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Analysis of the Aboriculture Industry Safety Culture from the Standpoint of Injures, Illnesses, Employee Response, and Industry Standards

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ANALYSIS OF THE ABORICULTURE INDUSTRY SAFETY CULTURE FROM THE STANDPOINT OF INJURIES, ILLNESSES, EMPLOYEE RESPONSE, AND INDUSTRY STANDARDS

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SAFETY IN THE ARBORICULTURE INDUSTRY BASED ON AN ANALYSIS OF INJURIES AND ILLNESSES, EMPLOYEE RESPONSE, AND INDUSTRY STANDARDS

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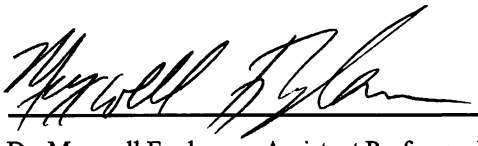

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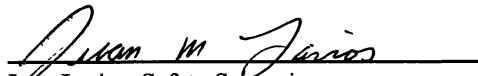

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ABSTRACT

SAFETY IN THE ARBORICULTURE INDUSTRY BASED ON AN ANALYSIS OF INJURIES AND ILLNESSES, EMPLOYEE RESPONSE, AND INDUSTRY STANDARDS

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The author researched 215 recorded injuries and illnesses to all field employees between January 1, 1991 and July 1, 2002 at an arboricultural company in California. Detailed interviews were conducted with each of the 38 field employees to determine employee perceptions of safety training, management, communication, and personal discomfort to provide a clearer picture of the company safety program. This information was correlated with the tree worker claims and industry standards to determine the effectiveness of the safety program based on employee discomforts and claim related

descriptive statistics. The claims' tabulations show that back strains are the most prominent injuries in terms of lost days and total costs, but pruning has the greatest number of lost time injuries. Pruning involves equipment such as chainsaws, hand saws, and pole saws, which equate to 35% of the total lost time injuries and 38% of the total claims' costs. More specifically, pruning equipment such as hand saws and pole saws, result in only 8% of total lost time injuries and only 10% of the total cost of claims. The arborist discomfort surveys revealed that elbow and shoulder pain are just as common as lower back pain. The body motion from the use of pole saws and pole pruners are the direct cause of this pain and this is consistent with employee opinion. This repetitive strain disorder is becoming an epidemic among arborists and has not been adequately addressed by arborist trade organizations, the State of California, or the American National Standards Institute. Because the safety program is based on the ANSI Z133 Tree Care Operations standards and the California Code of Regulations: Tree Work, Maintenance or Removal, significant deficiencies in the program can be correlated with the inadequacies of the standards. Based on the information collected for this thesis, recommendations were made regarding company safety training, arborist work practices, mechanical assists, equipment design, and industry standards.

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CHAPTER I

INTRODUCTION

The most prominent dilemma found in safety program management involves the provision for safeguards intended to mitigate or eliminate accidents and the resulting injuries and damages. The dilemma for the company is influenced by two opposing considerations. One is the cost associated with accident prevention, while the other is a moral and ethical regard for human life and well-being. Gradually, compromises have been made weighing the benefits and costs of accident prevention. Many companies have found protecting workers is beneficial to all. A strong reduction in litigation costs and insurance premiums, as well as more efficient operations, are results of hazard awareness plans and risk mitigation measures.

When the Railway Safety Act was being discussed in 1893, a railroad executive issued an infamous statement referring to safety in monetary terms. He felt it would cost less to bury a man than to install air brakes on railroad cars. The last century shows evidence of a disappointing recurring trend that has gradually improved. Unless accidental deaths and injuries are massive or bring about enormous or recurring lawsuits involving the press, the federal government is hesitant to initiate any corrective action. In past years, many small business owners felt concerned and personally responsible for the safety of their employees. The motivation was not because of cost or regulation, but because of a genuine concern for a fellow human being. The emergence of large corporations introduced many new workplace dynamics to employees including:

technological advancements, on-the-job (OJT) hazards, and a far more impersonal relationship with management. This impersonal relationship made it easier for management to continue their drive for minimum cost at maximum profit, at the expense of the well-being of the employee. Employees were not known by name, only as a number. The fact that employees were considered as numbers and not real people, made it much easier for management to cope with frequent fatalities. The past century has shed new light on the importance of workplace safety, with large corporations leading the way in many instances. The Railway Safety Act of 1893 not only reduced the number of injuries and fatalities, but proved the rail system operated more efficiently and effectively with fewer accidents. In 1908, U.S. Steel began its first formal safety program and quickly realized how beneficial an effective safety program is for reducing costs. Operations soon became smoother and more efficient because of fewer accidents (Hammer, 2001).

Many small businesses currently believe that safety programs are unprofitable and nonproductive. Many of their accident rates rival or exceed their larger counterparts. Their primary concern when any new safety regulation is enacted or even considered is the cost of such a change. To such businesses, monetary considerations seem to be of more concern than the value of human life. This mentality has forced numerous small businesses to declare bankruptcy. Safety and efficiency have become very simple. Protect the people working under you in hazardous conditions and they will protect your finances by staying healthy and being productive (Hammer, 2001).

Since the introduction of tools and machinery, people have been exposed to more complex hazards than ever before. Throughout the 1990's, according to the Bureau of

Labor Statistics, one of the leading categories of occupational injuries and illnesses was cumulative trauma disorders. This is obviously due to issues of repetitive motion in the workplace. Although back injuries have been prevalent for many years, it has only been in the last few decades that they have been linked to repetitive motion.

The days of letting safety programs fall out of the budget, get ignored, or be organized by incompetent safety professionals are ending. Extensive regulation and lawsuits have forced management to stop ignoring safety and treat it as a reality. Management must leave no doubt in the minds of employees that they are concerned and committed to their accident prevention programs. This commitment must be extended to all employees on an everyday basis, not just on days an accident occurs. Unless management can provide this continual support, accidents will always take place.

The OSHA Act places the responsibility for employee safety principally on the employers. Under California OSHA regulations this may be any "employee having direction, management, control, or custody of any employment, place of employment, or other employee." In a small business, such as the company examined in this thesis, all of the responsibility for safety is in the hands of the managing board of directors.

