Auto Manufacturing Injuries And Workers Compensation

BY

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THESIS

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LIST OF ABBREVIATIONS AND NOMENCLATURE

BLS	Bureau of Labor Statistics
EEC	European Economic Community
IADs	Intelligent Assist Devices
IWCC	Illinois Workers Compensation Commission
LO/TO	Lock Out/Tag Out
NAICS	North American Industry Classification System
OSHA	Occupational Safety and Health Administration
PPD	Permanent Partial Disability
PPE	Personal Protective Equipment
PTD	Permanent Total Disability
SIC	Standard Industrial Classification
SOII	Survey of Occupational Injuries and Illnesses
TPD	Temporary Partial Disability

LIST OF ABBREVIATIONS AND NOMENCLATURE (continued)

TTD	Temporary Total Disability
UAW	United Auto Workers

Summary

This study was conducted to compare Illinois Workers Compensation claim rates to national injury rates, identify the types of injuries that occur, identify monetary compensation amounts for injuries, and categorize types of workers compensation claims filed in auto manufacturing.

This study was conducted using a dataset from the Illinois Workers Compensation Commission (IWCC) that contained "claims" that had been filed between 1970 to the first quarter of 2008. We only included claims filed from 1995 to 2008 because this would capture any changes leading up to the United States peak in auto manufacturing (1999) as well as any changes that may have occurred in safety and health following the peak of auto manufacturing activity (Platzer, 2009). All cases in this study were from the North American Industry Classification System (NAICS) sector 3361 (motor vehicle manufacturing) in Illinois.

To determine which of the cases were in the auto manufacturing sector, we first obtained a list of automobile manufacturing companies and their addresses from Hoovers (http://www.hoovers.com), a company that publishes directories and databases of businesses.

We attempted to match every company in the "claims" dataset with the Hoovers list. However, the Hoovers database didn't identify the primary industry of the companies. For this reason, the United Auto Workers (UAW) Union research department was asked to help provide additional information on auto manufacturing sites, which they represent in Illinois. Ultimately

we narrowed the UAW sites down to 23 worksites within 19 different companies that were directly involved in auto manufacturing within Illinois.

From 1995 to 2008 14,277 claims were identified for companies with auto manufacturing names. However, many of the claims were for worksites unaffiliated with manufacturing automobiles (For example, Mitsubishi which makes both cars and electronics, and all the auto manufacturers which also have dealerships). When we narrowed this down further based on the UAW list the number of claims was reduced to 11,152.

There are three main claim categories; dismissed, in progress, and with a decision. For some calculations, “claims dismissed” (586) and “claims in progress” (1,186) were excluded from the total 11,152 claims. The total number of claims with final decisions was 9,380.

Disability can be broken down into five types of disability compensation (temporary partial disability, temporary total disability, permanent partial disability, permanent total disability, and disfigurement). In addition, there can be other types of settlements such as legal fees or medical costs.

Although there were 9,380 claims with final monetary decisions awarded to the workers, there were only 5,722 unique workers injured between 1995 and 2008. Of the 5,722 (61%) unique workers injured in the automotive injury that filed claims with the IWCC, 3,902

filed a claim only once, 980 workers filed two claims (a total of 1,960 claims), and 840 workers filed three or more claims during the 13 years of follow-up (a total of 3,518 claims).

Most injuries involved male workers (72.1%). Most injured workers were married (63.4%) and without children (55.2%). The mean age of workers on the date of injury was 42.3 years. The median time from the time a claim is filed to a decision is reached is 714 days (1.96 years) and a mean of 959 days (2.63 years).

Mitsubishi Motors had the highest number of overall claims 4,352 (46.4%) followed by Ford Motor Company 3,569 (38.1%), Chrysler 908 (9.68%), and Airtex 248 (2.64%). These four auto manufacturing assembly companies account for 9,077 (96.8%) of all the decided claims, the total number of claims filed by employees with a decision. The single year highest claim rate for any company was 27.36 per 100 employees for Mitsubishi in 1999!

The top five classifiable injuries were sprains or strains, carpal tunnel syndrome, surgeries, fractures, and lacerations. Claims classified as permanent partial disability (PPD) had a median percentage of disability of 15.00% (n = 5,224 and mean 17.73%). Claims classified as temporary total disability (TTD) had a mean number of weeks of 7.71 (n = 3,322 and mean of 12.64 weeks). The highest payout of body area was the upper extremities followed by back and spine and lower extremities.

The key findings of this study are that: 1) the auto manufacturing industry in Illinois has a very high claim rate compared to other industries, 2) assuming low turnover, 71% of the employees who work in the auto manufacturing industry have not only been injured, but they have also had to file a workers' compensation claim to get appropriately compensated, 3) claim rates differ substantially by worksite (highest 27.36 per 100 employees injured in one year), 4) our claim rates are comparable with Bureau of Labor Statistics (BLS) Survey of Occupational Injuries Illnesses (SOII) rates, but our claim rates represent only a fraction of total injuries, 5) claim rates should be lower than the recordable injury rates due to companies' rightfully paying for injuries which employees have obtained while working. However, companies are either: a) "forcing" every injured employee to take the injury to workers compensation or b) companies are paying for some injuries already on top of the workers compensation claims, which would mean that the BLS is underestimating the number of injuries which occur in the auto manufacturing industry.

I. INTRODUCTION

A. History

In the late 1700s Nicolas Joseph Cugnot invented the first known automobile. It was a steam driven tractor with three wheels which was used by the French army to move materials around Paris (Brianard, 2005). Although steam powered vehicles were produced first, the automotive industry really originated in the mid to late 1800s when the gasoline engine was developed. One of the advantages of the steam engine was that it did not require a complex transmission. On the contrary, steam engines were heavy, expensive to construct, and were harder to maintain than gasoline engines. By the early 1900s almost all automotive engines were gas powered and steam engines became obsolete (Encyclopedia Britannica, 2011).

Although the automobile was rooted in Europe in the late 1900s, the United States conquered the automotive industry for the first half of the 20th century. One of the main reasons for the United States domination was because of the invention of mass production. Henry Ford integrated the concept of mass production into the auto manufacturing process. Ford had a vision of his dream car and designed his “car for the great multitude” (Encyclopedia Britannica, 2011) first, then began to figure out how to produce it cheaply. Ford’s dream car, more commonly known as the Model-T, is one of, if not the best known automobile in history. The Model-T was designed and built to be durable for bumpy and rough early American country roads of the period. Likewise Ford designed the Model-T to be economical to operate, easy to maintain, and simple to repair (Encyclopedia Britannica, 2011). The Model-T first took the

market in 1908 and the same model stayed on the market until it was discontinued in 1927. Over that time period, over 15 million Model-Ts were built.

As soon as the Model-T proved to be successful, Ford quickly began to think of a way of to produce the Model-T in large quantities, while at the same time at low cost. His resolution to the problem was the invention of the assembly line. After some experimentation and trials, in 1913 Ford Motor Company displayed to the public the complete assembly line developed for mass producing their automobiles. The assembly line was made up of two parts. The first was a conveyer system and the second was that each worker was to do a single repetitive task. This allowed each worker to specialize and become efficient and skilled in that one task rather than be less efficient at all the tasks. However, the assembly line technique did require lengthy planning and precise timing to keep the line on pace.

One of the limitations of Ford's assembly line was that it only allowed minor modifications to the base model. This was partially to help keep the cost of the Model-T down. During the Model-T years, the price dropped from $950 in 1909 to $360 in 1916 and eventually even lower to $290 in 1926. By that time Ford was producing half of all automobiles in the world (Encyclopedia Britannica, 2011).

After Ford's success with the assembly line and Model-T, others took notice and imitation and competition followed. Ford remained unchallenged until the mid 1920s because Ford refused to accept that the Model-T had became out modeled. Competition of more luxurious and stylish cars began to come about with price tags not much higher than that of the

Model-T. In addition, automobiles were becoming progressively more available for purchasing through the used car market.

In the late 1920s the “Big Three” (Ford, General Motors, and Chrysler Corporation) were responsible for more than 75% of the United States automobile market. Most of the remainder was divided up between the next five largest auto manufacturers (Hudson, Nash, Packard, Studebaker, and Willys-Overland). In less than a decade the number of automobile manufacturers had dropped from more than a hundred to less than 50. Coupled with the depression of the 1930s all but the largest automobile manufacturers had been eliminated in the industry. As a result, the supremacy of the “Big Three” got even greater. The automotive vehicle production had declined from its peak in the late 1920s of excess of five million to just over one million in the early 1930s. It did rise again, but at a slow pace and did not return until World War II started.

After World War II had come to a halt, there was a major explosion in automobile production. During the next 35 year period, the world’s total automobile output increased almost ten times. The largest increase in automobile production came outside of the United States. Even with the American automobile production continuing to increase, its fraction of the World’s total automotive production decreased from approximately 80% to approximately 20%. Conversely, the United States remained the leading producer in automobiles until the recession in the early 1980s (Encyclopedia Britannica, 2011).

At the beginning of the recession in the early 1980s, the majority of the United States automotive industry was mostly split among four firms, General Motors, Ford, Chrysler, and AMC. Besides the four that had a majority of the United States auto industry there were a few producers of specialized vehicles and a small assortment of companies that produced automotive parts and components (Encyclopedia Britannica, 2011).

Japan, which had little to do with auto manufacturing before the war, became the world's leading producer of automobiles. The second leading producer was the European Economic Community (EEC). It took until 1994 for the United States to regain the title as the leader. Part of the reason the United States took over was because foreign owned auto manufacturers began building more of their cars in factories in their major overseas markets, such as the United States. Part of the reason manufacturers began to build overseas can be credited to economic and political pressure in those markets. Although the United States auto manufacturing market was controlled by United States owned manufacturers through the end of the 20th century, new European and Japanese automaker manufacturing facilities in the United Sates helped increase foreign owned companies' share of the United States and world markets.

