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**Transportation Ergonomics II:  
Implementation of a Pre-Work Screening Process to  
Address Ergonomics Risk for New Drivers**



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### **Introduction**

Background information is provided on the prevalence and scope of injuries within the commercial transportation industry along with pertinent details of the Pre-work Screening process and its effectiveness.

### **Pre-work Screen Protocol**

A review of the Pre-work Screen testing protocol employed during the duration of the study.

### **Data Collection**

The process used to collect data on injury, illness and Pre-work Screens outcomes.

### **Pre-work Screen Outcomes**

The comparative relationships seen prior to and post implementation of the Pre-work Screening process.

### **Conclusions**

A review of the relationships learned and recommendations.



## INTRODUCTION

When it comes to musculoskeletal disorders (MSDs), the commercial transportation industry experiences a unique set of workplace circumstances that create the perfect storm for increasing both the frequency of injuries and the costs to the industry. The following facts describe the make-up of this storm:

1. Commercial transportation jobs expose workers to high physical demands and extended hours of exposure.
2. The transportation industry experiences one of the highest work-related injury rates among all workplace sectors.
3. The transportation industry experiences a high level of turnover on an annual basis.
4. Elevated turnover rates result in a high number of newly hired employees exposed to unfamiliar and physically demanding tasks.

Given these facts, the transportation industry is faced with the task of developing strategies to address each of these components that drive risk and cost in the environment. The first step in this process is to understand each of these components in greater detail.

### Physical Demands

The transportation industry is a sector that has been researched extensively over the years, primarily to improve safety for the driver and others on the road. A literature review reveals studies focusing on seatbelt use, fatigue, cognition, psychosocial factors, drugs/alcohol usage, and work scheduling. Until recently, little focus has been placed on strategies to address MSDs within the workforce.

The MSDs, which are commonplace to the transportation industry, are typically driven by over-exertion of heavy routine tasks performed within the industry. They present as sprains and strains most often affecting the lower back or shoulder joints. Examples of these heavy routine tasks include:

- Cranking of the dollies
- Pulling the 5<sup>th</sup> wheel
- Sliding the tandem
- Loading and unloading freight
- Securing loads
- Pre and post-trip inspections



Measurements of Essential Functions (physical demands of the job) have been collected for numerous trucking fleets. These physical demands represent significant levels of physical exertion associated with the performance of routine task within the industry. For example forces to "Pull the 5<sup>th</sup> Wheel" have been measured between 119 - 191 pounds; average force of 150 pounds. Forces to "Slide the Tandem" have been measured between 76 - 159 pounds; average force of 104 pounds.<sup>1</sup>

## Work-Related Injuries

The transportation industry experiences one of the highest rates of workers' compensation claims in the nation. A recent State of Washington study noted that on an annual basis, 1 out of every 13 truck drivers experienced a work-related injury resulting in a lost-time injury claim.<sup>2</sup> Beyond that, the Bureau of Labor Statistics (BLS) has reported on the top 12 industries with respect to MSDs based on total number of incidents and MSD incidence rate (see Figure 1 below)<sup>3</sup>. The top 5 job categories on the list involve tasks with heavy material handling activities. Number six on the list (based on incidence rate), heavy and tractor trailer truck drivers, has the third highest number of MSDs, at 16,470 cases. This high frequency and incidence rate of injury clearly makes MSDs a major concern for the transportation industry.

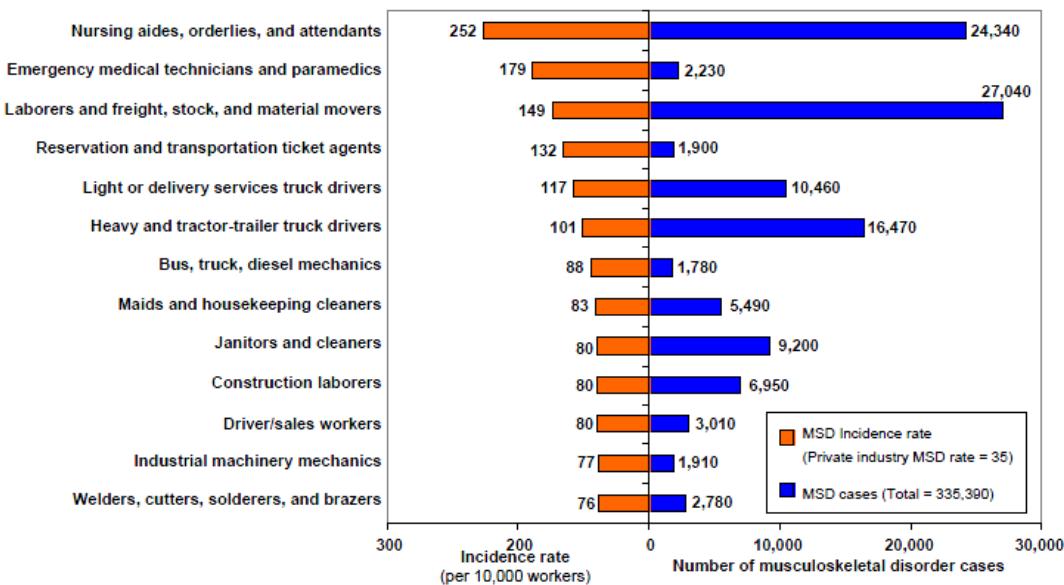


Figure 1: MSD Cases and Incidence Rate by Industry

<sup>1</sup> Atlas Ergonomic Data of Essential Functions Measurements; August 2008

<sup>2</sup> Rauser, E., Foley M., Bonauto, D., Edwards S., Spielholz, P., Silverstein, B., 2008, Preventing Injuries in the Trucking Industry. Washington State Department of Labor & Industries. Technical Report No. 90-17-2008, p 18.

<sup>3</sup> Source: Bureau of Labor Statistics, U.S. Department of Labor, Survey of Occupational Injuries and Illnesses, cases involving days away from work. Chart 21; 2007 Nonfatal Occupational Injuries and Illnesses Case and Demographics, November 20, 2008.