Research Questions

The text, tables, and figures that follow are a result of comprehensive research of the arboricultural industry, management, tree workers, training, and standards. The following research questions outline the scope of this thesis and its intended purpose.

- Based on industry standards, incidence rates, employee perception, and claims analysis is the existing safety program at the company effective and adequate?

- How does the attitude of management and field employees in association with safety training comprehension relate to injury prevention?
- Is there a relationship between injury prevention and safety training at the company based upon a claims analysis of all injuries and illnesses between January 1, 1991 and July 1, 2002?
- Do the arboricultural industry standards have effective injury and illness preventative measure written into them?
- What aspects of safety training are beneficial not only for the reduction of claims, but increased hazard awareness for field employees?
- Are there differences between employee perception of hazards and employee claims filed between January 1, 1991 and July 1, 2002?

Purpose

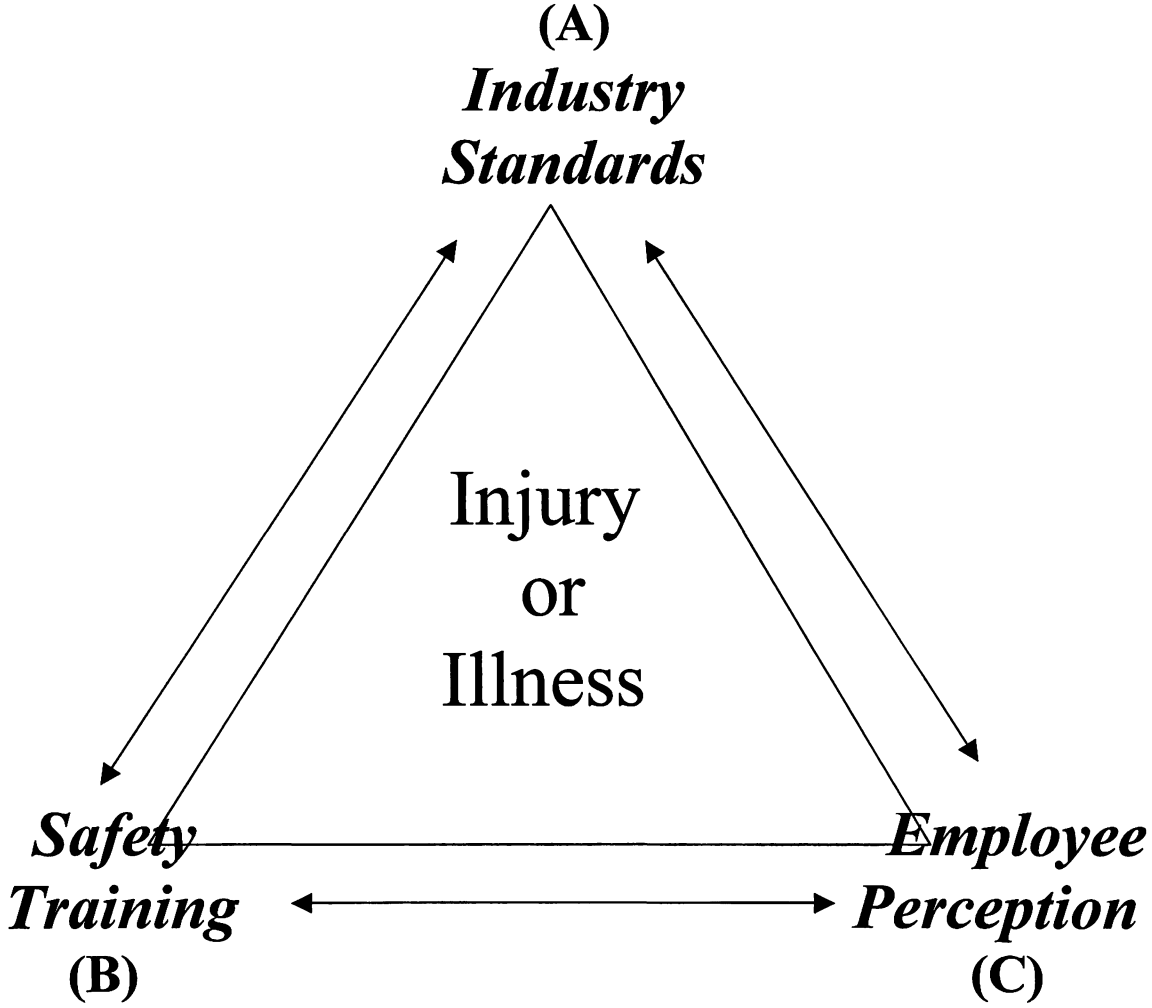
The purpose of this research is to identify significant safety and health problems in the organization and determine if the injury and illness prevention plan is functional in terms of addressing the critical issues and trends over the last decade. This information will also be correlated with safety training, employee discomfort, employee perception, and industry standards to effectively analyze tree care industry safety. This information will determine if training in the tree care industry is adequate by further understanding of content, employee understanding, and attitudes from management and field employees. The descriptive statistics presented in the claims analysis section will be compared to the employee interviews to highlight any significant areas overlooked by the management of the organization and the arboriculture industry as a whole. Injury and illness in private industry remains a complex problem today. This research will determine the injury type,

severity, and particular activities involved at the time of the accident. After first identifying specific parameters involved with the claims, training, perception, and standards can then be used to determine inadequacies in the safety program at the company and with the arboriculture industry safety culture.

Tree surgery is an industry riddled with hazards. Often, employees perform their daily duties one hundred feet in the air with all of their tools attached to them by ropes, belts, and clips. All employees, whether a groundman, climber, top climber, or foreman, have specific responsibilities essential for a crew's overall production. Every person on a crew is a pertinent piece of an overall accident prevention program. If one person does not look out for another or they don't work together in their regular duties their risk increases exponentially.

Figure 1 presents a safety triangle as a method of describing any kind of breakdown leading to an injury or illness. Any possible combination or single occurrence listed can result in an injury or illness. Events A, B, and C are not dependent on each other to result in an injury or illness. Because an accident or single event does not need to occur in order for a CTD for example, the center of the triangle does not list accident. Repetitive strain disorders must not be forgotten in accident prevention programs. If there is a void in any part of the triangle, the risk for a lost time injury or illness increases, and hazard awareness decreases on any jobsite. This combination of increased risk and decreased hazard awareness increases the likelihood for a serious injury or fatality to occur. When this is the case, any day that goes by without a recordable claim is pure luck, not prevention.

