename=CorporateInternet percent2FPage percent2FPressReleaseTeal&c=Page . Last accessed on December 14, 2006.
43. NIOSH [1972]. NIOSH and "Safety" in The Advisor, Number 1 (July 1, 1972). Rockville, MD: The National Institute for Occupational Safety and Health. 6 pp.
44. Arthur D. Little, Inc. [1972]. Final Report relating to The Present Status and Requirements for Occupational Safety Research, prepared for the National Institute for Occupational Safety and Health, Health Services and Mental Health Administration, Public Health Service under Contract No. HSM 099-71-30. Cambridge, MA: A.D. Little. 203 pp.
45. NIOSH [1973]. The President's Report on Occupational Safety and Health, 1973. HEW Publication No. (NIOSH) 73-11014. Cincinnati, OH: National Institute for Occupational Safety and Health. 1973.
46. NIOSH [1975]. Occupational Safety Research Specifically Related to Personal Protection—A Symposium. HEW Publication No. (NIOSH) 75-143. Cincinnati, OH: National Institute for Occupational Safety and Health. May 1975. 252 pp.
47. NIOSH [1975]. Machine Guarding—Assessment of Need. DHEW (NIOSH) Publication No. 75-173. Prepared by the Bendix Corporation, Launch Support Division, Cocoa Beach, FL: Contract HSM-99-73-71. Cincinnati, OH: National Institute for Occupational Safety and Health, 202 pages (June 1975).
48. NIOSH [1975]. Criteria for a Recommended Standard…Emergency Egress from Elevated Workstation, DHEW (NIOSH) Publication Number 76-128. Cincinnati, OH: National Institute for Occupational Safety and Health, 57 pages.
49. NIOSH [1976]. Criteria for a recommended standard…Logging from Felling to First Haul. HEW Publication No. (NIOSH) 76-188. Cincinnati, OH: National Institute for Occupational Safety and Health.
50. NIOSH [1979]. Criteria for a recommended standard…Working in Confined Spaces, DHEW (NIOSH) Publication Number 80-106. Cincinnati, OH: National Institute for Occupational Safety and Health, 68 pages. (December 1979).

51. NIOSH [1980]. Program Plans by Program Areas FY 1979. DHEW (NIOSH) Publication No. 80-103. Cincinnati, OH: National Institute for Occupational Safety and Health.
52. Oppold J, Jensen R, Blaskovich N [1979]. Occupational Safety Research: A NIOSH Strategy. Professional Safety (July 1979): 29-33.
53. NIOSH [1981]. Program Plans by Program Areas FY 1980. DHEW (NIOSH) Publication No. 81-112. Cincinnati, OH: National Institute for Occupational Safety and Health.
54. NIOSH [1981]. NIOSH Program Plan by Program Areas—Fiscal Year 1982. DHHS (NIOSH) Publication No.82-108. Cincinnati, OH: National Institute for Occupational Safety and Health. December 1981. Page 179.
55. NIOSH [1980]. Program of the National Institute for Occupational Safety and Health: Program Plan by Program Areas for FY1981. DHHS (NIOSH) Publication No. 81-112. Cincinnati, OH: National Institute for Occupational Safety and Health, December 1980. page 155.
56. MMWR [1983]. Leading work-related diseases and injuries, United States. MMWR 32(2): January 21, 1983.
57. NIOSH Division of Safety Research [1987]. Program Area Narratives (PANs). Unpublished internal planning documents.
58. NIOSH [1984]. NIOSH Program Plans by Program Areas, Fiscal Years 1984-89, DHHS (NIOSH) Publication Number 84-107. Cincinnati, OH: National Institute for Occupational Safety and Health, page 139.
59. CDC [1987]. Traumatic Occupational Fatalities—United States, 1980-1984. MMWR 36(28);461-4,469-70.
60. CDC [2005]. CDC Timeline (http://www.cdc.gov/od/oc/media/timeline.htm). Website last updated September 22, 2006; last accessed on November 14, 2006.
61. NIOSH [1989]. National Traumatic Occupational Fatalities: 1980-1985. DHHS (NIOSH) Publication Number 89-116. Cincinnati, OH: National Institute for Occupational Safety and Health.