In addition to the incidence rate for MSDs, the severity of injuries as demonstrated by lost work day rates provides further indication of the musculoskeletal stressors within the transportation sector. The BLS reported that MSDs had the highest number of days away from work per incident. The full transportation and warehousing sectors had median days away from work of 14 days, double the national median. The highest reported median days away from work was under the category of tractor-trailer truck drivers / delivery service truck drivers, at 15 days each<sup>4</sup>.

The 2008 Liberty Mutual Workplace Safety Index provides the most current data on workplace injuries and their associated costs<sup>5</sup>. The report estimates that the direct cost for the most disabling workplace injuries and illnesses in 2006 was \$48.6 billion. As Figure 2 indicates over 25% of the most disabling workplace injuries in 2006 were caused by overexertion. The direct costs of these injuries were in excess of \$12.4 billion dollars.

### Top 10 Causes of the Most Disabling Workplace Injuries in 2006

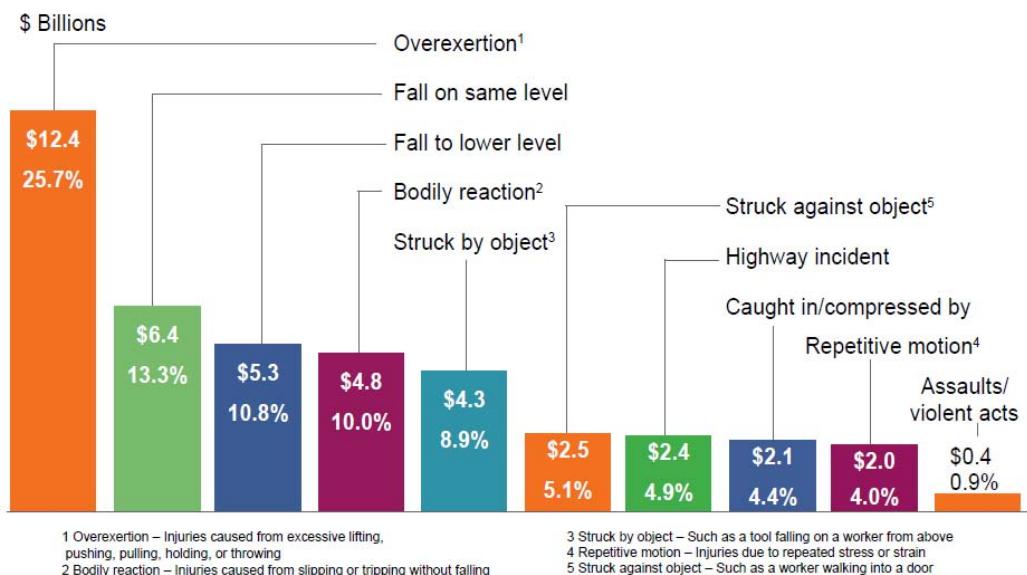


Figure 2: Top 10 Causes of the Most Disabling Workplace Injuries in 2006

<sup>4</sup> Source: Bureau of Labor Statistics, U.S. Department of Labor, Survey of Occupational Injuries and Illnesses. Nonfatal Occupational Injuries and Illnesses Case and Demographics, November 20, 2008.

<sup>5</sup> Source: 2008 Liberty Mutual Workplace Safety Index; Liberty Mutual Research Institute for Safety.



The 2008 Liberty Mutual Workplace Safety Index sites “hard” direct dollar costs within its study. Various resources go beyond these direct dollars costs to incorporate a multiple of direct to indirect costs related to workplace injuries thus providing a “Total Cost” of an injury. Resources outlining indirect costs include:

- OSHA: for every dollar of direct cost, organizations spend \$1-4 in indirect cost.<sup>6</sup>
- 2002 Liberty Mutual, *“Workplace Safety Index”* reported that for each \$1 of direct costs organizations experience between \$3 and \$5 of indirect costs<sup>7</sup>.
- Colorado State University Health & Safety Consultation Program reports that indirect costs of injuries may be 20 times the direct costs<sup>8</sup>.

When providing details of the indirect costs, the studies noted workplace factors including<sup>9</sup>:

- Damage to equipment, machinery, materials, facility, etc.
- Production downtime
- Lower employee morale
- Loss of products or services
- Delays in shipment or filling orders
- Additional overtime
- Managers' lost time resulting from the accident. Also includes inspections, investigations, meetings, and administration
- Employees assisting with the accident. Includes administering first aid, and witness interviews
- Hiring and training replacement workers
- Wages of replacement workers
- Other non-productive time incurred by the injured employee. Includes all medical related appointments
- Potential OSHA penalties
- Attorney fees

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<sup>6</sup> Source: OSHA: How to Estimate the Impact of Accidents on Your Profit and Sales  
Link: <http://www.osha.gov/SLTC/etools/safetyhealth/safpay.html>

<sup>7</sup> Source: 2002 Liberty Mutual Workplace Safety Index; Liberty Mutual Research Institute for Safety.

<sup>8</sup> Smith, I., *Do You Know How Much Accidents Are Really Cutting Your Business?* Colorado State University, Heath & Safety Consultation Program, 1996.

<sup>9</sup> Slusser, J., Direct Versus Indirect Costs of Workplace Injuries. Article Source: <http://ezinearticles.com/?Direct-Versus-Indirect-Costs-of-Workplace-Injuries&id=2509218>



Hence, the total cost of workplace overexertion injuries (injuries caused by excessive lifting, pushing, pulling, holding or throwing) could range from a conservative estimate of \$49.6 billion dollars annually to \$99.2 billion dollars annually or beyond depending upon your consideration of indirect costs (Figure 3).