Safety Triangle



*Combinations: **AB; AC; BC***

Figure 1. Safety Triangle

CHAPTER II

REVIEW OF RELEVANT BACKGROUND INFORMATION

History of Arboriculture

In his book *Arborist Equipment*, Don Blair offers one interpretation for the history of arboriculture that has become widely acknowledged. As the explorers arrived in the New World several hundred years ago, they discovered a land with forest wealth nearly beyond description. It was said that a squirrel could walk from Plymouth Rock, Massachusetts, to the Mississippi River without ever having to leave the forest canopy. The forested land provided resources and material for shelter, fuel, food, clothing, but above all were viewed as both an obstacle and a resource. In the age of sail and steam, abundant forest resources were a strategic reserve, as important as oil and hydroelectric power are today. During the American Civil War (1861-1865), one railroad alone, the Pennsylvania Central, burned 3,200,000 cubic feet of firewood a day on military priority transportation. Logging was an essential piece of 19th Century industry, but it still was not considered arboriculture (Blair, 1995).

As America began to heal the wounds of the Civil War, it also began to enjoy the prosperity that its emerging industrial power was beginning to create. At the same time western expansion gained popularity, settlements in the east had given way to thriving cities. Railroads stitched the nation together, bringing long-range mobility to the masses and never before imagined wealth to many individuals. As these wealthy people began settling in their vast estates, they wanted the best money could buy in art and architecture,

land and landscaping. The American people began to see trees as individual specimens for beauty, shade, and privacy. Towns began to set aside wooded land as parks and trees gradually gained notoriety and a usefulness beyond energy and other resources. By 1900 America had tamed enough wildernesses, built enough cities, and made enough money to be ready to accept a stewardship role in caring for urban trees. Thus began the growth of the industry, profession, art, and science that is recognized as arboriculture (Blair, 1995).

By 1907, both the Bartlett and Davey Tree Expert companies were established and just four years later in 1911, the company examined in this thesis was born. They all continue to operate to this day as the oldest established tree care companies in the world. These companies, as well as many others, have recognized that training, research, new products, and technique development are critical to successful business plan (Blair, 1995).

The original office for the company consisted of desk space in the Mercantile Exchange Building in San Francisco. During this period, the company provided agricultural services in various locations throughout the state. In 1915, in response to growing demand on the San Francisco Peninsula, the original owner moved the base of operations to Palo Alto, California. During the early years, most of the company's clients were living on large estates. In the mid-1930's, the company was contracted by architect Julia Morgan to perform extensive tree surgery operations at the Hearst Castle in San Simeon, California. In the late 1930's, the company accomplished a forestation project at the Hearst Estate on McCloud River in Shasta County, which involved the transplanting of some five hundred Pine Trees. During the decade of the 1930's, the company employed an average of six men.

From its early beginnings before World War One, the residential/commercial sector of arboriculture has matured into an industry of approximately 15,000 commercial tree care firms employing an average of ten employees each. This figure can only include those known to be involved in tree maintenance not arborist otherwise employed through the normal work week. As history in communications was being made, the need for a new industry devoted to the maintenance of trees in utility corridors was born. Alexander Graham Bell perfected the telephone in 1876, and Thomas A. Edison's light bulb illuminated America in 1882. By the end of World War Two a study estimated that some 6,000,000 miles of overhead conductors affected, in any small part, 400,000,000 trees. The U.S. Bureau of Labor estimates that over 40,000 workers account for nearly 2 billion dollars annually in utility-related services (Blair, 1995).

Arborists can be employed in many other areas additional to private companies. Many cities maintain their own tree crews, under forestry or public works departments. Other entities employing arborists and tree workers are water companies, county governments, municipally owned and operated utilities, natural gas and oil pipeline companies, and the railroads. The National Arborist Association (NAA), with financial support from the U.S. Forest Service, conducted an extensive tree maintenance survey to determine the number of trees that were pruned, fertilized, cabled, treated for insects, treated for disease, removed, and or planted in 1993. The results of the study were intended to provide a baseline for further research on the benefits of large tree maintenance. The study estimated that professional arborists administered to 25,575,000 trees in the urban and suburban forests of the continental United States, in 1993 alone.

Ninety percent of those trees were cared for by commercial tree care firms, the remainder by municipal agencies (NAA Reporter, 1994).

The 1993 survey further indicated that 13,807,898 trees were pruned; 6,006,784 trees were treated for insects; 3,793,173 trees were fertilized; 1,698,995 trees were treated for disease; 1,663,235 trees were removed; and 268,376 trees were cabled (NAA Reporter, 1994).

Trees in the United States are maintained and removed as necessary for many reasons. Some trees are pruned for beauty and historical significance, while others are pruned because they interfere with the movement of vehicles, railroads, and aircraft. Trees cost utility companies millions more in interrupted service than they receive in budgeted care. Tree-related obstructions continue to be the number one cause of municipal litigation.

Job Title Safety Responsibilities

The following information listed by job title is included to provide background understanding of how the tree care industry operates. Safety has an important role with every employee leaving no exclusions. In order for this to be successful, everyone within the company must fulfill his or her job responsibilities to those above and below of any significant changes in policy. Thorough understanding and effective execution of job responsibilities not only allows the opportunity for the company to succeed, but also provides a strong foundation for the effectiveness of a safety program.

Owner

Much of the following description of owner responsibilities is provided by Donald Blair in *Arborist Equipment*:

A. Provide orientation and training of sufficient and necessary nature pertinent to worked assigned the employee.
B. Provide equipment in a serviceable condition and in a good state of repair.
C. Clearly specify the nature and service requirements of equipment required to be used by employees.
D. Provide necessary workers compensation insurance and multi-peril coverage.
E. Foster an atmosphere of communication. General MacArthur once said, "It is not enough to give instructions that can be understood, instructions must be given that simply cannot be misunderstood." A boss or supervisor must also remain accessible and approachable to the needs and concerns of foremen and field-level employees.