62. NIOSH [1993]. Fatal Injuries to Workers in the United States, 1980-1989: A Decade of Surveillance (National Profile). DHHS (NIOSH) Publication Number 93-108. Cincinnati, OH: National Institute for Occupational Safety and Health, 27 pages. Available on The Web at: http://www.cdc.gov/niosh/93-108.html. Last accessed on January 10, 2007.
63. NRC (National Research Council/Institute of Medicine) [1998]. Protecting youth at work: health, safety, and development of working children and adolescents in the United States. Washington, DC: National Academy Press.
64. NIOSH [1994]. Worker Deaths in Confined Spaces: A Summary of NIOSH Surveillance and Investigative Findings. DHHS (NIOSH) Publication Number 94-103. Cincinnati, OH: National Institute for Occupational Safety and Health, 273 pages. Available on The Web at: http://www.cdc.gov/niosh/pdfs/94-103.pdf. Last accessed on February 16, 2007.
65. NIOSH [1998]. Worker Deaths by Electrocution: A Summary of Surveillance Findings and Investigative Case Reports. DHHS (NIOSH) Publication Number 98-131. Cincinnati, OH: National Institute for Occupational Safety and Health, 43 pages. Available on The Web at: http://www.cdc.gov/niosh/pdfs/98-131.pdf. Last accessed on February 16, 2007.
66. NIOSH [2000]. Worker Deaths by Falls: A Summary of Surveillance Findings and Investigative Case Reports. DHHS (NIOSH) Publication Number 2000-116. Cincinnati, OH: National Institute for Occupational Safety and Health, 322 pages. Available on The Web at: http://www.cdc.gov/niosh/pdfs/00-116.pdf. Last accessed on February 16, 2007.

67. NIOSH [2003]. FACEWeb: The Fatality Assessment and Control Evaluation (FACE) Program Website. Available on the Web at: http://www.cdc.gov/niosh/face/In-house/full8201.html. Last accessed on January 10, 2007.
68. NIOSH Division of Safety Research [1993]. Strategic Plan for DSR. Unpublished internal document.
69. NIOSH [2005]. Division of Safety Research (DSR). DSR description on NIOSH Website at: http://www.cdc.gov/niosh/im-dsr.html.
70. NIOSH Division of Safety Research [1993]. Protective Technology Research Plan. Unpublished internal document.
71. Stout N, Borwegen W, Conway G, et al. [1998]. Traumatic Occupational Injury Research Needs and Priorities: a Report by the NORA Traumatic Injury Team. DHHS (NIOSH) Publication No. 98-134, Cincinnati, OH: National Institute for Occupational Safety and Health, 15 pp. Available on the Web at: http://www.cdc.gov/niosh/traumado.html. Last accessed on January 10, 2007.
72. BLS [2002]. Occupational Safety and Health Summary Data. Available on the Web at: http://www.bls.gov/iif/oshsum1.htm. Last viewed on January 10, 2007
73. Consumer Product Safety Commission (CPSC) [2007]. National Electronic Injury Surveillance System (NEISS) On Line. Available on the Web at: http://www.cpsc.gov/LIBRARY/neiss.html. Last accessed on January 10, 2007.
74. Institute of Medicine [1999]. Reducing the Burden of Injury: Advancing Prevention and Treatment. Bonnie RJ, Carolyn E. Fulco CE, and Catharyn T. Liverman CT, Editors. Washington, DC: National Academy Press, 336 pages. 1999
75. Informal communication from Corinne Peek-Asa, University of Iowa School of Public Health, at meeting of the NORA-TI team in October 2003, Pittsburgh, PA.
76. NIOSH [2007]. National Occupational Injury Research Symposium (NOIRS) Homepage. Available on the Web at: http://www.cdc.gov/niosh/noirs/noirsmain.html. Last accessed on January 10, 2007.
77. NIOSH [2007]. NIOSH Safety and Health Topic: Traumatic Occupational Injuries. Available on the Web at: http://www.cdc.gov/niosh/injury/. Last accessed on January 10, 2007.