	Indirect Multiple of 3	Indirect Multiple of 4	Indirect Multiple of 5	Indirect Multiple of 6	Indirect Multiple of 7
Direct Cost	\$12.4 B				
Indirect Cost	\$37.2 B	\$49.6 B	\$62.0 B	\$74.4 B	\$86.8 B
Total Cost	\$49.2 B	\$62.0 B	\$74.4 B	\$86.8 B	\$99.2 B

**Figure 3: Total Costs of Workplace Overexertion Injuries**

### Economic Factors Influencing Injuries in the Transportation Industry

A 2008 report from the State of Washington, “Preventing Injuries in the Trucking Industry”<sup>10</sup>, outlines various economic factors which have led to an increase in the risk of injury within the transportation industry.

- A number of changes to the structure of the transportation industry and to the transportation workforce came with the deregulation of transportation industry in 1980. Deregulation resulted in a reduction in the “barriers of entry” into the marketplace. As competition increased, profit margins for trucking companies eroded. This raises concerns that competitive pressures within the marketplace may lead to decreased investments in safety training and equipment.
- A second factor was a shift among manufacturers from an inventory-based “push” system driving the marketplace to a just-in-time “pull” system for goods. This shift in inventory has placed a tremendous performance burden on the trucking workforce to meet the demands of shippers and customers. For drivers this can mean increased pressure to make time schedules, as well as idle periods waiting for slots at shipping terminals. This lengthens working hours, increases the unpredictability of driving schedules, thus leading to an increase in the risk of injury to drivers.

<sup>10</sup> Rauser, E., Foley M., Bonauto, D., Edwards S., Spielholz, P., Silverstein, B., 2008, Preventing Injuries in the Trucking Industry. Washington State Department of Labor & Industries. Technical Report No. 90-17-2008, p 9.

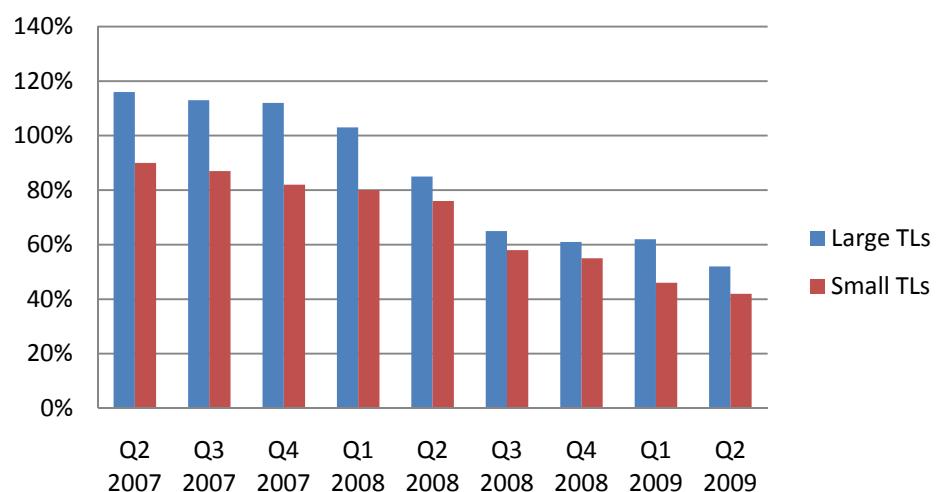


- Finally, with the rise of a more competitive marketplace there has been a shift away from a high-wage, union-organized workforce toward lower-wage non-union drivers and owner-operators. Lower wages, coupled with unpredictable work schedule has result in higher driver turnover within the industry. This in turn increases the risk of injury to drivers.

### Turnover Rates in the Transportation Industry

Driver turnover rates within truckload carriers, those carriers who, by definition, contracts an entire trailer-load to a single customer have traditionally been high. Turnover rates for large truckload companies swelled to 136% during the fourth quarter of 2004.<sup>11</sup> With the recent contraction of the U.S. economy and transportation industry, the turnover rate of drivers has moderated yet remains at substantial levels (Figure 4).

**Driver Turnover Rates - Truckload Carriers**



**Figure 4: Driver Turnover Rates - Truckload Carriers**  
Source: American Trucking Association: Q2 2009

As noted above in the State of Washington study, higher turnover rates have led to higher risks of injury within the workforce. This is supported by BLS data which indicates that 10-20% of injuries occur within in the first 3-12 months of employment.<sup>12</sup>

<sup>11</sup> Transport Topics, April 4 2005. Reported by Daniel W Guido

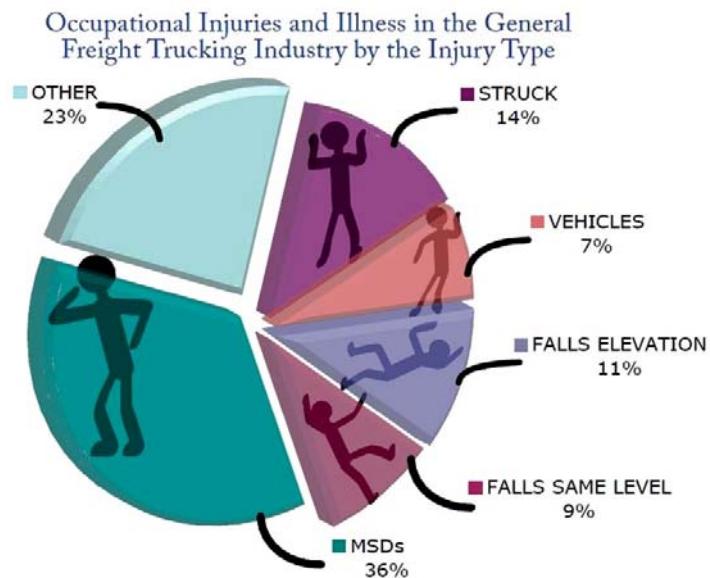
<sup>12</sup> Bureau of Labor Statistics, U.S. Department of Labor, March, 2009.