Supervisors

Owners or executives often create safety problems for middle managers and supervisors by pressing them for production that is hazardous to their personnel. The result is many times increased production at unsafe rates of work or supervision, and the possibility of a reduction in expenditures necessary for safety equipment. An essential piece for any successful accident prevention program is to ensure all employees that supervisors are concerned about their safety (Hammer, 2001). The following description of supervisor or salesperson safety responsibilities is provided by Donald Blair in *Arborist Equipment*:

A. View the job with an eye towards recognition of hazards and communicate the same on work orders. Accompany the crew to the job site whenever possible.

B. Note special equipment necessary to accomplish the job. Chainsaws with bars longer than usually carried and lowering ropes of appropriate size and length must not be forgotten. Plywood tires and other property protections aids may all be needed to prevent property damage. Having to "make do" with inadequate or inappropriate equipment is an unsafe practice.

Safety Coordinator

To ensure the effectiveness of the safety program, management usually places program administration in the hands of a safety director. The safety and health professional must identify and adapt to several critical roles in a small business setting. The specialist must always work to save lives, prevent harm to workers, maintain productivity, and encourage retention of all productive employees by ensuring they are operating in the safest conditions possible.

Safety requires knowledge of system safety analysis, job safety analysis, job instruction training, human factors engineering, biomechanics, and product safety. The safety coordinator must have a thorough knowledge of the organizations equipment, facilities, job procedures, OSHA regulations, worker compensation, and must be able to communicate and work with all types of people. The safety professional advises and guides management, supervisors, foreman, and all field employees on all matters pertaining to safety. Other responsibilities include formulating, administering, monitoring, evaluating, and improving the accident prevention program. It is also essential for the safety professional to understand that safety culture is an evolving process that undergoes continues changes, as new research is completed and regulations

implemented. The safety manger must keep up with the current industry trends and be able to convey the knowledge to all employees in the company (Hammer, 2001).

Foreman

Foreman in the field have the closest contact with workers and can provide the closest control of all activities and safe operations. Because many foremen have so many duties to complete, they are often overworked and certain duties are not accomplished adequately. Neglect of hazard assessments and accident prevention, which often occurs, can have the most detrimental consequences. In addition to the supervisor, the foreman's responsibility is to ensure that ignoring proper safety measures does not happen. For field employees, a foreman represents authority, or otherwise a piece of management. He must develop a good rapport with all employees under him, in order to properly exert his authority and influence so that the intentions of management are properly carried out. If the foreman or top climber does not take safety seriously no member of his crew will spend the time to protect themselves. If the foreman is convinced of the importance of safety and displays that on every jobsite then his example will be certain to trickle down to all employees under him (Hammer, 2001). The following description of foreman safety responsibilities is provided by Donald Blair in *Arborist Equipment*:

A. Follow applicable Department of Transportation guidelines for a pre-trip inspection. Check that vehicle and towed equipment is in proper working condition, including brakes, lights, horn, engine and running gear, tires. Be sure that fire extinguisher and rescue equipment is onboard and in serviceable condition. First aid kits must be inspected and replenished whenever stocks are depleted.

B. Check that crew and equipment are suited to the job ahead.

C. Be sure that work assignments are appropriate to the abilities of the workers so assigned. For example, a first-day trainee should not be assigned to be the principal climber on the major removal of a truly hazardous tree directly over a home.

D. As you begin to lay out the job, look for obvious and obscure hazards. An obvious hazard might be a broken top, close proximity to electrical conductors, or dead branches. An obscure hazard is one that is not so readily apparent. Children playing ball at the neighbors across the street might be an obscure hazard.

E. If an accident or injury occurs to one of your co-workers, you will have to make the right decisions in the correct order. Above all, you must maintain control of the situation.

Employers are required by law to provide training and certain specific personal protective equipment. Employers are required to enforce a safety policy. Although employers are not liable for wanton acts of noncompliance by employees, foremen and supervisors are viewed, by the law, as management. As such, foremen and supervisors must enforce applicable safety regulations on the job. Failure to do so can result in direct legal implications in case of an accident.

Top Climber or Climber

The following description of climber safety responsibilities is provided by Donald Blair in *Arborist Equipment*:

A. Know what the job is before you leave the yard. Be sure to have the tools that you'll need. Be sure that they are in good condition. The best time to inspect your

climbing line, saddle and other gear is at the yard, before getting to the job. Ensure all powered equipment and chain saws are in good condition and that the chain still has another job left in it.

B. Be sure to look for hidden electrical wires, hanging limbs, weak branches, etc. before planning your climb. Visually inspect the root collar and bole for indications of decay or instability, such as mushrooms, fruiting bodies, loose bark, cut roots. Be suspicious of trees that are engulfed in ivy.

C. Be sure to have a clear understanding of the job before commencement. Make sure that you know your role and that the ground crew understands their role. Saws should be test run and warmed up before they are sent aloft.

D. Work in pace with the ground crew. Speed without efficiency will actually bog down the job if the ground crew cannot keep up with you.

E. Don't make your only warning the sound of your saw starting up. Be sure that you can see where your ground crew is before cutting. Too many tree workers have been hit by thrown tools and falling tree parts. Incidentally, American National Standards Institute (ANSI) Z-133.1 standards prohibit the throwing of all tools, except ropes, out of a tree.

F. Take the time to situate yourself. Better to tie into a false crotch than to risk that one remaining stub on a long trunk stripped for falling, Better to recrotch than to work from an awkward, tiring, and unbalanced position.

G. Don't rely on sheer physical strength for lifting, holding or throwing.

H. To facilitate an aerial rescue, hang a second climbing line in the tree before beginning work above 40-50 feet. Regarding the proper use of a line, use your judgment as the structure of the tree, access and job site dictate.

I. Practice aerial rescue techniques with your crew on a regular monthly basis.

J. Wear your hard hat.

K. Keep up with first-aid training. Many cases involving injury above ground have required correct and immediate response from the climber himself. Failure to respond has also resulted in serious injury and death.

L. Always select a tie-in that will swing you away from energized conductors or other hazards. Use a false crotch if necessary. Be mindful of passing traffic that could snag your rope and tear you right out of the tree.