B. Employment

As of 2008 the total auto manufacturing industry in the United Sates employed 880,000 workers (Platzer, 2009). In the early 2000s the auto manufacturing industry had gotten rid of more than 435,000 jobs in the United Sates. Initially it fell below 1 million jobs in 2007 and then

down to 880,000 in 2008 (Table I). According to the BLS, in 2009 there were 155,477 workers employed in the motor vehicle manufacturing industry subsector (NAICS 3361) and preliminary data for 2010 is indicating another decline with slightly over 150,000 employees. In 2008, employment in the motor vehicle manufacturing subsector (NAICS 3361) constituted approximately 1.5% (n = 196,000) of all the United States manufacturing industry employment. According to the BLS, 29% of workers in the motor vehicle and parts manufacturing industry worked more than 40 hours a week in 2008 (Bureau of Labor Statistics, 2011).

The BLS Quarterly Census of Employment and Wages indicates that from 2001 to 2009 the number of employees in the Illinois motor vehicle manufacturing sector (NAICS 3361) fell by 52% (Table II). It also indicates that in 2008 there were 24 establishments (worksites) listed for the NAICS 3361 sector in Illinois. In our study, we found 23 establishments in auto manufacturing. In 2008 there were 6,845 people employed in 3361 in Illinois with an average weekly wage of $1,339 compared to $998 for NAICS 336 (transportation equipment manufacturing), and $976 of all other sectors in Illinois combined.

Table I

UNITED STATES MOTOR VEHICLE MANUFACTURING EMPLOYMENT (NUMBER EMPLOYEES, IN THOUSANDS)

Industry Segment	1990	2000	2003	2007	2008
Motor Vehicle Mfg. (NAICS 3361)	261	292	258	222	196
Motor Vehicle Body and Trailer Mfg. (NAICS 3362)	128	188	153	166	143
Motor Vehicle Parts Mfg. (NAICS 3363)	729	835	700	605	541
Motor Vehicle Mfg. (Employment Total)	1,118	1,315	1,111	993	880
Manufacturing Employment	17,797	17,314	14,460	13,833	13,383
Motor Vehicle Mfg. as % of Total Mfg. Employment	6.30%	7.60%	7.70%	7.20%	6.60%

Source: U.S. Department of Labor. Bureau of Labor Statistics, Quarterly Census of Employment and Wages (QCEW), July 27, 2009. http://bls.gov/cew/.

Table II

ILLINOIS MOTOR VEHICLE MANUFACTURING EMPLOYMENT (ESTIMATED NUMBER OF EMPLOYEES)

Industry Segment	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Motor Vehicle Mfg. (NAICS 3361)	8,716	8,459	8,423	7,908	7,450	7,655	7,819	6,548	4,184
Motor Vehicle Body and Trailer Mfg. (NAICS 3362)	4,743	3,993	3,642	3,623	3,797	3,671	3,618	3,455	2,854
Motor Vehicle Parts Mfg. (NAICS 3363)	31,101	29,965	29,052	39,113	28,072	28,077	27,112	24,279	18,617
Vehicle Mfg. (Employment Total)	44,560	42,417	41,117	50,644	39,319	39,403	38,549	34,282	25,655

Bureau of Labor Statistics. U.S. Department of Labor. Quarterly Census of Employment and Wages.

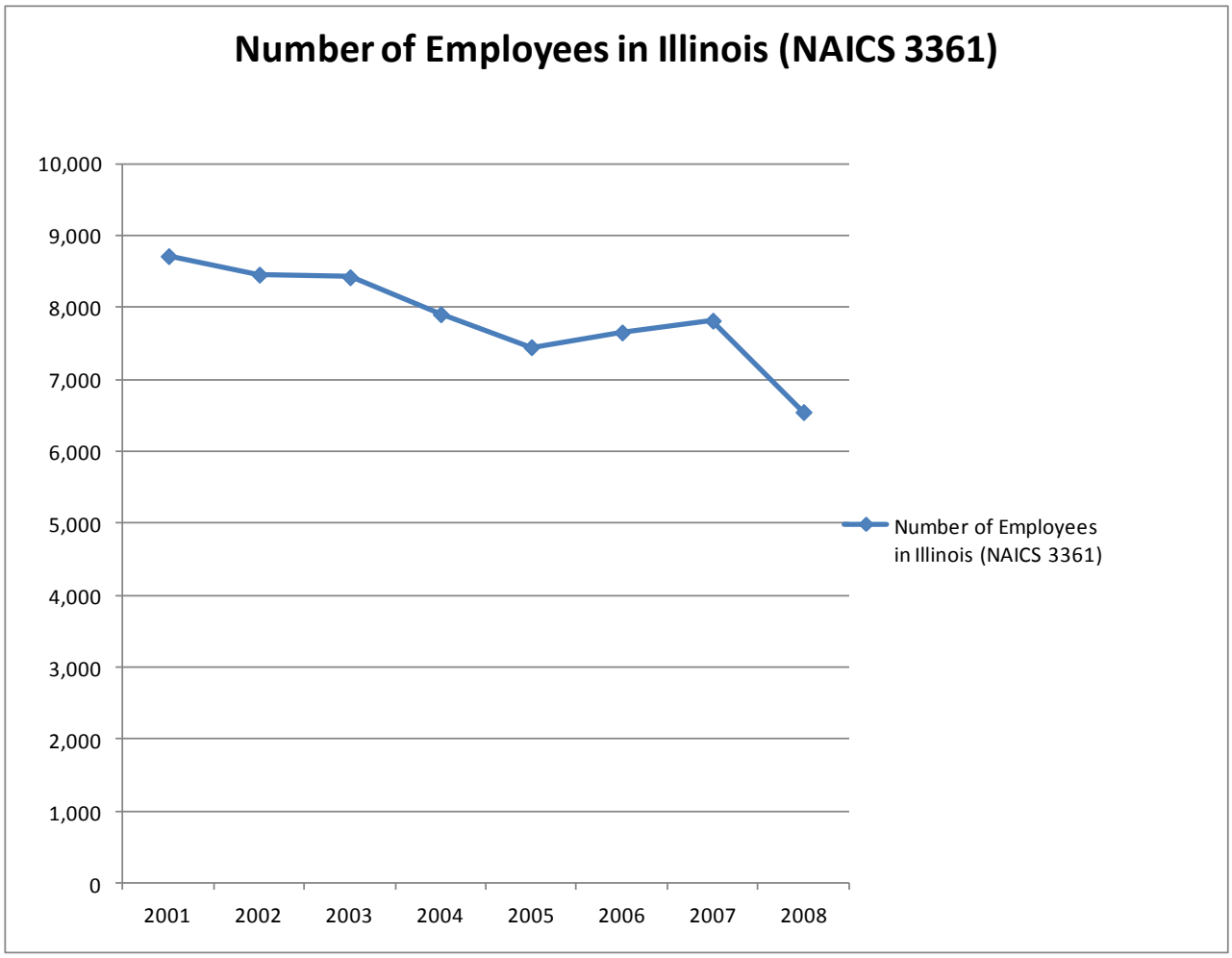

Figure 1. Number of Employees in Illinois (NAICS 3361) Bureau of Labor Statistics. U.S. Department of Labor. Quarterly Census of Employment and Wage.

The "Big Three" have had a major setback throughout the last decade. From 2001 to 2008, market share for domestic automotive manufacturers fell from 64.5% to 47.5% (Platzer,

2009). In particular this has been devastating to the major auto manufacturing states of Michigan, Indiana, and Ohio. In these three major auto manufacturing states, alone, the workforce in auto manufacturing has dropped by 152,000 jobs in five years, from 2004 through 2009. The United States auto manufacturing industry is expected to continue to decrease further over the next few years. General Motors is expected to close 14 plants and cut 21,000 jobs as part of its government bankruptcy plan (Johnson, 2009).

However, on the contrast, many foreign owned companies are now opening auto manufacturing plants in the United States. Toyota was supposed to open an auto manufacturing plant in Tupelo, Mississippi in 2010, but has put that on hold. When the plant opens, it is planned to employ approximately 2,000 workers (Chambers, 2011). This new facility will not be unionized. In 2009 Kia opened a one billion dollar auto manufacturing plant in West Point, Georgia. Kia had 43,000 applicants in less than 30 days for 2,500 positions at the new plan (Atlanta Business Chronicle, 2008). However, these new jobs are non-union. Although the non-union worksites generally receive comparable wages to union sites, the benefit packages are substantially reduced in addition to lower job security. In Chattanooga, Tennessee, Volkswagen opened an auto manufacturing plant in spring of 2011 and hired more than 2,000 employees at its new facility (Atlanta Business Chronicle, 2008). The shift of areas from the Midwest to the South for auto manufacturing may be due to the strength of the UAW in the Midwest where virtually all auto manufacturing plant workers are represented by the UAW. The new plants in the South are likely to find applicants “lining up” to take jobs because of the current economic status of the United States economy.

C. Occupational Safety

As technology has evolved, so has the automation in automobile assembly facilities. Today auto manufacturing plants use hundreds of robots to help assemble vehicles (Modern Automobile Manufacturing). In the past decades vehicles were assembled by humans doing the majority of the work. However, there are some limitations to what robots can do, such as fragile tasks (Business & Economics Research Advisor, 2004). The advantages of using robots are that they can reduce or eliminate ergonomic concerns and injuries, improve general safety, have higher quality outputs, speed up productivity, and are less costly to "employ" than human beings (Business & Economics Research Advisor, 2004). This is particularly important for ergonomic working conditions because using robots can help reduce the three major factors for ergonomic injuries: awkward posture, repetition, and excessive force.

Due to rising health care costs and injuries in auto manufacturing, companies have looked for ways to prevent and lower injury occurrence in the auto manufacturing industry. In one particular instance there was a partnership between a variety of automobile manufacturers and Ohio State University to form the Center for Occupational Health in Automotive Manufacturing (Center for Occupational Health in Automotive Manufacturing).

According to the Center for Occupational Health in Automotive Manufacturing (Center for Occupational Health in Automotive Manufacturing), the big three manufacturers spend more money on health care than on steel, which is one of the main components of the automobile. In addition, health care costs are approaching $2,000 per vehicle produced for the big three (Center for Occupational Health in Automotive Manufacturing, 2011). The goal of

partnerships like this are to find new ways to reduce injuries and medical costs by studying worker injuries and improving manufacturing practices to make for safer working conditions. Other factors considered during the partnership are increasing productivity and raising automobile quality.