## Pre-Work Screens (PWS) and the Transportation Industry

When developing a solid ergonomics program, the goal is to implement elements that address the root cause of the problem. Further, these elements must address the problem at multiple points of exposure for the employees. In the case of the transportation industry, the high turnover rate presents the first opportunity that must be addressed by an ergonomics program. By including a program element that focuses on MSDs at the point of hire, a company can address the issue of injuries during the early days (3-12 months) of employment.

The issue of MSDs in the transportation industry is well grounded in the findings of the State of Washington study previously cited.<sup>13</sup> The study found that MSDs accounted for:

- 36% of all Occupational Injuries and Illness (Figure 5)
- 35% of all lost work time claims
- Equivalent to 640,000 lost workdays

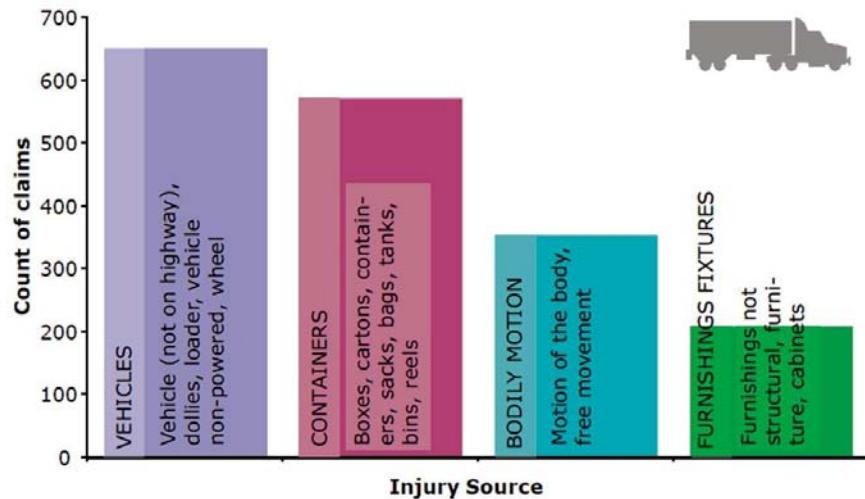


**Figure 5: Occupational Injuries and Illness in General Freight Trucking**  
**Source: Washington State Department of Labor & Industries**

In addition, the study found that the most common MSD claims were secondary to overexertion activities including cranking dollies, sliding tandems, and moving freight, i.e., use of pallet jack (Figure 6).

<sup>13</sup> Rauser, E., Foley M., Bonauto, D., Edwards S., Spielholz, P., Silverstein, B., 2008, Preventing Injuries in the Trucking Industry. Washington State Department of Labor & Industries. Technical Report No. 90-17-2008, p 27.

## Common Sources of Injury for MSDs



**Figure 6: Common Sources of Injury for MSDs**  
**Source:** Washington State Department of Labor & Industries

A PWS is an ergonomics program element that fits into this situation. When deployed appropriately, PWS can match a worker's physical abilities with the pre-determined physical demands of the job. It is important that the screen is designed to assess an individual's ability to work safely at a specific job. A PWS is typically administered after a conditional offer of employment has been made. Hence, in actuality it is a Pre-employment Post-offer screening tool. Although the use of a PWS does not guarantee that a particular worker will never get injured on the job, it does assure that at the time of employment, the applicant has the ability to complete the essential physical functions of the job.

Given the level of exposure and costs associated with MSDs in the transportation industry, implementation of any program must show a level of effectiveness that demonstrates a tangible return on investment. This paper will use data from a large commercial carrier that has implemented a PWS program to compare four years of workplace injury data; two years prior and two years post implementation of PWS. It will compare and contrast injury rates, lost workday cases, lost workdays, injury types & causation and other pertinent data points. It will examine tangible outcomes for the organization including a return on investment calculation.



## PRE-WORK SCREEN TESTING PROTOCOL

The development of the PWS protocol for this study was initiated in August 2006 with the formation of a PWS Task Force to investigate potential screening protocols and the development of a viable action plan. The team determined that a functional testing approach would be most appropriate.

In November 2006 a formal Job Analysis was completed. The components of the Job Analysis included:

- a. Reviewing the current job descriptions
- b. Meeting with current job-holders to identify major job functions and daily operational tasks for each job function.
- c. Determining the physical demands of the work.
  - ✓ Activity Level
  - ✓ Functional Activities: Objectively measure the physical nature of these requirements:
    1. Reaching below / at / above shoulder level
    2. Pushing / Pulling
    3. Twisting / Bending
    4. Squatting / Stooping
    5. Climbing Stairs
    6. Climbing Ladders
    7. Walking
    8. Standing
    9. Sitting
    10. Repetitive Hand / Wrist Activity
    11. Fingering / Grasping / Handling
    12. Balancing
    13. Lift / Carry / Lower 0-10 lbs.
    14. Lift / Carry / Lower 10-30 lbs.
    15. Lift / Carry / Lower 31-50 lbs.
    16. Lift / Carry / Lower >50 lbs.
  - ✓ Talking Requirements
  - ✓ Hearing Requirements
  - ✓ Vision Requirements
  - ✓ Elevated Work Requirements
  - ✓ Confined Space Requirements
- d. Environmental Conditions
  - ✓ Environmental Factors
  - ✓ Percent of Time: Inside / Outside
  - ✓ Percent of Time: In temperature extremes



- ✓ Atmospheric Conditions
- e. Personal Protective Equipment
  - ✓ General: hard hat, foot wear, eye protection, hearing protection, etc.
- f. Mental Activity
  - ✓ Application: techniques and principles
  - ✓ Problem Solving
- g. Gathering the data and reviewing the findings with management, supervisors, and job-holders to discuss and provide final validation and sign-off on a completed document.

Concurrent with the Job Site Analysis was a Financial Analysis to determine the potential investment requirements, implementation costs and return on investment scenarios (November 2006).

During December of 2006 alternative testing protocols were developed and reviewed by the PWS Task Force. This led to the formation of a “Draft Test Protocol”.