Equipment Operator

The following description of equipment operator safety responsibilities is provided by Donald Blair in *Arborist Equipment*. Some firms and municipalities have equipment operators who either drive the chipper trucks or aerial lifts, or operate cranes, stump grinders, and log loaders as well as other specialized pieces of equipment. If your job meets this description you should:

A. Make sure that the equipment you operate is thoroughly checked out before you leave the yard. Wheel chocks, cones and flags, if necessary should be on hand.

B. Whatever you operate or whatever your specific role, make sure that you understand what is expected of you. Make sure that those working with you understand what precautions they must take to work safely as you complete your job duties. Stump grinders can throw stones, cranes require knowledge of hang

signals, and log loaders need some room to operate. Every piece of equipment has special precautionary requirements.

C. Make sure that operation of your equipment at a given time is in sync with the flow of work around you.

D. Do not let anyone make you operate equipment in a manner that in unsafe or not in keeping with the intended function of the machine.

E. Do not allow anyone to make you operate equipment that you are not trained or qualified to operate.

Groundman

The following description of groundman safety responsibilities is provided by Donald Blair in *Arborist Equipment*:

A. Know you role in the job.

B. Keep an eye up for the climber. Your judgment and communication from the ground can be of great help to the climber in:

1. Looking for ropes caught on stubs or other branches.
2. Spotting a climber, tool or tree part getting too close to an energized conductor, obstacle or potential hazard.
3. Helping with the quality control of a job by spotting height reductions, overlooked deadwood or other material to be removed.

C. Know what the climber has in mind before you move underneath the drop zone to move brush, logs or equipment.

D. Don't start up ground saws or other noisy equipment without first checking to see that the climber won't need to communicate with you during that period. Teamwork requires each person working in concert with the others.

E. Learn "the ropes" literally and be able to tie true knots.

F. Be sure that the rope you're holding is the same rope that the climber thinks you are holding.

G. If you don't understand an instruction from a superior, say so before the climber or foreman puts you and the rest of the crew in danger.

H. Do not throw tools up to the climber.

I. Be mindful of the climber's rope. Keep it untangled from brush. Climbing line has been run through brush chippers.

J. If the climber has an accident, you must respond in an orderly and correct manner. If your foreman or leadman is in charge, do precisely what is directed to you. If you are alone or the foreman cannot respond, then you must act quickly, decisively, and correctly.

Company Services Provided and Areas of Specialty

The following is a brief list and description of the services provided by the researched company, which is very similar to most large tree care companies. This should be used as background information for the purpose of better understanding the text.

Table 1 Company Areas of Specialty

- Diagnosis of Tree and Landscape Problems
- Hazard Tree Assessments
- Insect and Disease Identification and Management
- Plant Health Care Programs
- Tree Pruning
- Tree Cabling and Bracing
- Tree Removals

Plant Health Care Programs

The objective of a plant health care program is to minimize the amount of disease • and insect problems in a particular landscape. The scope of plant health care encompasses pruning, cabling, bracing, fertilizing, planting, mulching, monitoring for disease and pest problems, and treating disease and pest problems.

Cabling and Bracing

Trees with significant leans or weak branching characteristics may require various methods of cabling and bracing to reduce the risk of tree failure.

Removal

Dead or diseased trees create hazards, which may result in property damage. In this case removal is the only option to reduce the risk of the tree falling and creating undue hazard to persons or property under its canopy

Pruning

Pruning of the foliar canopies and removal of dead wood should increase tree vitality. Pruning will lessen the likelihood or potential for limb breakage, reduce 'windsail' effect, and provide an environment suitable for healthy and vigorous growth.

Industry Standards Overview

On December 29, 1970, President Richard M. Nixon signed The Occupational Safety and Health Act of 1970, also known as the Williams-Steiger Act in honor of Senator Harrison A. Williams Jr. and Representative William A. Steiger, the two men who pressed for its passage. The Act established three permanent agencies: the Occupational Safety and Health Administration (OSHA) within the Labor Department to set and enforce workplace safety and health standards; the National Institute for Occupational Safety and Health (NIOSH) in what was then the Department of Health, Education and Welfare to conduct research on occupational safety and health; and the Occupational Safety and Health Review Commission (OSHRC), an independent agency to adjudicate enforcement actions challenged by employers. The OSH Act charged OSHA with assuring safe and healthful conditions for workers. When the agency opened for business in April 1971, OSHA covered 56 million workers at 3.5 million workplaces. Today, it covers 105 million private-sector workers and employers at 6.9 million sites (NAA, 2002).

There are two basic types of OSHA standard. First, there are vertical standards, which affect just one industry or a small group of closely related industries. Second, there are horizontal standards, also known as general industry standards, which affect a broad range of industries. Notably, there is no vertical standard for the tree care industry, except 29 CFR Part 1910.269, the Electric power generation, transmission, and distribution standard, which regulates utility line clearance tree trimming (NAA, 2002).

OSHA published its first consensus standards on May 29, 1971. Some of those standards remain in effect today. Others have been updated or expanded through public rulemaking, dropped as unnecessary or overly specific, or amended to clarify their intent. OSHA employed several enforcement strategies. Initially the agency emphasized voluntary compliance with inspections dedicated to catastrophic accidents and the most dangerous and unhealthful workplaces. Later, the agency adopted a "get tough" stance that evolved to a more targeted approach based on significant hazards. OSHA further refined its inspection targeting system in the late 1970s to focus 95% of health inspections on industries with the most serious problems (NAA, 2002).

Congress recognized when debating safety and health legislation that several states already were operating effective occupational safety and health programs. The law, therefore, provided an option for states that wanted to run their own OSHA programs to apply to OSHA to do so. Participating states had to adopt a program comparable to the federal one, with standards at least as effective as federal standards. Currently, 24 states and two territories operate programs covering private-sector and state and local government employees. Connecticut and New York have state plans that cover public employees only. These states can be found in Appendix D.

To encourage voluntary compliance and assist businesses, particularly small businesses, OSHA established free onsite consultation programs, delivered through state authorities, in 1975. The agency took its outreach efforts a step further in 1978 with its New Directions grants program. The program provided seed money to other organizations to develop and offer safety and health training to employers and employees.