On the contrast, automation and robotics can create additional hazards beyond the biomechanical ones. By automating processes, hazards which were not there when humans were doing the job, may be created. Machines do not have eyes to see that a worker is in the area and will continue the process it is doing even if the worker is “in the way”, whereas if an employee were doing the task (in lieu of the robot) he/she could stop if another employee were in harm’s way. Some ways to help control the additional hazards are by properly safeguarding robots, machines, and equipment, putting warning lights or sounds on them, having automatic shutoffs, among other safety precautions. Examples of this may be light shields, lasers, interlocks, and cameras, though those may be expensive. Additionally, machinery also requires maintenance (such as greasing, filter changes, and seal replacement). During preventive maintenance operations and in malfunction, the machines require maintenance employees to repair or work on them. This can be a dangerous task due to workers doing non-routine tasks and dealing with hazards they may not normally encounter or be familiar with. Furthermore, robots and machinery have pinch points, rotating parts, heat sources, and other injury sources. Machine guarding to prevent injuries can be costly, as well. Finally, when machinery is being worked on it must have all sources of energy locked out and controlled or lock out/tag out (LO/TO) to eliminate additional hazards; robots and machinery could require complete line shut

downs to repair or maintain the machines, whereas having humans to do these jobs could create less “out of commission” portions of the line, and allow some parts of production to continue.

Table III

HAZARDS OF AUTO MANUFACTURING

Physical	Pinch points
	Noise exposure
	Hot work environment
	Struck by/Impact
	Vibration
	Burns
Chemical	Oil
	Grease
	Paint fumes
	Welding fumes
Ergonomic	Awkward posture
	Repetitive motions
	Excessive force
Psychological	Work related stress
	Job security
	High injury industry
	Automotive economy

While working conditions have improved in recent years, there are still many hazards in auto manufacturing (Table III). There are numerous hazardous conditions that include: a hot

working environment; exposures to fumes; noise; and ergonomic factors such as awkward postures, repetition, and force; lifting heavy objects is still seen in auto manufacturing. In some cases, workers are exposed to chemicals, solvents, oils, or grease through inhalation and skin contact. Pinch points and exposed machinery can also present hazards, unless properly guarded. Slips, trips, and falls due to objects in the way or liquids on the floor are not uncommon. Auto workers may be struck by moving equipment or "flying" parts and hand tools. Finally, welding arcs which are very prevalent throughout auto manufacturing sites are hazardous to the eyes.

New equipment such as hydraulic lifts, zero gravity lifts, machine guarding, automation, and other engineering controls have helped eliminate hazards. Other control measures include administrative controls, such as rotating workers in and out of jobs, taking breaks to address fatigue, conducting regular safety meetings, and use of personal protective equipment (PPE), such as goggles, gloves, respirators, and aprons. Finally, by properly designing work areas to fit the worker; awkward postures, excessive force, and sometimes even repetitive motion can be reduced or eliminated. Awkward postures can be reduced by the height limitations, reach limitations, and other limitations of the work being conducted; excessive force can be reduced by using lift assisting devices to do the lifting for the worker while the worker does the guiding of the machine: repetitive motion may be reduced if parts are placed in a "worker friendly" location, if parts can be pre-assembled ahead of time, or if machines can operate several items at once (example: tightening multiple bolts at one time instead of individually).

Table IV

STUDIES IN AUTO MANUFACTURING

Author	Title	Setting	Source	Study Design	# Workers / Cases / Injuries	Findings
Dong-U.K., Park	A survey for rhinitis in an automotive ring manufacturing plant	One plant in Seoul Korea	*Industrial Health (2008)*	Cohort	115	Rhinitis was confirmed in 99 of 115 workers who were medically examined and exposed to metal working fluids. 10 of 19 grinding workers had rhinitis. 67 of 142 production workers, and 22 of 26 quality control workers. These rates are much higher than the rates of rhinitis related automobile plants and other occupational settings. This study concludes that exposure to metal working fluid aerosol, which would contain microbes and metals could contribute to a high occurrence of rhinitis in grinding and production workers.
Ferguson, Sue	Musculoskeletal disorder risk as a function of vehicle rotation angle during assembly tasks	The Ohio State University, Biodynamics Laboratory, Center for Occupational Health in Automotive Manufacturing	*Applied Ergonomics (2011)*	Experimental Study	12	Spine loads, posture, shoulder posture and muscle activity, neck posture and muscle activity, and wrist posture were all assessed during the study. In all areas of the study rotating the vehicle reduced the musculoskeletal exposure to workers. The study showed that vehicle rotation during production can reduce musculoskeletal disorders during the automobile assembly tasks.
Graham, Ryan	Effectiveness of an on-body lifting aid at reducing low back physical demands during an automotive assembly task: Assessment of EMG response and user acceptability	One automotive assembly plant	*Applied Ergonomics (2009)*	Experimental Study	10	Surface EMG data concerning the lower back and abdomen were collected at six sites to investigate the effectiveness and user acceptability of a personal lift-assist device (PLAD). The operators jobs require forward bending and static holding. The use of the PLAD significantly reduced the thoracic and lumbar erector spinal activity and EMG predicted compression at the 10th, 50th, and 90th percentile level without significantly increasing rectus abdominus activity or trunk flexion.

Table IV (continued)

Author	Title	Setting	Source	Study Design	# Workers / Cases / Injuries	Findings
Nelson, Nancy	Cumulative trauma disorders of the hand and wrist in the auto industry	Five U.S. auto plants over two years 1984-1987.	*American Journal of Public Health (1992)*	Cohort	209 cases	Results indicate that hand and wrist disorders may be more common in foundries than in other types of automotive plants. Also, in assembly plants, employees in certain departments appear to be at a higher risk for cumulative trauma disorders.
Park, Robert	A Survey of Mortality at Two Automotive Engine Manufacturing Plants	Two Detroit based engine plants employees who worked between 1966 to 1987 and died between 1970 to 1989.	*American Journal of Industrial Medicine (1996)*	Cohort	1,870 Decedents	Stomach cancer mortality increased with duration in camshaft and crankshaft production in Plant 1 (OR = 5.1, 95% CI = 1.6,17) likely due to nitrosamines present. Pancreas cancer risk at both plants for workers ever employed in inspection was increased (OR = 6.4, 95% CI = 2.5,16), machining with straight oil (OR = 3.6, 95% CI = 1.04, 12), and in skilled trades (OR = 3.9, 95% CI = 1.4, 11). Lung cancer was increased in cylinder head machining (OR = 3.9, 95% CI = 1.4, 11), millwright work (OR = 3.8, 95% CI = 1.6, 9.0). Potential lung carcinogens included heat treatment emissions, chlorinated oils, and coal tar fumes. Bladder cancer was increased for workers grinding in straight oil (OR = 3.0, 95% CI = 1.15, 7.8) and in machining/heat-treat operations (OR = 2.9, 95% CI = 1.14, 7.2).

Table IV (continued)

Author	Title	Setting	Source	Study Design	# Workers / Cases / Injuries	Findings
Punett, L.	Ergonomic stressors and upper extremity musculoskeletal disorders in automobile manufacturing: a one year follow up study	One automotive stamping plant in Detroit, Michigan in 1993-1994.	*Journal of Occupational and Environmental Medicine (2004)*	Cohort	820	The cumulative incident of upper extremity disorders was 14% by symptoms and 12% by symptoms plus examination findings. The rates increased with the level of physical exposures primarily among subjects who had the same jobs at the follow up time as at baseline time. Increased exposure during follow up increased risk of incidence. The persistence of upper extremity disorders from baseline to follow up examinitation was nearly 60% and somewhat associated with the baseline exposure score.
Spallek, Michael	Work related musculoskeletal disorders in the automotive industry due to repetitive work implications for rehabilitation	Two automotive plants in Germany	*Journal of Occupational Medicine and Toxicology (2010)*	First part: Cross-Sectional Second part: Cohort	276	Rates of musculoskeletal complaints were higher among experienced workers doing new tasks and younger trainees. The most common MSD in the group were disorders of flexor tendons of the forearm.
Vena, J. E.	Mortality of workers in a an automobile engine and parts manufacturing complex	Three unions representing automobile forge, foundry, and engine plants. Death certificates for workers from 1970-1979.	*British Journal of Industrial Medicine (1985)*	Cohort	821	Workers who were employed 20 or more years had increased mortality ratios for cancers of the digestive system (1.9), cancer of the pancreas (2.3), and cancer of the rectum (2.8). Workers who began working during or prior to 1950 had an increased proportionate mortality ratio for cancers of the digestive organs (1.8), pancreas (2.5) and the bladder (3.4). Workers who started after 1950 had raised PMRs for cancer of the respirator system (1.5) and the kidney (3.2).

Table IV (continued)

Author	Title	Setting	Source	Study Design	# Workers / Cases / Injuries	Findings
Warner, Margaret	Acute traumatic Injuries in automotive manufacturing	54 facilities in 29 states within the U.S. (9 assembly, 3 stamping, 8 power train, 19 parts depots/distribution centers, and 15 administrative/design offices from 1989 to 1991.	*American Journal of Industrial Medicine (1998)*	Cohort	35,483 Injuries	The most common injuries in auto manufacting were sprains/strains (39%), lacerations (22%), and contusions (15%). Forty nine percent of injuries resulted in one or more lost or restricted workdays. Sprains/strains were responsible for 65% of all lost workdays. Injury rates varied widely among plants.
Werner, Robert	Incidence of carpal tunnel syndrome among automobile assembly workers and assessment of risk factors	One automotive assembly plant in the U.S.	*Journal of Occupational and Environmental Medicine (2005)*	Cohort	189	The estimated annual incidence rate of carpal tunnel syndrome ranged from 1% to 10% depending on the case definition. Significant predictors for carpal tunnel syndrome included a higher baseline, median ulnar peak latency difference, history of wrist/hand/finger tendonitis, history of diabetes, nonneutral wrist and elbow postures, and a lower self-reported social support.

Table IV (continued)

Author	Title	Setting	Source	Study Design	# Workers / Cases / Injuries	Findings
Woskie, Susan	Size-selective pulmonary dose indices for metal-working fluid aerosols in machining and grinding operations in the automobile manufacturing industry	Three automotive parts manufacturers	American Industrial Hygiene Journal (1994)	Cohort	475	Exposures were assessed in conjunction with epidemiological studies of the mortality and respiratory morbidity experiences of workers at the three plants. Results obtained from personal impactor samples with predictions from an aerosol-deposition model for the human respiratory tract showed a high correlation. However, the amount collected on the impactor stage underestimates extrathoracic deposition and overestimates tracheobronchial and alveolar deposition. Finally, there was no significant difference between impactor concentrations and deposition-model concentrations that were used to estimate the cumulative thoracic concentrations for work lives.