In January and February 2007 two non-binding Mini-Pilots were conducted with existing fleet drivers to determine the impact of PWS implementation on the current fleet. The Mini-Pilots were deemed necessary to fully understand the implications of implementation and the resultant failure rate of the fleet. These results directly influenced the fleet’s recruitment efforts going forward. Upon completion of the Mini-Pilot finalized Testing Protocol was determined (See Figure 7. PWS Testing Protocol).

Over the next three months, equipment was purchased, third party external staffing was secured, facilities were prepared and both internal and external staff was trained at each of six regional on-boarding facilities of the fleet. The full program went live in May of 2007.

**Atlas Ergonomics**

*Pre-Work Screen Process*

This Pre-Work Screen has been designed to reflect the physical demands associated with the work at... Throughout the screening process your heart rate will be monitored. As a safety measure and per our testing procedure, your screen will be stopped if your heart rate meets or exceeds 90% of your age predicted maximum [(220 - age) X 0.9]. This is considered a failed screen.

 <b>Step Test (12" step)</b> 1 min.	 <b>Step/Step—Kneel/Kneel</b> 2 reps Ability to: Step up to / down from the cab, the trailer, and cat-walk
 <b>Squats</b> 10 reps Ability to: Perform repeated clutching Step up to / down from the cab, the trailer, and cat-walk Perform Pre-trip & Post-trip inspections	 <b>Floor to Waist Lift</b> 30 lbs. X 3 reps  60 lbs. X 3 reps Ability to: Load / unload freight
 <b>Front Carry—30 Feet</b> 30 lbs. X 1 rep  60 lbs. X 1 rep Ability to: Carry product / cargo the length of the trailer	 <b>Waist to Shoulder Lift</b> 20 lbs. X 3 reps  40 lbs. X 3 reps Ability to: Load / unload freight Raise the hood of the tractor
 <b>Floor to Head Lift</b> 30 lbs. X 1 rep Ability to: Lift personal gear into the cab (i.e., duffle bag)	 <b>Horizontal Push (80 lb. average)</b> 3 reps Ability to: Crank the dollies Open / Close trailer doors Utilize a "Pallet Jack"
 <b>Crouch</b> 2 reps Ability to: Perform Pre-trip & Post-trip inspections of the truck	 <b>Horizontal Pull (100 lb. average)</b> 3 reps Ability to: Crank the dollies Open / Close trailer doors Close / Lower tractor hood Enter the Tractor & Trailer "Pull the 5th Wheel" "Slide the Tandem" Utilize a "Pallet Jack"

Figure 7: PWS Testing Protocol



## DATA COLLECTION

The population for this study included all fleet drivers for a large truckload carrier. The total workforce during the time frame of the study was relatively stable at approximately 13,000 drivers. The population was predominantly male, at an average age of 40 years.

Data for this study came from two sources. The first source, the carrier's Health and Safety organization, provided four years of workplace injury and illness data; two years prior to the implementation of PWS (April 2005 through March 2007) and two years post PWS implementation (April 2007 through March of 2009). It is inclusive of the following elements:

- Injury Date
- Injury Claim Date
- Claim Status (open / closed)
- Incurred Costs
- Injury Type Description
- Injury Cause Description
- Body Part Description
- Lost Workdays
- Tenure
- Home Operating Center

It should be noted that the analysis relative to lost workdays will be limited within this study by the fact that the Post-PWS implementation data on lost workdays has not fully realized; lost workdays continue to accrue at the time of this study.

The second source of information was Atlas' outcomes data on approximately 20,000 screens obtained during two years after implementation (April 2007 through March of 2009). Data includes:

- Date of Testing
- Testing elements and relationship to commercial transportation
- Qualification standards and failure mode as applicable

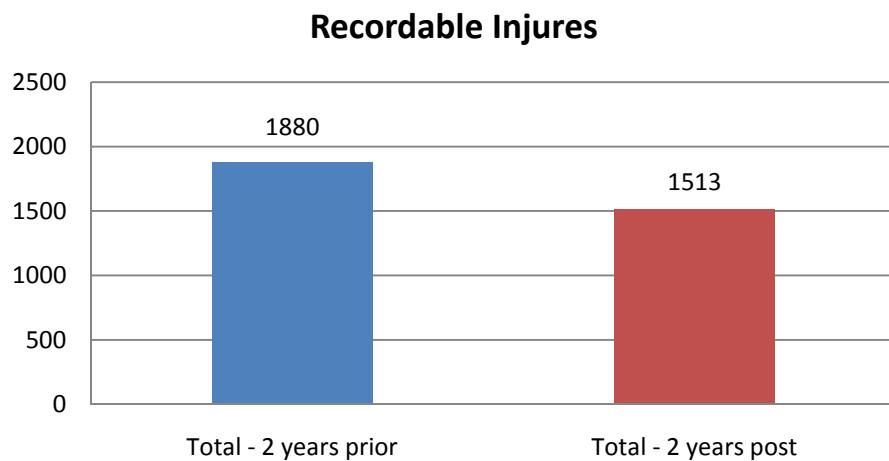
Finally, it is important to note that the employment pool of the two, two-year time frames of the study were virtually unchanged. Hence there was no need to normalize the data for the prevalence of injuries within the fleet of the duration of the study.