In its third decade, OSHA re-examined its goals as part of the overall government reinvention process, looking for ways to leverage its resources and increase its impact in reducing workplace injuries, illnesses, and deaths. Many standards published during the 1990s relied on a performance-oriented approach setting specific goals for worker safety and health, but providing flexibility in how those goals were to be met. In 1994-95, OSHA promulgated two electrical safety-related work practices standards, one for general industry and one for the utility line clearance tree trimming industry. For the NAA and the tree care industry, it was the culmination of almost 12 years of effort: working with OSHA standards writers, developing model standard language in committees, testifying at hearings and providing written commentary for the public record.

The agency continued to refine its inspection targeting system to focus on serious violators, proposing sizable penalties when inspectors found sites where safety and health problems were most serious. In 1990, Congress increased maximum penalties for OSHA violations from $1,000 to $7,000 for serious violations and from $10,000 to $70,000 for willful and repeat violations. During the mid-1990s, OSHA began collecting data annually from about 80,000 employers in high-hazard industries to identify sites with high injury and illness rates. In 1999, the agency adopted the Site Specific Targeting Program, which for the first time directed inspections to individual workplaces with the worst safety and health records (NAA, 2002).

For arborists, American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), and American Society of Mechanical Engineers (ASME) standards are applicable and referenced by the safety coordinator as often as

necessary. ANSI Z133.1 and A300 specifically address tree maintenance safety and practice along with others addressing safety belts, ladders, aerial lifts, traffic control, eye and face protection, respiratory protection, and head protection (Blair, 1995).

ANSI Z133.1 standards for tree maintenance safety, like many others, came as a result of a preventable fatal accident. Mrs. Ethel Hugg of Johnstown, New York, lost her son in a tree-related accident. Channeling her grief into a proactive campaign for safety led to the formation of the ANSI Z133.1 committee on April 4, 1968. Many tree workers have been killed or seriously injured over the last 100 years of field work. The lessons learned form these losses have translated into Z133.1 standards whenever possible (Blair, 1995).

CHAPTER III

RESEARCH METHODOLOGY

The method used to evaluate the data found in the research was to relate several different data sets to reach a common conclusion. The claims analysis database was established from a compilation of OSHA 200 forms, OSHA 300 forms, workers compensation reports, and medical and indemnity reports, in order to better analyze the injuries and illnesses that were reported. The data was extracted from an eleven year period between January 1, 1991 and July 1, 2002, during which 224 injuries and illnesses were reported. Of the total recorded claims, 215 involved field employees. Proper interpretation and understanding of many claims required regular contact with management and the safety manager. Many of the claims were not reported with a cause of injury or specific type of equipment used. The resulting cause of some injuries and illnesses is the result of inference, interpretation, and unique knowledge of the industry. The type of equipment listed under chainsaw may actually include other devices mechanical and non-mechanical including hand saws, hand snips, or any other pruning device, excluding pole saws.

This information is used in conjunction with employee questionnaires, employee discomfort surveys, industry standards, and safety training information to answer the research questions for this thesis. The questionnaires provide employee perception data of the safety program, management, personal protective equipment, medical information,

and safety training. The discomfort surveys provide data for individual field worker pain locations and their opinion of the potential cause. This information was collected in the morning before all employees started their regular duties to keep the data as consistent and accurate as possible. A sample of the discomfort survey can be found in the appendix. The information is compared to the claims analysis to determine potential inadequacies in the industry and also with the company safety program for possible correlations.

The analysis of the injury data provided a thorough description of the employee that was injured, body parts that were affected, the frequency of the claims, and the severity based on lost work days, medical, and indemnity costs. The data collection used a compilation of several sources described earlier and categorizing based on significant information and inputting into a database format. The list of database parameters for significant categories used for extracting the data can be found in Appendix C.

A unique feature about the collection of data for this research was the tremendous amount of information supplied to be analyzed. Because of this, more accurate conclusions and recommendations can be drawn from a very specific set of data. A listing of many of the variables used in the database is also located in Appendix C.

American National Standard for Tree Care Operations

ANSI Z133

ANSI Z133.4 outlines the general safety requirements for arborists including standards for personal protective equipment, emergency procedure and readiness, and noise. Included in the section are the general requirements for employers and employees. "Employers shall instruct their employees in the proper use, inspection and maintenance

of tools and equipment, including ropes and lines, and shall require that working practices be followed (ANSI Z133.4.1.2)." All equipment is inspected thoroughly before leaving the equipment yard. Chainsaws are fixed and sharpened as often as necessary, ropes are replaced on a regular basis, and a mechanic is on site to keep the vehicles and brush chippers in the best operating condition possible each day.

"A job briefing shall be performed by the qualified arborist in charge before the start of each job. The briefing shall be communicated to all affected workers. An employee working alone need not conduct a job briefing (ANSI Z133.4.1.3)." This standard is referenced in the employee questionnaire later in the text. According to those questionnaires, all 38 field employees believed that job briefings were an essential part of their daily responsibilities. The briefings are accomplished at every job site, usually with the supervisor present.

The next section of the ANSI Z133 standards covers employee personal protective equipment (PPE). "Personal protective equipment as outlined in section 4.2 shall be required where there is a reasonable probability of injury or illness that can be prevented by such protection (ANSI Z133.4.2.1)." The wording of this standard is very ambiguous and left for individual interpretation giving the employer many more options with the purchase of personal protective equipment.

Individual articles of PPE are also referred to ambiguously. The Z133 head protection standard states, "Workers engaged in arboricultural operations shall wear head protection that conforms to ANSI Z89.1 (ANSI Z133.4.2.2)." The same standard continues with electrical references, "Class E helmets shall be worn when working in proximity to electrical conductors, in accordance with ANSI Z89.1 (ANSI Z133.4.2.2)."