In a group effort between Northwestern University and General Motors intelligent assist devices (IADs) are being researched. The “hybrid” devices help direct physical interaction with humans. They are designed to reduce ergonomic concerns while improving safety, quality, and productivity (Akella, 1999). The main driving force behind this approach is to reduce ergonomics concerns and improve safety, quality, and production all at once. The concept is based on three things: inertia management, power assistance, and force amplification. Inertia is to be minimized, as felt by the operator; power assistance is to compensate for frictional, acceleration, and deceleration forces; and force amplification compensates for frictional and gravitational forces (similar to how power steering in a car minimizes the drivers effort) (Akella, 1999). Some secondary advantages of this method are less energy used than by machines, flexibility to switch over to new vehicles quickly, error proofing (a worker could see if he/she were placing the wrong vehicle badge on a machine, whereas a computer couldn’t), and tool development efficiency (the same “transmission” or “guts” of the IAD can be used in multiple devices).

Auto manufacturing has some controls in place already, although, controls can vary greatly from plant to plant. The industrial hygiene hierarchy of controls is first: elimination, substitution, engineering controls; second, administrative controls; and third, PPE. “Engineering out” or “substituting out” a problem is a failsafe way to prevent injury, contrasted with relying on the company to provide appropriate PPE and employees to use it.

Some examples of current controls in place for each group are as follows. Elimination could be done by assembling groups of parts prior to complete, overall assembly of the vehicle

(i.e., transmission, airbag, exhaust). This could eliminate awkward postures that may be created if everything were assembled at the time the vehicle was being built. Substitution is the next way to control hazards. Examples of substitution controls could be using less hazardous paints and chemicals or using stamping machines instead of manually bending metal. Engineering controls are used to move the worker out of the hazardous exposure scenario. Some engineering controls are automated spray booths, automated welding to remove hazards the worker my otherwise encounter, and use of robots. Administrative controls are policies or procedural rules. Examples are rotating workers through different jobs to reduce excessive exposure at one point in the process, having restricted areas, or training for employees. Finally, the last way to control hazards is with the use of PPE. Some forms of PPE are safety glasses, cut resistant gloves, and respiratory protection.

When it comes to injuries and illnesses, the auto manufacturing industry (NAICS Code 3361) has had higher total recordable cases than the general manufacturing industry. This is shown in the tables below.

Table V

TOTAL RECORDABLE INJURY CASES, PER 100 FULL TIME WORKERS (TOTAL U.S.)

Year	Motor Vehicle Manufacturing (NAICS 3361)	General Manufacturing
2003	10.2	6
2004	8.7	5.9
2005	8.9	5.6
2006	8.2	5.5
2007	6.8	5.1
2008	5.9	4.6
2009	5.7	3.9

BLS. U.S. Department of Labor. Total Recordable Injury Cases

Table VI

DAYS AWAY, JOB RESTRICTION, OR TRANSFER, PER 100 WORKERS (TOTAL U.S.)

Year	Motor Vehicle Manufacturing (NAICS 336100)	General Manufacturing
2003	9.3	3.8
2004	7.7	3.6
2005	7.7	3.5
2006	6.5	3.3
2007	5.0	3.0
2008	3.9	2.7
2009	3.8	2.3

BLS. U.S. Department of Labor. Nonfatal cases involving days away from work, job restriction, or transfer

Although the motor vehicle manufacturing industry still has a higher number of total recordable cases, the number decreased in the years 2003 to 2009. This might be credited to the more automated and newer auto manufacturing facilities. Many tasks have reduced the number of repetitions now needed by a worker and workstations are adjustable to fit the worker, making them more ergonomically friendly.

D. Workers Compensation

Workers compensation is a way of ensuring that injured employees get timely compensation for their injuries as well protecting employers from being sued by employees. Workers compensation came about to limit employer liability while allowing workers to recover health care and time lost costs without a lengthy, expensive, contentious court case. In the current workers' compensation system, workers are compensated for their work-related injuries regardless of fault of the injury. Employees gave up the right to sue employers for their injuries (unless in rare cases where employers knowingly put employees at risk), which saved companies from large settlements which they might get sued for.

Illinois Workers' Compensation first took effect in 1913 (Illinois Workers' Compensation Handbook, 2011). Called the Illinois Workers' Compensation Act, it was put in place to "promote the general welfare of the people of the State by providing compensation for accidental injuries or death suffered in the course of employment within the State, and without this State where the contract of employment is made within the State" (Illinois Workers'

Compensation Act, 2011). The IWCC acts to resolve disputes between injured employees and their employers from injuries or illnesses that have occurred while working.

If an employee is injured and misses three days of work for the injury or illness, a first report of Injury should be filed with IWCC. This registers the events, and results in a document being sent to the injured or ill employee about his rights and how workers compensation proceeds in Illinois. If the injury is accepted by the employer as being occupational, the employer (or its workers compensation insurer) is responsible for covering medical bills and lost wages for time lost from work. When the injured employee is not satisfied with the payment, he or she may file a claim with IWCC. A claim is opened when a worker files an application for adjustment of claim along with a proof of service stating that the employer was given a copy as well. This can be done in person or by mail. Once filed, an arbitrator listens to the workers' compensation claim and will make a decision on the case. Additionally, at any point, the employer can settle the claim independently of the IWCC (Illinois Workers' Compensation Act, 2011). Barring an emergency, the arbitrator cannot resolve the case until the worker has finished healing (reached "maximal medical improvement"). The case is then set for a status call every two months. At that time the parties may request a trial or the case is continued for another two months. If not settled after three years, the arbitrator may dismiss the case unless there is good reason to continue it (Illinois Workers' Compensation Handbook, 2011). Once the worker is healed, the arbitrator schedules a trial and issues a decision within 60 days, stating the amount of benefits to which the employee is entitled (Illinois Workers' Compensation Handbook, 2011). If the employee or employer is unhappy with the ruling they can appeal the

case before a panel of three commissioners. If agreement is not reached, the case may move into the Civil Court system.

Figure 2 shows the number of cases going through the IWCC system at each level.

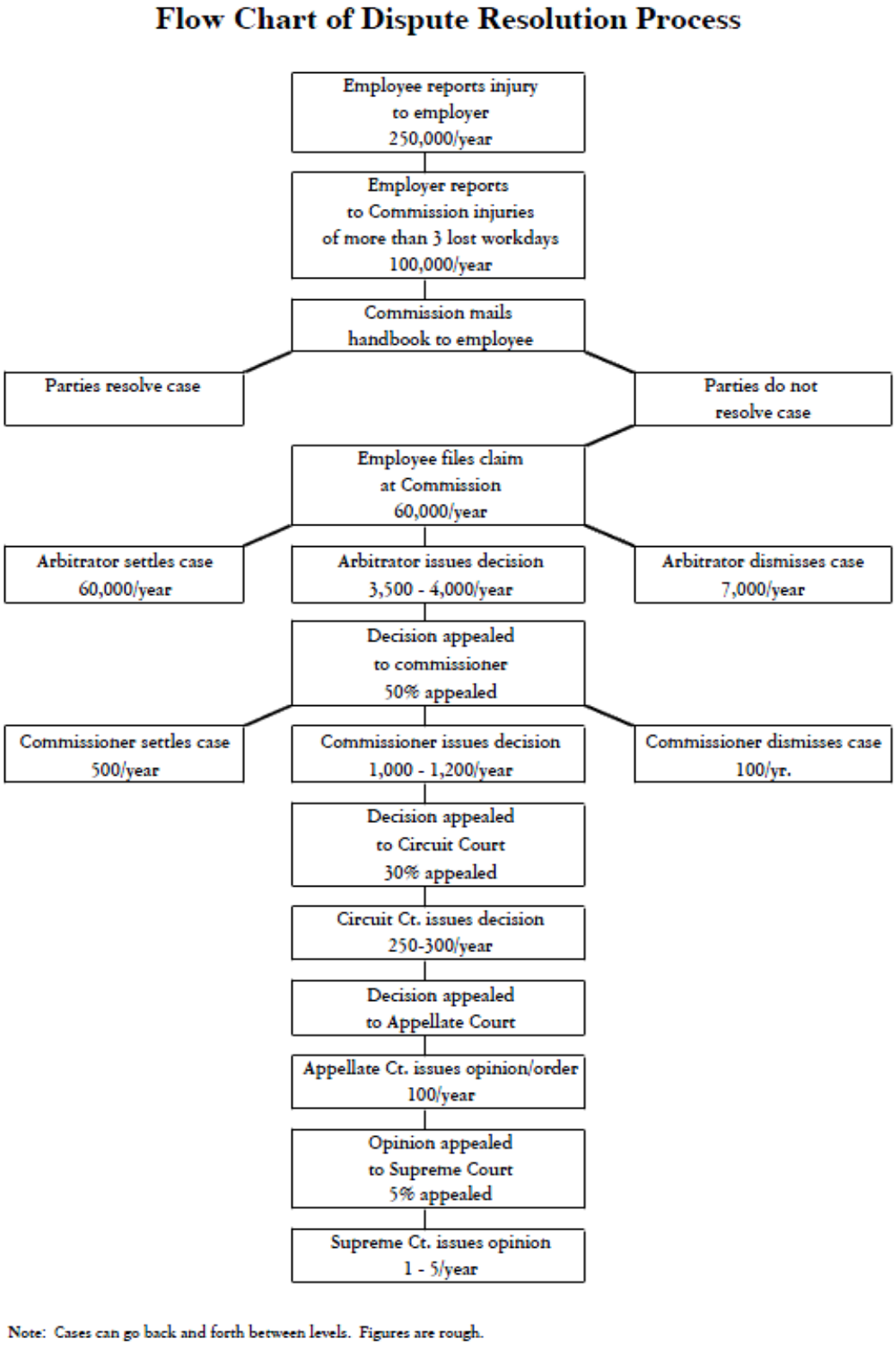

Figure 2. Flowchart of dispute resolution process.
IWCC Handbook, Page 18

II. METHODS

A. Data Source

The IWCC provided us with a dataset containing "*Claims*" that were filed between 1970 and the first quarter of 2008. Data included claims that have already been decided, claims in progress, and claims that have been "thrown out" or dismissed. The data set contains the following variables: employer information (company name and company address), employee information (state, zip code, age, sex, marital status, and number of dependents), compensation costs (medical fees, lost wages, attorney fees, burial costs, and dependent benefits), as well as case identification numbers, nature of injury, percent of loss, accident type, part of body code, accident location, date filed, date closed, date of accident, and decision type (temporary partial disability, temporary total disability, permanent partial disability, and permanent total disability). The costs paid include those stemming from decisions made on appeals or general settlements. The compensation costs are actual costs and are not adjusted for inflation. For this study, we included only claims filed from 1995 to 2008 because this would capture any changes leading up to the United States peak in auto manufacturing (1999) as well as any changes that may have occurred in auto manufacturing safety and health following the peak of United States auto manufacturing activity (Platzer, 2009).