## PRE-WORK SCREEN OUTCOMES

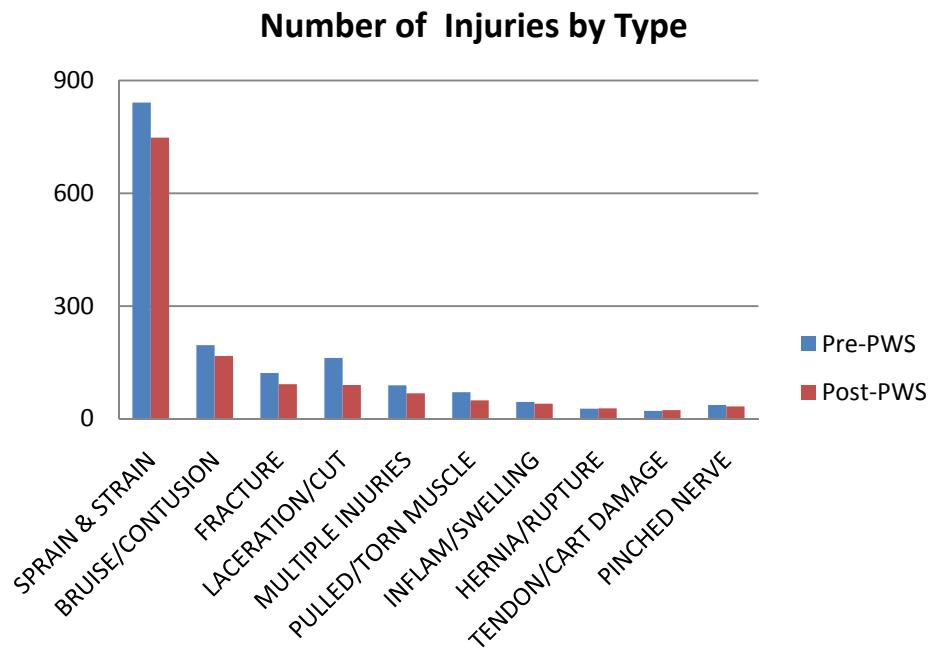
Over the course of the two year period from April 2007 through March 2009, 19,093 screens were performed. The population that was tested consisted largely of males, with 9% of the screening population being female. The age distribution of the population was broad with the mean age being 40. The physical stature of the population, as described through the body mass index (BMI), illustrated that the average applicant had a BMI of 31 and would be classified in an obese category (BMI  $\geq 30$ ).

Injury and illness data was reviewed for two two-year time frames: prior to and post PWS implementation. Comparisons of all recordable injuries demonstrated a 20% incidence reduction (1880 injuries vs. 1513 injuries).



**Figure 8: Number of Recordable Injuries**

Figure 9 outlines the Top Ten Injury Types over the four year time frame of our study. Sprains and strains, the majority of which are driven by over-exertion, are steadfastly anchored in the number one position for both of the two year time frames of the study. The data indicates that as a category, sprains and strains has a prevalence of over 4 times the next closest categorization, bruise / contusion. Considering the intrinsic relationship between the performance of heavy routine tasks performed within the industry (i.e., pulling of the 5<sup>th</sup> wheel / tandems, cranking of the dollies, freight loading / unloading) and the development of MSDs, it is a reasonable conclusion that the industry would be at high risk for the development of sprains and strains.



**Figure 9: Number of Injuries by Type of Injury**

As a result of the screening process, 1023 applicants failed the screen (5.4%). A review of the individual elements within the PWS protocol indicated that tests focusing on high force and cardiovascular challenging activities produced the most common points of failure. These failure points illustrate that the screens were targeting employees who were incapable of performing the heavy tasks required within the jobs. These employees represent a group that would be exerting a maximal effort every time they performed a critical task, and were thus at high risk for an overexertion injury. The significant reduction in sprains and strains seen within the pre and post implementation periods (see Figure 9) illustrates that the testing process had a direct impact on reducing risk to the company due to hiring employees incapable of completing tasks safely.

To further determine the impact of the PWS program the data was analyzed based on the causation of the injury. The causation categories used include such events as slips/falls, loading freight, cranking dollies, etc., are industry specific. Figure 10 illustrates the pre-/post- implementation injury rates by causation. Slips/falls are clearly the leading cause of all injuries by a factor of greater than four.

### Causation of Injury

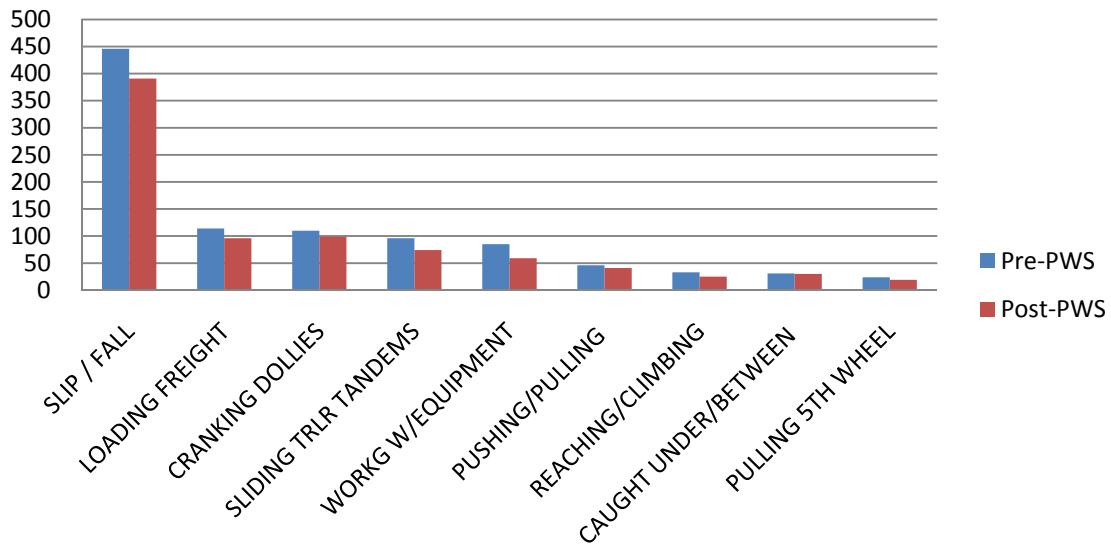


Figure 10: Number of Injuries by Causation

The high incidence rate of slips/falls in relation to the other values affects the scale of Figure 10, making it difficult to see the impact on the remaining causation types. Therefore, data on slips/falls has been removed in Figure 11 so as to provide a better visual, specific to these issues.