Face protection and respiratory protection are both as required pieces of equipment and must comply with other standards that apply to fit and coverage. "Eye protection shall be worn when engaged in arboricultural operations (ANSI Z133.4.2.5)". Section 4.2.6 of this PPE standard state "Clothing and footwear appropriate to the known job hazards shall be approved by the employer and worn by the employee (ANSI Z133.4.2.6)." The wording of this standard does not imply that slips and falls are two of the industry's leading causes of lost workday cases. Section 4.2.7 addresses leg protection for chainsaw ground operations. According to the standard, leg protection is not required unless the chainsaw use is for ground operations. Under this interpretation, many tree care employees shall not have to wear leg protection because the majority of their chainsaw work is in trees. Nonetheless, chaps are provided for field employees even though they are very rarely used. This is because they are thick, hot, uncomfortable, and most likely of all, the employees are not used to wearing them. Many pieces of equipment can feel overbearing during the first period of adjustment.

Section 4.3 of the ANSI Z133 standards involves emergency procedure and readiness. This covers the location and readiness of first aid kits, the identification of poisonous plants and various insects, and emergency response procedures training. This particular training is done annually at the company and is in conjunction with aerial rescue training, cardio-pulmonary resuscitation (CPR), and first aid training.

Section 4.6.1 is the only noise reference in the Z133 standards even though it is becoming a significant industry wide problem. There are several articles published linking safety hazards with lack of adequate hearing capabilities. Currently there are two of thirty-eight field employees who suffer from significant hearing loss. If the remaining

thirty-six employees continue in this line of work, they will very likely suffer some measurable hearing loss. "When noise levels exceed acceptable standards, as established by Federal regulations, the employer should take appropriate measures to suppress noise levels (ANSI Z133.4.6.1)." The two ways to suppress noise, in this case, are quieter equipment and effective hearing protection. This section of the standard continues, "approved hearing protection as provided by the employer shall be worn when it is not practical to decrease the level of or isolate the noise (ANSI Z133.4.6.1)." This company supplies several models of ear plugs and earmuffs based on employee comfort.

The standards dictate the requirements and recommendations of the tree care industry for satisfactory performance of tree care maintenance. This means tree care companies who perform work according to ANSI A300 or ANSI Z133 standards are following accepted industry practices for tree care maintenance operations and safety requirements.

California Code of Regulations Article 12

Under the California Code of Regulations, Subchapter 7, General Industry Safety Orders, is Article 12. Article 12 covers tree work, maintenance and removal, which applies to work performed and equipment used in tree removal and general maintenance. The article defines a qualified tree worker as "an employee who, through related training and on-the-job experience, has demonstrated familiarity with the techniques and hazards of tree maintenance, removal, and the equipment used in the specific operation involved."

The regulations have many similarities to the ANSI Z133 standards, but also are more explicit on how tree work should be accomplished. According to the regulations all work whether its trimming, repairing, or removal, shall be under the guidance of a

qualified tree worker. This same qualified arborist must conduct a job briefing prior to starting at a new jobsite. In addition to the Z133 standard, this briefing must include a description of the hazards present on the site, procedures for the job, and work assignments for the crew. This briefing is intended to keep all crewmembers working as a team to finish the job as safely and efficiently as possible. Also part of the briefing or prior to leaving the equipment yard, shall be an equipment inspection to determine if everything is functioning properly with no defects or safety equipment removed.

Section 3428 of the California Code of Regulations, tree work, maintenance or removal, defines the operating rules for every employer engaged in tree work. Rule eight states that power saw engines must be turned off when carried either for more than 100 feet, or in hazardous conditions, such as slippery surfaces or uneven terrain. Saws should always be at idle speed if not cutting, especially when carrying short distances. Rule fourteen describes procedures for using pole pruners and pole saws, a significant source of injuries for most tree companies. When not in use they should be hung vertical in a secure location to prevent dislodging and in the case of pole saws, the shape edge side shall always point away from the operator. These all represent safe work practices, some of which are often violated at this company and all others in the tree care industry. Many of these have led to accidents at the company and will continue to do so as long as employees are complacent and careless on the jobsite.

Company Safety Training

The purpose of training is to make a person proficient by means of specialized instruction and practice. The purpose of safety training is to inform employees how to complete their job responsibilities safely and efficiently. Effective job orientation and

safety and health training is a key element in every accident prevention program. It is management's responsibility to implement a training program, but the safety professional must meet certain objectives.

Training is primarily focused on changing employee behavior. Safety training must focus on how to apply lessons learned and job skills to finish a job appropriately. The intended purpose of training should not be to fulfill a government requirement, but to reinforce methods and teach new skills which can be applied to make a task safer. When implemented properly, these methods can improve performance, reduce injuries and illnesses, and lower worker's compensation costs (Accident Prevention Manual, 2001).

The injury and illness prevention program at this company utilizes several safety training methods throughout the year to cover their safety material. The primary method is on-the-job training because it allows the tree worker to be productive during the training period. This is also the most beneficial and effective of all the initial training methods because it involves first hand experience. Independent study programs, such as the Electrical Hazard Awareness Program and the Certified Tree Worker Program, are some of the most beneficial training methods for experienced employees because they require self motivation and a willingness to learn the material. There is also a group safety meeting every quarter utilizing discussion, lecture, question and answer sessions, demonstrations, video-based training, and tailgate training. According to the employee questionnaires, which can be found later in the text, the question and answer sessions, tailgate training, independent study, and the demonstrations are the most productive and educational aspects of the safety training.

The lecture session is either done by the safety supervisor, a risk management consultant from a brokerage firm, or a State Fund Insurance safety professional. The outside personnel always present excellent material, but are often faced with a language barrier relating to the employees. The current safety supervisor accepted the position about five years ago and was promoted from the field. This allows him to relate to the employees not only through personal experience and knowledge, but with no communication barrier. His relationship with the field employees, ability to convey his knowledge and experience, and care for the well-being of his co-workers has reflected on the company incidence rates, total claims, and worker's compensation costs over the last five years. This is presented later in the text under claims analysis. This part of the training is somewhat beneficial, but most employees would rather be elsewhere than sit in an office and listen to someone speaking. Therefore, this method of training is probably the most difficult because it requires the motivation and attention of nearly forty employees in order to be successful. According to the majority of field workers, they prefer other training methods over the lecture session.

Video training tends to be repetitive and most employees complain of seeing the same video several times. This method does a poor job of motivating employees and teaching anything they might not already know. Videos that depict what can happen to arborists around power lines do an effective job at showing everyone that electricity can cause a fatality with just the slightest mistake. The videos shown involve one of the following topics: chainsaw use and safety, first aid, basic rigging and roping limbs, technical rigging, ropes, knots, and climbing, chipper operations safety, electrical hazards, aerial rescue, and operational safety.