B. Case Definition

Cases in this study were from NAICS 3361 (motor vehicle manufacturing) in Illinois. A fourteen year period was used for cases, from 1995 to 2008.

C. Case Ascertainment

The IWCC *Claims* database does not include information on industrial sector for neither the Standard Industrial Classification (SIC) nor NAICS codes. To determine which of the cases came from automobile manufacturing, we obtained a list of automobile manufacturing companies and their addresses from Hoovers (http://www.hoovers.com), a company that publishes directories and databases of businesses in the State of Illinois. We attempted to match every company in the claims dataset with the Hoovers list, and established a list of auto manufacturing companies for which claims had been filed during this period. However, the list didn't identify the primary industry of the companies. The majority of the companies listed in the auto manufacturing industry were suppliers or service providers (including credit agencies). For this reason, the UAW Union research department was asked to help provide additional information on auto manufacturing sites, which they represent in Illinois. The UAW provided us with a list of 38 sites, not all of which were auto manufacturers of private light weight vehicles, but included companies manufacturing specialized engines, locomotives, heavy machinery, and other products not directly related to the manufacturing of private light weight vehicles. Within the UAW list we kept 23 worksites within 19 different companies that were directly involved in the manufacturing of private light weight vehicles. The final list of 19 companies matched the

NAICS classification for automotive manufacturing (3361) listed in the Hoovers Business Database. The UAW also provided us with the number of employees paying union dues at each of their locals. However, one of the union locals had two auto manufacturing worksites which we could not break down independently. The total UAW numbers for union paying members in Illinois also resembles the BLS employment numbers.

The IWCC dataset was screened for claims from auto manufacturing companies in the list provided by the UAW. To do this, we had to modify the list to allow for variations in the spelling of company names (abbreviations, shortened names, acronyms) because the data input for this variable is not uniform. The total number of claims filed in the years 1970 to 2008 for workers injured in companies associated with the auto industry was 28,572. Since we decided to include cases (claims) from the years 1995 to 2008, all prior claims to 1995 had to be removed, which reduced the number of claims to 14,277. Next, we included only worksites with a known assembly plant based on the UAW list. Many of the claims were for worksites unaffiliated with manufacturing automobiles (For example, Mitsubishi which makes both cars and electronics, and all the major companies' auto dealerships). This further reduced the number of claims to 11,152, the total number of claims filed from 1995 to 2008 by employees in auto manufacturing in Illinois.

D. Claim Categories

There are three main claim categories; dismissed, in progress, and with a decision. Claims dismissed are claims that have been either thrown out or dropped by the injured employee. In progress claims are those that are in the system and the outcome is still pending. Finally, the third category is claims that have a decision. The decision could be in favor of either the company or the employee. For some calculations, “claims dismissed” (586) and “claims in progress” (1,186) were excluded. The total number of claims with final decisions was 9,380.

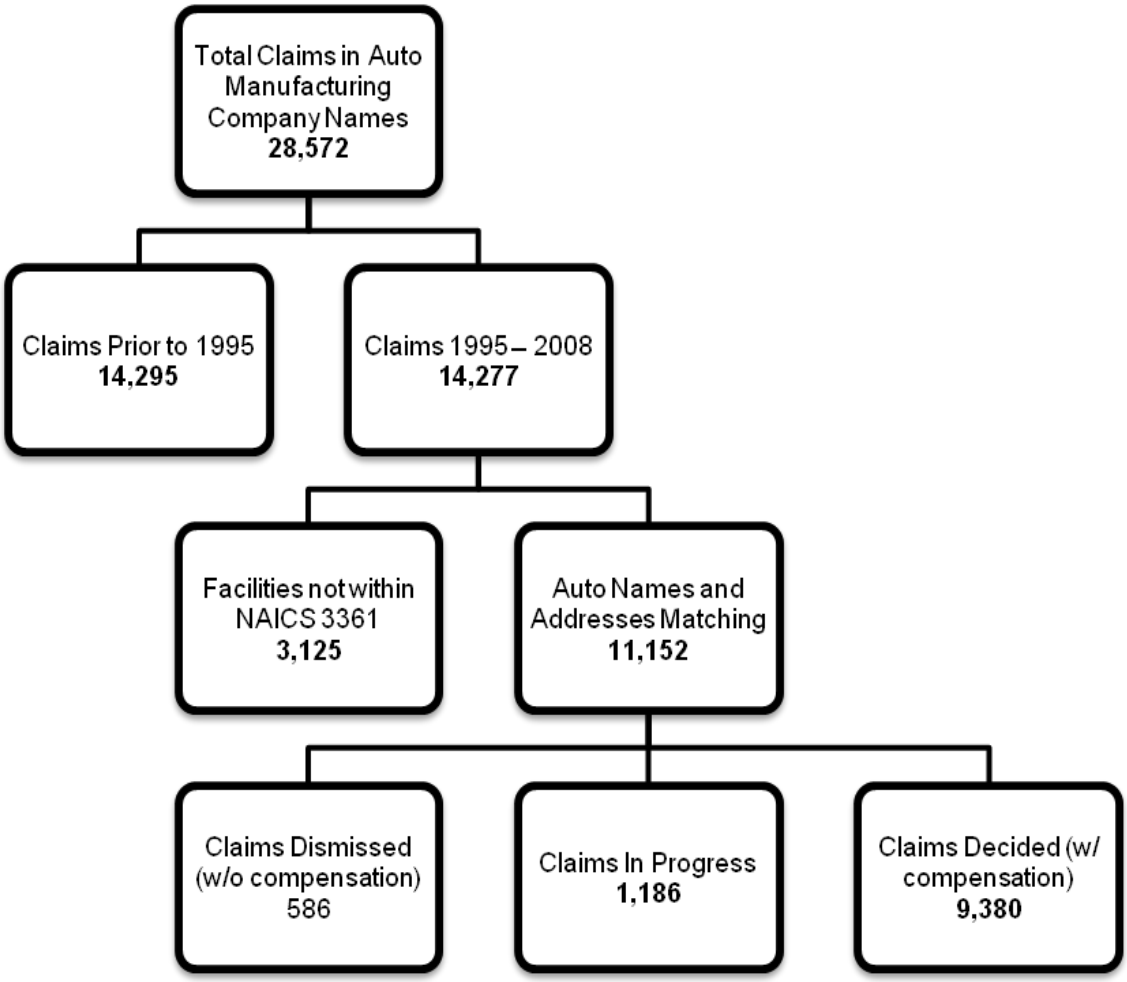

Figure 3. Claim narrowing process.

E. Main Settlement Categories

There are five types of disability compensation (temporary partial disability, temporary total disability, permanent partial disability, permanent total disability, and disfigurement). In addition, there can be other types of settlements such as legal fees or medical costs.

1. The first settlement category Temporary Partial Disability (TPD), is when a employee is still healing and working light duty, part time, or full time and earning less than they did before the injury. This is very rare in workers compensation. An example would be an employee who sprained their ankle but can still work in light duty status.
2. Next, TTD is when the injured employee is unable to return to work by doctors recommendation or the employer is unable to accommodate light duty work. TTD is calculated in number of weeks lost. An example would be and employee who broke their hand and cannot return to work temporarily.
3. The third type of settlement PPD, is the complete or partial loss of use of a part of body. PPD is calculated as a percent loss of function and also depends on what part of the body lost function. An example would be a person who either cuts off a digit or looses function of a digit.
4. The fourth type of settlement is Permanent Total Disability (PTD), PTD is the complete loss of both hands, arms, feet, legs, eyes, or any two such parts. It can also be an injury in which the employee is permanently unable to do any kind of work to provide stable employment. Additionally, this includes brain and peripheral nerve

injuries. An example of this would be an employee who loses both legs and can no longer work.

5. Finally, disfigurement is the last type of disability. Disfigurement a permanent alteration in appearance to the head, face, neck, chest, arms, hands, or legs below the knee. Scars that employees may have from an injury are a good example of disfigurement. Employees can only be awarded either disfigurement or PPD.

For calculations of both temporary disabilities and PPD or PTD only cases with a final decision made were used in the analysis. In the workers' compensation system, a determination of PPD or PTD is made when the injured employee reaches "maximum medical improvement". We used the Illinois statutory formula to calculate cumulative percent disability when more than one body part was injured and limited in function (Friedman, 2009). An example of the statutory formula for computing cumulative disability is A + (1 - A) x B, where A is the percent disability for a specific injury involving a specific body part and B is the percent disability for a second specific injury involving a specific body part (Friedman, 2009). Since employees can receive payment for both temporary and permanent disability, these items were calculated separately from one another, and then added in the final, overall cost.

F. Comparison with Bureau of Labor Statistics Data

For all statistical analyses we used SAS software (v.9.1: SAS Institute, INC. Cary, NC). We calculated crude and adjusted rates of injury, overall, and for specific injury types.

In order to index the data to underlying employment numbers (i.e., workers in the auto manufacturing industry who were at-risk for becoming injured and filing a claim), the BLS quarterly census of employment and wages was used to obtain the number of employees in the auto manufacturing industry in Illinois (NAICS 3361). However, for the State of Illinois in auto manufacturing there were only annual employment numbers available, so we used those numbers as the denominator data in our rate calculations. Additionally, the UAW provided the number of employees represented at each facility monthly from 1995 to 2007. In other calculations, each facility's average annual employment was used as a denominator to calculate claim rates for all facilities which had more than 50 total claims.