### Causation of Injury (Minus Slips / Falls)

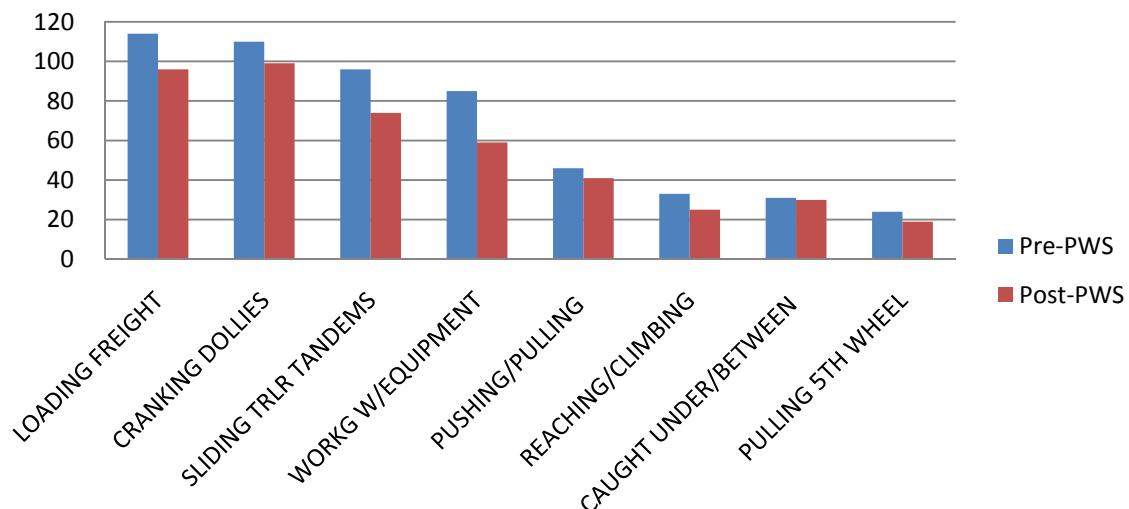


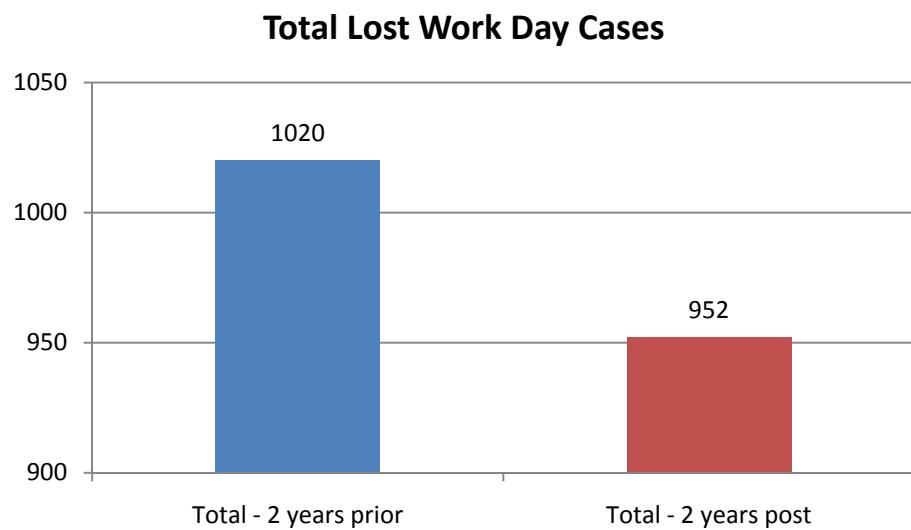
Figure 11: Number of Injuries by Causation (Minus Slip / Falls)



Virtually all of the identified heavy routine tasks performed within the industry demonstrated a reduction of injuries during the time frame of the study. The reduction of these injuries by causation ranged from 3% to 31%; with an average of 18% across all of the above identified causations. Despite not being directly addressed via the PWS testing protocol, this carrier experienced a 12% reduction in slips/falls during the time frame of the study. Many issues may play a role in the reduction of slips/falls injury events, not-with-standing, the consideration of a “more-fit” workforce should not be overlooked and should be considered for further study.

### **Lost Workday Cases (LWDC)**

By definition a Lost Workday Case (LWDC) is a recordable case that requires the injured worker to miss a minimum of one day away from work. Amongst the safety community, a LWDC is typically considered a severity index of an injury in that an injury that requires time away from work is generally more severe than an injury that does not require time away from the job. Most large organization will include LWDC's as a key measure of performance year over year. As noted earlier in this study, analysis relative to lost workdays will be limited within this study. That is not an issue with LWDC's, where within a few days of the injury event, the absolute majority of cases have been realized. Given the three month gap from the end of our data-set to the start of this data analysis, it is safe to say the virtually all LWDC's have been identified.



**Figure 12: Number of Lost Workday Cases**



Figure 12 illustrates a 7% reduction in the number of LWDC between the two reporting time-frames; with a total of 68 fewer LWDC.

As noted earlier in this study, the Lost Workdays per LWDC are a significant issue within the transportation and warehousing sectors with median days away from work of 14 days, double the national median<sup>14</sup>. Understand that this BLS data incorporates all warehousing and all segments of transportation industry, from local delivery drivers to long-haul, over-the-road drivers. A subset of this broader data set provides insight to the magnified issues associated with the long haul segment of the transportation industry. A two year data run for long haul trucking (manual class code 7229) indicates that across the insured marketplace, the range of Lost Workdays per LWDC equaled 74 - 126 days per case.<sup>15</sup>

Hence the 7% reduction in LWDC's has the potential of adding between 5000 - 6500 additional days of transport for the carrier. This is a pertinent issue for trucking fleets particularly when one has to consider the infrastructure and costs of sustaining an "on-boarding" training process to bring on drivers when demand is high and driver shortages exist. This represents one of the many Indirect Costs of an injury referred to early in this study.