As a comparison group for number and rates of injuries among auto manufacturing employees, the BLS SOII was used. This is an annual survey, in existence since 1992, of a pre-selected, representative sample of private employers across industrial sectors. At the beginning of the year, the selected companies are requested to carefully maintain the Occupational Safety and Health Administration (OSHA) injury and illness logs and to submit them. The BLS partners with state agencies to collect these data, and uses the reports to extrapolate the total number of injuries, stratified by sector, demographics, and other variables (Bureau of Labor Statistics, 2011). NAICS 3361 motor vehicle manufacturing was used to obtain total recordable injuries per 100 full-time workers for the comparison group. These data was available for the United States as a whole, not specifically for Illinois.

III. RESULTS

A. Claim Breakdown

Between 1995 and 2008, we identified a total of 11,152 claims filed with the IWCC by workers employed in the auto manufacturing industry in Illinois. Of the 11,152 claims filed, 9,380 had a final decision with monetary compensation awarded to injured workers. Decisions are typically only made once the injured employee reaches the point of maximum medical improvement (the point the employee has finished healing). However, many of the injured workers filing claims, filed more than once for multiple accidents or injuries for a previously decided claim in which the level of impairment or associated costs changed from the time of the initial decision. Although there were 9,380 unique claims with final monetary decision awarded to the worker, after identifying workers who filed more than one claim there were only 5,722 unique workers injured between 1995 to 2008. Of the 5,722 (61%) unique workers injured in the automotive injury that filed claims with the IWCC, 3,902 filed a claim only once, 980 workers filed two claims (a total of 1,960 claims), and 840 workers filed three or more claims during the 13 years of follow-up (a total of 3,518 claims). When we looked at the date of accident for those filing multiple claims, only 83 claims (0.88%) shared the same date of accident, indicating that the majority of persons filing multiple claims involve separate incidents.

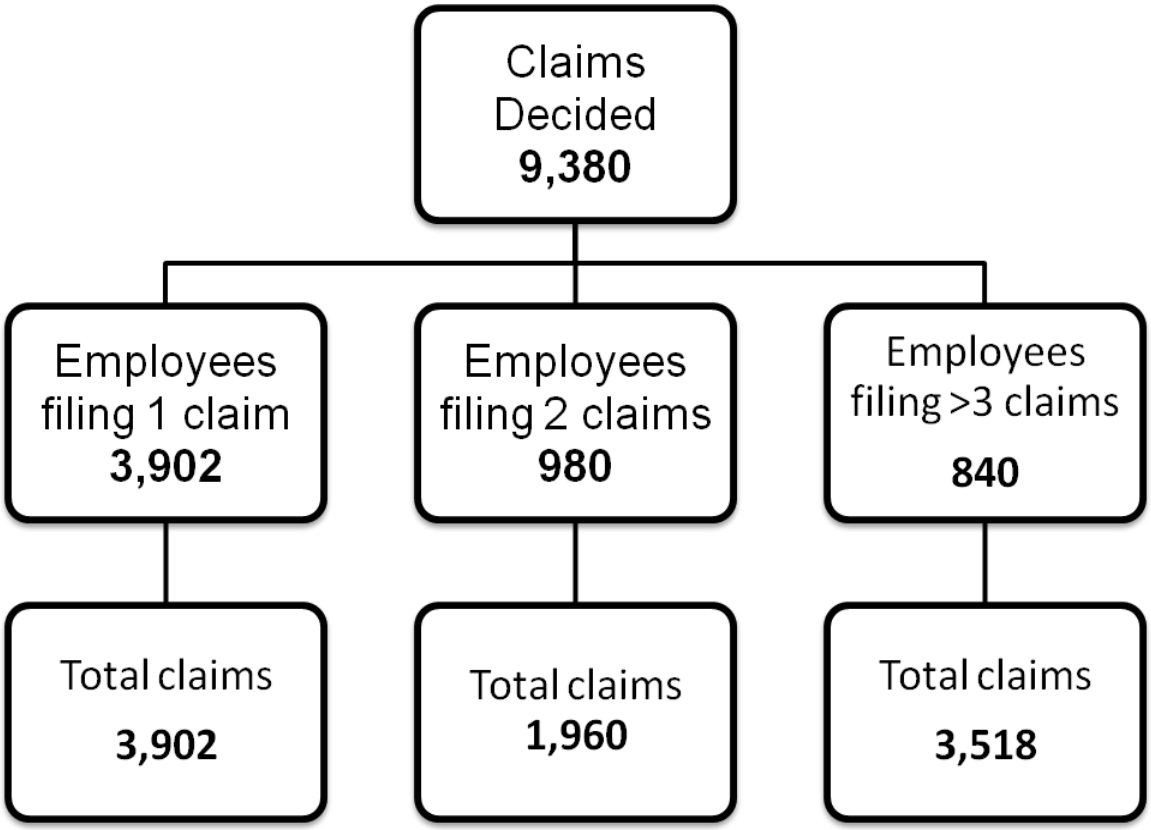

Figure 4. Claim breakdown.

Table VII shows the demographic information of the workers filing claims. Most injuries involved male workers (72.1%), who were married (63.4%), and without children (55.2%). The mean age of workers on the date of injury was 42.3 years. Overall, the mean weekly wage was $841 and the median weekly wage was $845. The average weekly wage for males (mean $866, median = $860) was higher than females (mean = $775, median = $787). Individuals representing themselves without an attorney received an average of $5,000 in compensation, compared to a median of $4,005 among persons using an attorney.

Table VII

DEMOGRAPHIC DATA FOR INDIVIDUAL WORKERS' COMPENSATION CLAIMS AMONG AUTO MANUFACTURING WORKERS

			Compensation (USD$)				
Gender	**N**	**%**	**Mean**	**SD**	**Median**	**Min**	**Max**
Female	3110	27.9	11577	91668	1989	0	4561660
Male	8040	72.1	11109	46086	3000	0	3211690
Unspecified	2	0	15161	17792	15161	2581	27742
Marital Status							
Divorced	197	1.8	11692	18077	3373	0	115567
Married	7072	63.4	12005	72889	3000	0	4561660
Single	3693	33.1	9738	38614	2804	0	2120072
Widowed	22	0.2	9305	14239	3341	0	50475
Unspecified	168	1.5	11798	16789	3529	0	110000
Number of Dependents							
0	6159	55.2	10692	21247	3000	0	4561660
1	1806	16.2	12776	71743	2500	0	2120072
2	1879	16.9	11884	76555	1924	0	3211690
3	911	8.2	10980	17678	3339	0	152342
4 or more	397	3.6	10307	21247	1156	0	280296
Age Range (years)							
15–25	318	2.9	12556	118881	2570	0	2120072
25–35	2534	22.7	10380	42744	3000	0	2000410
35–45	3761	33.7	13037	93279	3000	0	4561660
45–55	3139	28.1	10015	17611	2065	0	235639
55–65	1151	10.3	10818	17065	3308	0	160663
65 and older	87	0.8	8452	13542	3514	0	60157
Unspecified	162	1.5	8605	13975	2154	0	81326

B. Claim Compensation

Table VIII shows that the prevalence of claims for injuries by year has been steadily declining since 1999, the year with the highest number of claims for injuries. The year 2008 had the least number of claims for injuries (30). However, this is probably the result of the long lag time in filing claims. From the date of accident to the filing date of all claims from 1995 to 2008 there was a median of 228 days (n = 11,134, mean = 324, maximum = 3,488, 14 claims missing). From the filing date to the decision date there was a median time of 486 days (n = 9,375, mean = 635, maximum = 4,056, decisions only, 5 claims missing). This means the median time from the time a claim is filed with a decision is reached is 714 days (1.96 years) with a mean of 959 days (2.63 years). However, the data are skewed right, and there are some cases that take much longer than even the median time. Because of the skewedness, the median is more realistic to use than the mean.

Table VIII

CLAIMS AND COMPENSATION BY YEAR

Accident Year	Frequency	%	Mean Compensation (USD)	Median Compensation (USD)
1995	889	8.41	12257.47	3421.89
1996	1016	9.62	10420.38	4460.86
1997	970	9.18	14390.54	3962.57
1998	837	7.92	10767.68	3978.24
1999	1300	12.3	11382.63	3000.00
2000	995	9.42	13112.92	4000.00
2001	939	8.89	13006.17	3035.40
2002	795	7.52	18744.09	3494.16
2003	685	6.48	12628.18	3971.17
2004	774	7.33	9946.72	5000.00
2005	538	5.09	10572.69	1191.77
2006	462	4.37	5696.14	0
2007	336	3.18	860.25	0
2008	30	0.28	0	0

* Dismissed claims not included

Table VII above shows corresponding to the decline in the number of claims, the number of employees in auto manufacturing in Illinois has also been precipitously declining.

C. Claim Rates

Table IX shows claim rates from 1995 to 2007. As stated earlier, the most recent years are also probably not complete workers compensation claims due to lag time. The overall claim rates for Illinois as a whole compared to BLS data for total recordable injuries (Table XIII) nationally are fairly consistent. The BLS SOII reports only 5.6% of total cases are illnesses. In our dataset 146 classified illnesses, 98.36% of our classifiable claims were injuries. Based on this, a more accurate comparison is the recordable injury rate and not the injury and illness rates.

Table IX

ILLINOIS CLAIM RATES VS. BLS TOTAL U.S. NAICS 3361 RATES

Year	# Claims	# Employees	Illinois Claim rate (per 100 Employees)	BLS Total Recordable Injury Rate (per 100 Employees)	BLS Total Recordable Injury and Illness Rate (per 100 Employees)
1995	937	10679	8.77	-	-
1996	1070	10287	10.40	-	-
1997	1035	9674	10.70	-	-
1998	896	9570	9.36	-	-
1999	1342	9532	14.08	-	-
2000	1043	8636	12.08	-	-
2001	980	8080	12.13	-	-
2002	829	7814	10.61	-	-
2003	707	7784	9.08	10.2	15.2
2004	811	7319	11.08	8.7	13.1
2005	597	6835	8.73	8.9	12.9
2006	520	7077	7.35	8.2	11.4
2007	355	7227	4.91	6.8	9.3

* BLS data prior to 2003 was not available because there was a change in BLS Current Employment Statistics (CES) record keeping rules. Previously Standard Industry Classification (SIC) codes were used and in 2003 the CES were switched to NAICS coding. Additionally, there is not an exact SIC code that would match the NAICS 3361 prior to 2003.

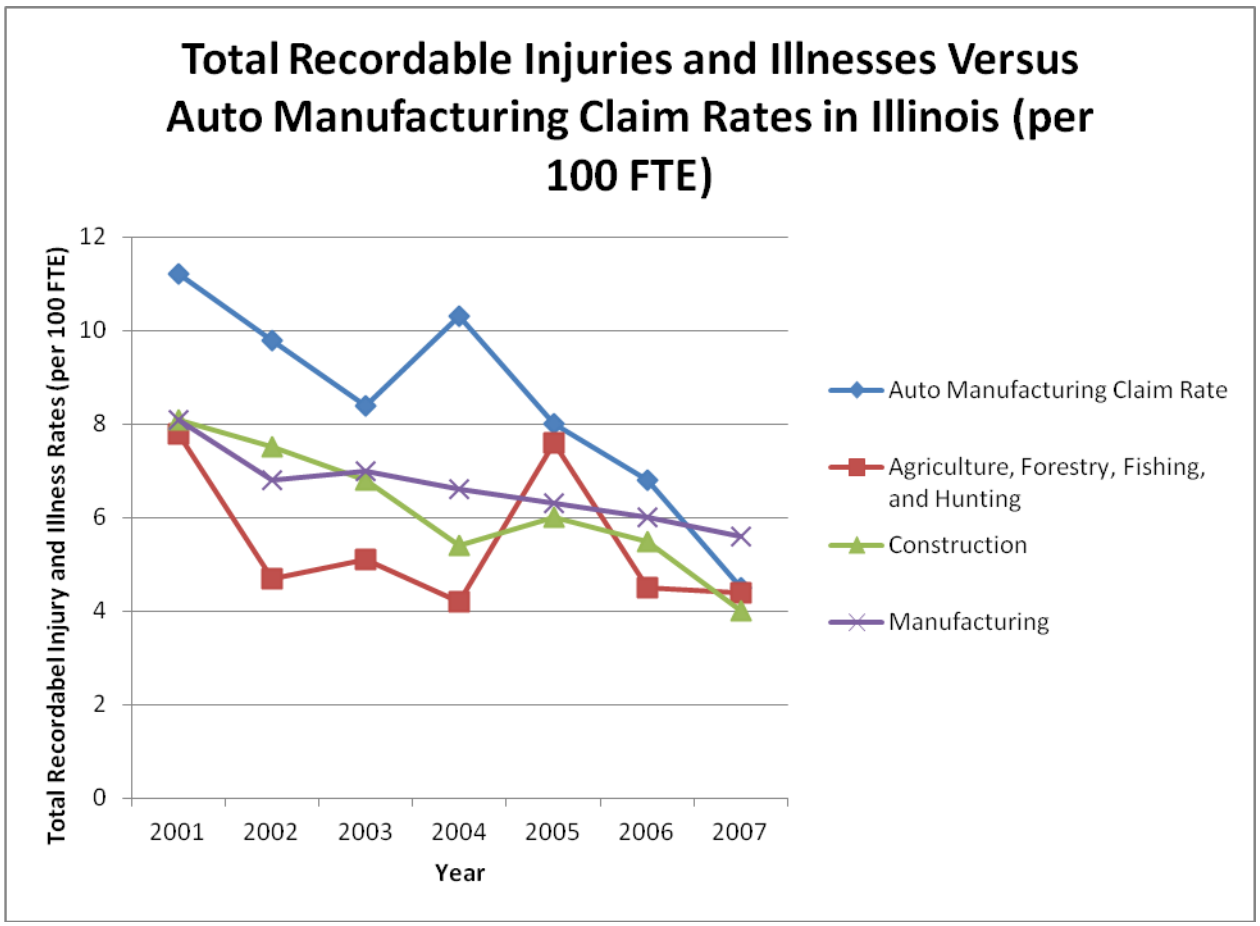

Figure 5. Total recordable injuries and illness versus auto manufacturing claim rates in Illinois.

Figure 5 shows recordable injury and illness rates of various industries in Illinois compared to our auto manufacturing claim rate in Illinois for years 2001-2007.

Table X shows claims by company. Mitsubishi Motors had the highest number of overall claims 4,352 (46.4%) followed by Ford Motor Company 3,569 (38.1%), Chrysler 908 (9.68%), and Airtex 248 (2.64%). These four auto manufacturing assembly companies account for 9,077

(96.8%) of all the decided claims. This percent is based on the number of claims filed by employees with a decision. However, this data do not indicate a claim rate.

Table X

TOTAL CLAIMS BY COMPANY

Company	**# Claims**	**Total %**
Mitsubishi Motor Corporation	4352	46.4
Ford Motor Company	3569	38.05
Chrysler LLC	908	9.68
Airtex Products (United Components Inc.)	248	2.64
General Motors Corporation	75	0.8
Johnson Controls Incorporated	62	0.66
MBL (USA) Corporation	49	0.52
Tower Automotive	38	0.41
Austin-Westran Incorporated	19	0.2
East Moline Metal Products Company	18	0.19
Mclaughlin Body Company	12	0.13
Dana Corporation	12	0.13
Jones Lang Lasalle and Kimco	8	0.09
Honeywell International	4	0.04
Grupo Antolin North America	2	0.02
GKN PLC	2	0.02
Freightcar America	1	0.01
Arvinmeritor Incorporated	1	0.01

* Decisions only

Table XI shows claims by company and year for companies who had more than 50 claims filed against them. The single year highest number of claims at one site for any company was 790 in 1999 for Mitsubishi.

Table XI

CLAIMS AT FACILITIES BY YEAR

Year	Chrysler	Ford (1000 Lincoln Hwy.)	Ford (12600 South Torrence Ave.)	Ford (2225 West North Ave.)	General Motors Corporation	Johnson Controls Inc.	Mitsubishi	United Components (Airtex)
1995	272 (29.96)	117 (10.49)	274 (11.51)	17 (25.76)	6 (8.0)	2 (3.23)	173 (3.98)	16 (6.45)
1996	252 (27.75)	147 (13.18)	281 (11.8)	7 (10.61)	10 (13.33)	5 (8.06)	265 (6.09)	20 (8.06)
1997	198 (21.18)	137 (12.29)	252 (10.58)	4 (6.06)	17 (22.67)	6 (9.68)	308 (7.08)	21 (8.47)
1998	80 (8.81)	111 (9.96)	252 (10.58)	6 (9.09)	13 (17.33)	7 (11.29)	319 (7.33)	32 (12.9)
1999	31 (3.41)	127 (11.39)	260 (10.92)	9 (13.64)	9 (12.0)	16 (25.81)	790 (18.15)	30 (12.1)
2000	22 (2.42)	101 (8.97)	258 (10.84)	4 (6.06)	12 (16.0)	13 (20.97)	515 (11.83)	34 (13.71)
2001	15 (1.65)	98 (8.79)	205 (8.61)	9 (13.64)	5 (6.67)	6 (9.68)	528 (12.13)	17 (6.85)
2002	10 (11.0)	86 (7.71)	215 (9.03)	8 (12.12)	3 (4.0)	0 (0)	387 (8.89)	22 (8.87)
2003	6 (0.66)	74 (6.64)	124 (5.21)	2 (3.03)	0 (0)	2 (3.23)	352 (8.09)	17 (6.85)
2004	7 (0.77)	51 (4.57)	92 (3.86)	0 (0)	0 (0)	4 (6.45)	455 (10.45)	14 (5.65)
2005	3 (0.33)	45 (4.04)	124 (5.21)	0 (0)	0 (0)	0 (0)	120 (2.76)	15 (6.05)
2006	5 (0.55)	18 (1.61)	39 (1.64)	0 (0)	0 (0)	1 (1.61)	130 (2.99)	10 (4.03)
2007	7 (0.77)	4 (0.36)	5 (0.21)	0 (0)	0 (0)	0 (0)	10 (0.23)	0 (0)
Total	**908**	**1115**	**2381**	**66**	**75**	**62**	**4352**	**248**

*Only companies with over 50 total claims (percent of claims for each year by company shown in parentheses)

Table XII shows claims rates by company and year for companies who had more than 50 claims filed against them. The single year highest claim rate for any company was 27.36 per 100 employees for Mitsubishi in 1999!

Table XII

CLAIM RATES BY FACILITY AND YEAR (PER 100 EMPLOYEES)

Year	Chrysler	Ford (1000 Lincoln Hwy.)	Ford (12600 South Torrence Ave.)	Ford (2225 West North Ave.)	General Motors Corporation	Johnson Controls Inc.	Mitsubishi	United Components (Airtex)
1997	-	7.1	9.4		3.76	-	9.2	3.43
1998	-	5.94	10.01		2.98	-	9.77	5.51
1999	-	7.02	10.56		2.23	-	27.36	4.93
2000	-	5.73	10.24		3.26	-	19.17	5.37
2001	0.57	5.76	7.78		1.5	-	19.97	3.19
2002	0.43	5.41	8.91		0.94	-	14.91	3.99
2003	0.27	4.85	4.48		0	2.66	12.75	3.07
2004	0.33	3.59	2.82		0	4.31	17.74	2.63
2005	0.16	3.14	4.26		0	0	5.01	3.07
2006	0.13	1.22	1.28		0	0.64	7.95	1.94

*Only companies with over 50 total claims

D. Injury Breakdown

Shown in table XIII are the top ten injury types from 1995 to 2008: poorly described/unclassified (65.60%), sprain or strains (7.58%), carpal tunnel syndrome (7.31%), surgery (3.72%), fracture (3.24%), laceration (2.91%), disfigurement (2.21%), vertebral or spinal column injury (1.87%), contusion or superficial injury (1.12%), hernia (0.64%), and mental disorders (0.64%). The top ten injury types account for 96.18% of all the injuries that occurred. There were also 10 total or partial amputations in our data, as well as 4 fatalities.