### **Financial Impact of PWS Process**

In the two year time frame prior to the implementation of the PWS process, the carrier experienced 1880 injuries. The total cost associated with these 1880 injuries was approximately \$36 M of direct costs to the organization or an average cost per event of  $\approx \$19,000$ .

In the time frame post implementation of the PWS process, the carrier experienced 1513 injuries or 367 fewer injuries. Using the historical average cost per event of \$19,000 the carrier would have experienced a direct cost savings of \$6,973,000.00 over the two year period Post-PWS.

The delivery costs to perform the PWS process over the two year period were equal to \$1,107,000.00. Thus in terms of direct cost savings, the carrier saved \$6,973,000.00 over the investment of \$1,107,000.00 or approximately \$6.30 for every dollar invested into the program.

If one considers the Total Cost savings (Direct Cost + Indirect Costs) the payback on the investment of \$1,107,000.00 is substantial. Total cost savings for various multiples of Indirect Costs are noted in Figure 13.

<sup>14</sup> Source: Bureau of Labor Statistics, U.S. Department of Labor, Survey of Occupational Injuries and Illnesses. Nonfatal Occupational Injuries and Illnesses Case and Demographics, November 20, 2008.

<sup>15</sup> Proprietary insurance data of the studied Truckload Carrier.



	Indirect Multiple of 3	Indirect Multiple of 4	Indirect Multiple of 5	Indirect Multiple of 6	Indirect Multiple of 7
Direct Cost	\$6.9 M				
Indirect Cost	\$20.9 M	\$27.8 M	\$34.7 M	\$41.6 M	\$48.5 M
Total Cost	\$27.8 M	\$34.7 M	\$41.6 M	\$48.5 M	\$55.4 M

**Figure 13: Total Costs Savings of Pre-work Screening Process  
(Based on Multiples of Indirect Costs)**

Using the most conservative of estimates (Indirect Multiple of 3), the total cost savings equals \$27.8 million over the investment of \$1.1 million or approximately \$25.00 for every dollar invested in the program.



## CONCLUSIONS

Several studies have been published since the mid-1990's outlining the effectiveness of PWS programs. Reimers<sup>16</sup> et al found a significant decrease in injuries and injury related expenses over a 4 year period with an effective deployment of PWS combined with a work fitness program.

In 1999 Nassau<sup>17</sup> conducted 938 pre-work screens, of which 30 participants failed. When comparing the screened and non-screened groups Nassau identified that the average number of lost days in the screened group (0.83 days) was considerably lower than the unscreened group (3.83 days). Medical costs per 100 FTE were lower at \$311 compared to \$1,433, as were the number of injuries, 0.58 compared to 0.97.

Gassoway and Flory<sup>18</sup> conducted Pre-work Screens on 163 nursing assistants in 2000. A year later they compared the turnover rate, injury costs and injury rates to the group of 144 nursing assistants hired in the previous year. They found a slight decrease in injuries requiring medical intervention but a more significant decrease in job turnover rate. This study estimated a \$6 saving for every \$1 spent on screening.

Perhaps the most compelling study on the effectiveness of PWS was performed in 2003 by Littleton<sup>19</sup>. Physical plant applicants at the University of Illinois were tested and the results indicated that the number of lost workday cases decreased by 18% and the total injury cost decreased by 78%. Total cost savings were over \$18 per dollar spent on the program.

The commonalities within each of these studies were relatively straight forward:

1. A high-risk task was identified.
2. An elevated injury rate was noted for population performing the task.
3. Critical tasks could be identified that required high physical exertion.
4. Turnover rates resulted in continuous introduction of new hires into the work environment.

<sup>16</sup> Reimer, D., Halbrook, B., Dreyfuss, P., P.H. & Tibiletti, C., 1994, A Novel Approach to Pre-employment Worker Fitness Evaluations in a Material Handling Industry. *Spine* 19(18), 2026-2032

<sup>17</sup> Nassau, D. W., 1999, The Effect of Prework Functional Screening on Lowering an Employer's Injury Rate, Medical Costs and Lost Work Days. *Spine* 24(3), pp 269-274

<sup>18</sup> Gassoway, J. & Flory, V., 2000, Prework Screen: Is it helpful in reducing injuries and costs?. *Work* 15, 101-106.

<sup>19</sup> Littleton M., Cost-effectiveness of a prework screening program for the University of Illinois at Chicago Physical Plant. *Work* 21(2003) pp 243-250



These conditions created the opportunity for implementing a PWS program as a key component of a comprehensive ergonomics program. In this study, the exact same conditions were illustrated:

1. The evaluation of the physical demands of the tasks illustrated high force activities that would require a significant level of effort from many employees.
2. The injury rates, when evaluated by both type and causation, illustrated the commercial transportation industry has exposures that can lead to overexertion injuries. A high number of overexertion injuries indicate a strong mismatch between physical capabilities and job demands.
3. Specific tasks were identified as having the highest physical requirements, and these tasks generally involved short-term, high force activities that can result in overexertion injuries.
4. The commercial transportation industry as a whole, and the current study population included, experiences a relatively high level of turnover resulting in the continuous introduction of new hires to the workplace.

Given these conditions, the implementation of a PWS program was shown to be appropriate from both a safety and cost perspective. The PWS program implemented in this study provided positive results as shown by reductions in key injury types and a substantial financial return on investment.

A 7% reduction in LWDC's over a 2-year period post PWS implementation, with a significant reduction in injuries directly related to overexertion illustrates that a direct impact on core risk can be achieved through the PWS process. The cost of this program over the course of the 2-year period was covered by the approximate \$28 million in cost savings, resulting in a return of \$25 for every dollar spent in the program.

The results of this study provide further illustration of how a PWS program can be a strong component of a comprehensive ergonomics program. In upcoming papers by Atlas, control measures for current employees of a commercial transportation company will be evaluated to determine effective ergonomics measures to address and reduce risk further.

If there are any questions or comments related to this paper, they should be directed to [info@atlasergo.com](mailto:info@atlasergo.com).