Table XIII

TYPES OF INJURIES BY TOTAL

# Rank	Injury Type	Total injuries
1	Poorly Described/ Unclassified	6153 (65.60)
2	Sprain or Strain	702 (7.58)
3	Carpal Tunnel Syndrome	676 (7.31)
4	Surgery	344 (3.72)
5	Fracture	300 (3.24)
6	Laceration	269 (2.91)
7	Disfigurement	205 (2.21)
8	Vertebral or Spinal Column Injury	173 (1.87)
9	Contusion and Superficial Injury	104 (1.12)
10	Hernia	59 (.64)
	Total	**9044**

* Of companies with >50 claims

Cases with PPD had a median percentage of disability of 15.00% (n = 5,224 and mean 17.73%). The distribution of PPD was as follows: 1 to 24.99% PPD, n = 3,825 (73.22% out of total receiving PPD); 25 to 49.99% PPD, n = 1,232 (23.58% out of total receiving PPD); >50% PPD, n = 167 (3.20% out of total receiving PPD). There were only two workers who had claims for PTD. Table XIV shows types of disability and payouts by specific groups. Cases with TTD had a mean number of weeks of 7.71 (n = 3,322 and mean of 12.64 weeks). Once again the median is more accurate due to the number of claims skewed right.

Table XIV

MONETARY COMPENSATION BY DISABILITY AND BODY PART

	N=	Mean Total WC Compensation (USD$)	Median Total WC Compensation (USD$)
Awarded Temporary Total Disability			
0 Weeks	6377	8113	1804
0.1 to 9.99 Weeks	1782	17648	14233
10 to 19.99 Weeks	733	25430	22788
20 or more weeks	488	47507	29817
Permanent Partial Disability			
None	4156	3481	0
1% to 24.9%	3825	13183	10997
25% to 49.9%	1232	34081	30934
50% or more	167	73350	44970
Body Part			
Head, Neck, and Face	503	8877	1642
Torso	110	6224	3914
Back and Spine	1095	14445	3526
Upper Extremities	4252	16427	7013
Lower Extremities	1271	11411	5918
Systemic	655	7472	3000
Unspecified	1889	10681	3000

* Body part type are not mutually exclusive

Table XIV shows compensation amounts based on amounts of TTD paid out, percent of permanent disability, and by part of body. TTD went up in monetary compensation as the number of weeks went up and the higher the PPD percent, the higher the monetary compensation went up. The

upper extremities had the highest payout for part of body followed by back and spine, and then the lower extremities.

Table XV

AUTO MANUFACTURING COMPENSATION VERSUS ALL INDUSTRIES COMPENSATION

	Auto Manufacturing		**All Industries**	
	Mean	**Median**	**Mean**	**Median**
Total Compensation	$13,327	$4,666	$12,777	$4,665
Total TTD Weeks	12.6	7.7	19.0	8.0
Total PPD %	17.7%	15.0%	17.8%	13.6%

Table XV shows total compensation, TTD weeks, and PPD percent of the auto manufacturing industry in Illinois compared to the rest of the industries in Illinois. All data between both groups are comparable with the exception of TTD weeks in the auto manufacturing industry is 12.6 weeks compared to 19 weeks in the rest of the industries.

IV. DISCUSSION

A. Outcome

Several key findings come out of this study. These are:

1. The auto manufacturing industry in Illinois has a very high claim rate compared to other industries total recordable injury and illness rates. This can be seen in Table V and VI. This means that either the auto manufacturing industry in Illinois is very dangerous compared to other industries, or that workers in this industry are more likely to file claims. Given that many injuries do not reach the workers compensation system, this number could be low giving conservative estimates of injuries in auto manufacturing.
2. There were 5,722 unique employees filed claims for injuries, in an industry which employment has been dropping from slightly under 10,000 to 7,800 in 2007. The average employment from 2001 to 2007 was 8,061. Assuming a low turnover in the industry, the cumulative prevalence was approximately 71%. This means that 71% of the employees who work in the auto manufacturing industry have not only been injured, but they have also filed a workers' compensation claim to get appropriately compensated for their injury or illness.
3. Claim rates differ substantially by worksite. Mitsubishi had the highest rates for each year, with the highest rate in 1999 being 27.36 per 100 employees filing a claim. This

means over a quarter of employees at the Mitsubishi facility not only got injured in 1999 (Table VII), but they also had to file a claim. A rate this high is almost unheard of.

4. Our claim rates are comparable with BLS SOII rates, but claims represent only a fraction of total injuries. This study gives an underestimate of actual injury and illness rates in the auto manufacturing industry in Illinois.
5. Claim rates should be lower than the recordable injury rates due to companies' paying for lost time and medical care without the filing of a claim. The fact that they are not lower suggests that: a) Companies are "forcing" every injured employee to take their injuries to workers compensation or b) Companies are paying for some injuries already on top of the workers compensation claims, which would mean that the BLS is underestimating the number of injuries which occur in the auto manufacturing industry.

B. Limitations

This study has many limitations. The biggest is that our data only includes workers compensation claims and does not represent all injuries that occur in auto manufacturing in Illinois. However, this would mean our estimates are conservative, underestimating the real number of injuries that occur.

Lag time is another limitation. Lag time is the time it takes from the injury to the date a claim is filed plus the time filing to the date of the decision (median 1.96 years and mean 2.63

years respectively). Since we acquired our data in the first quarter of 2008, the last few years of our study is incomplete, further underestimating actual number of claims and injuries in auto manufacturing. There is also a lag time in the occurrence of cumulative trauma disorders and other chronic injuries and illnesses. These injuries may not reflect themselves until many years after the initiation of the pathology has started.

The number of employees for each facility we acquired from the UAW was based on dues paid for each union chapter. However, retirees can still be a part of the UAW if they pay dues. This limitation may overestimate the number of employees (denominator) at each or some of the facilities in the study. Furthermore, our study may miss companies that make multiple products. For example, a company that makes paint for vehicles may also make paint for other manufactured items and is not necessarily an automotive manufacturing site. Injuries occurring in sites that do not manufacturer automobiles are not included in this study.

The classifications of types of injuries are somewhat broad and overlap. The diagnosis of injury, multiple injuries, or unclassified are non-specific and not very useful (65.6%). This limits our ability to identify specific types of injuries, determine the cause or mechanism of injury, and thus acts to prevent these injuries. Requiring specific injuries to be listed could aid in prevention.

Compensation for claims is added to what employees may have received (for medical care and lost work time) prior to arbitration. Therefore, the listed compensation awarded may underestimate the actual compensation workers are getting.

Finally, the information currently recorded in the Illinois Workers' Compensation system is entered by hand (original filings) and after a decision is made, data are entered by either the lawyer or employee if he or she is self defending. If self defending the person may not know what every field is they should fill in and consequently, just leave it blank or inaccurate. The original filing with the name of the company, address, and other personal information is done by hand and lends itself to spelling and grammar errors. This is a limitation because there may be information that is not accurately recorded.

C. Recommendations

There are several important recommendations from this study moving forward. First, the UAW could make recommendations to auto manufacturing sites on high risk injuries that have been identified in this study. This can help companies to focus injury reduction on tasks with the highest risk ("get the most bang for their buck"). Secondly, industry focused audits from safety professionals within the industry can help provide recommendations for specific auto manufacturing sites as well as allow safety professionals to learn from other sites similar to theirs. Next, the Illinois Workers' Compensation system could be improved to provide more complete and specific data on each injury. Finally, it is important to investigate why so many claims in auto manufacturing in Illinois are filed. This suggests a level of contentiousness that is higher than for most segments of the workforce.

Since many auto manufacturing sites (particularly in the Midwest) belong to the UAW, there is the potential for similar companies to learn from one another. In addition the UAW has sites all around the United States that can provide feedback on what is effective to help control hazards and reduce injuries in auto manufacturing as well as what is not effective. This is a unique opportunity that not many other industries have, given that a consortium across companies is unusal. The UAW can help facilitate the evaluation of industry trends and effective controls, gather feedback or suggestions, and also make recommendations to the industry.

One way to help improve safety within the auto manufacturing sector is if the UAW established a certification to showcase sites that have a commitment to a safety and health and is focused on reducing injuries. An audit could be done every few years by safety and health professionals from across the industry. This would help do three things. First, it would provide an additional incentive for sites to get certified and be designated as role models. Secondly, it would help drive down injuries across the industry. Finally, it would allow safety and health professionals to learn from each other's sites about controls which may be available within the industry.

Another thing the UAW could do is recommend a better injury surveillance system. All companies it represents could report all incidents (first aid, recordables, and near misses), the task being done, machinery being used, how the incident happen, and any controls they may have installed or other means by which they have reduced injuries at their worksite. This information should be collected annually and analyzed by the UAW to provide feedback to all

its members related to with the top injuries, top hazardous tasks, near misses, any trends, and effective controls that have proven to reduce injuries. This could help companies know what to focus on to drive down injuries. Companies could also use this information to see if their interventions are effective or if there are other companies with more effective. All of this information could be used to improve the safety culture throughout the industry and help ensure that employees go home safely each day.

As far as the Illinois Workers' Compensation system, the IWCC should do the data entry for all claims. The more information gathered during the claim the better it could be evaluated to give a better understand of each case. Next, the addition of a data field to describe how the injury occurred is also recommended. This would facilitate examination of specific types of injury to see if there was a common mechanism (such as what the employee was doing, the method of injury, specific machinery that may have been involved). If you could determine what causes injuries, you could then examine and test interventions to help reduce the risk. Finally, the entry of industry coding such as the NAICS should be mandatory to allow simple filtering of the data to better evaluate claims that have occurred in a specific industry. Currently, there is no way to sort by specific industry type.

A reduced decision time by the Workers Compensation Committee would be best for the employee and the employer. The employee should not have to wait for a decision and the employer should have a deposition at the earliest possible time

Linking claims with medical records is another way to increase the utility of claims. Having access to the medical records for a claim would be helpful to see specifically what the injury was and how it happened.

A future study might be to see if automation in the auto manufacturing industry is actually lowering the injury rates. It seems there is a great shift to automation in the industry in part with a goal to improve safety. However, is unclear if the automation is actually reducing injures, or whether it is creating additional hazards and injuries in the industry.

Another study could be done to explain why so many employees that have filed claims and filed multiple claims (58%). It would be interesting to see if these injured employees are working in the same, high risk jobs or whether some other factor could explain this phenomenon comparing unionized to non-unionized shops and comparing the auto industry to a different manufacturing industry.

Lastly, an investigation as to why so many work related injuries within auto manufacturing are contested, is in order. Employees should not have to challenge every injury that occurs in auto manufacturing.

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