The first parts of the quarterly meetings are conducted with discussion and question and answer sessions to gain employee involvement and allow people to actively participate. All the employees who were written up, or suffered an injury or illness describe what happened, how it happened, and what they think could be done to prevent a similar occurrence in the future. According to the employees, this session is very informative and beneficial because of how well they relate to the material.

The annual training demonstrations cover aerial rescue, CPR, and lifting. CPR training is done every two years and is a requirement for all those with certifications. The aerial rescue training is the most dramatic and extensive. It provides employees with a hands-on experience and forces them to realize what may actually happen to them. A complete description of what this training requires is later in the text.

The lifting section of training does little to help employees because of the nature of their job. All lifting training can emphasize are proper techniques, rules-of-thumb, and general lifting criteria. The lifting done in the field is usually on uneven terrain, with loose footing, and picking up uneven pieces of wood. As the claim section describes, lifting is an area that should be substituted with mechanical devices because lower back claims severely hurt the company financially. A few employees requested that the company look into mechanical lifting aids to relieve strains from lifting. Limiting exposure to heavy lifting by using mechanical devices could reduce the amount of back strains and claims in the future.

Aerial Rescue Training

Throughout the industry, a great deal of emphasis is placed upon aerial rescue. Aerial rescue proficiency is required for most tree worker certification programs and is

required under ANSI Z133 and OSHA 29 CFR 1910.269 standards. Aerial rescue consists of the process and procedures necessary to effectively reach, aid, and bring an injured tree worker safely to the ground. Aerial rescue becomes necessary when either because of an injury, equipment, or tree failure, a tree worker aloft requires assistance in descending back to the ground and most likely requires first-aid or CPR. Aerial rescue is extremely difficult, hard, physical labor, but through conditioning and training, the mechanics of it can be mastered. What cannot be mastered is the psychological trauma associated with having to rescue a seriously injured coworker (Blair, 1993).

Aerial rescue avoidance must consist of training necessary to recognize and avoid the hazards that can lead to the accident requiring someone being stranded in a tree. The most successful aerial rescue is always that which never happens. You have to practice the rescue training annually by law and to maintain certifications, but the experience is the most rewarding. The grueling ascent up the tree often freezes many climbers and the experience of aiding a fellow employee in a training exercise is an invaluable experience (Blair, 1993). A climber working aloft may sustain an injury requiring aerial rescue from any number of accident scenarios. It is very important for employees to be aware of the hazards that exist while climbing, pruning, and removing.

Tailgate Safety Training

Tailgate training is a brief, informal, and informative lesson given at a job site or at the office. This is a routine training method the company examined in this thesis. It generally involves a specific jobsite and its related hazards making it easier for the employees to relate the material that can be addressed. Although it requires only a small amount of time, tailgate training can be highly effective. Typically, the safety supervisor

will visit the jobsite and pull the employees aside for a short time to discuss the job. This discussion may identify potential hazards, climbing methods, proper protective equipment, and equipment operation. This is a valuable method of training because it is job specific and provides a two to four man crew a chance to provide their opinions and be directly involved in the training process. According to employees, training is much more effective when it applies to what they recognize as problems. That is why this informal type of training can be a valuable measure if implemented properly in the safety program. The National Arborist Association (NAA) provides over 70 tailgate sessions employers can use to help supplement arborist safety training. These sessions may include topics such as climbing, struck by injuries, lifting injuries, and equipment use.

Accident Investigation

The lessons learned from arborist accidents illustrate the importance of accident investigation, which is the catalyst for risk mitigation and future accident prevention. Tree work has been known as a hazardous industry for many years, but timely and accurate accident reports are hard to find at many companies. Proper information dissemination is the only way for future arborists to be protected by appropriate standards. Although this is not a part of safety training, accident investigation should be an essential aspect of all safety programs. This is an area that could be investigated further to determine its role in contributing to accidents. Understanding what elements were involved in an accident are essential for future prevention

Independent Study Programs

Independent study is a valuable industry tool to increase employee hazard awareness and knowledge, while at the same time allowing them to gain recognition from

their peers. About 45% of the field employees have completed an independent study course and all of them believe the training was extremely beneficial and productive. Fifteen employees have completed the Electrical Hazard Awareness Program (EHAP), five are Certified Tree Worker's (CTW), and three are qualified pest control applicators. The qualified applicator certificate relates to pest control and its hazards and will not be described with the same detail as the other two certifications. It is presented for the purposes of demonstrating employee initiative to learn more about their industry. Knowledge of hazards should decrease risk, which in turn, decreases the risk of a potential accident.

Electrical Hazards Awareness Program

Electricity is a serious and widespread hazard to every arborist working in the vicinity of power lines. Electricity is the leading cause of worker fatalities among arborists, resulting in nearly 30 percent of the fatalities in the tree care industry. Every field employee has at least some exposure to electrical hazards on a routine basis. Whether the electricity is associated with power lines, a street lamp circuit, television wire, or phone line; they all can be energized with enough voltage to threaten the life of an arborist (EHAP, 2002).

About 50% of all electrocution related fatalities are the result of indirect contact with a power source. Possible conductors not only include chainsaws, aerial lifts, and pole saws, but green tree branches making tree work around power sources an extremely hazardous duty. If the jobsite has power lines in the immediate vicinity, it is company policy for every supervisor to use notation on work orders providing advanced warning

for the crew. In addition, the safety supervisor visits these sites throughout the day to ensure proper protective measures are taken to stay clear of the electrical hazards.

In 1994 OSHA stated that not only should electrical hazards training be a significant part of arborist training, it is required. OSHA 29 CFR, Part 1910.269, better known as the Vertical Standard, applies to the utility industry, including line clearance contractors, as well as all arborists who operate within 10 feet of an overhead electrical conductor to do their work (EHAP, 2002).

CalOSHA enforces a separate, but very similar set of regulations working in the vicinity of power lines. The employer and the employee have specific responsibilities under OSHA relating to electrical hazards. Every employer's main obligation with electrical hazards is to train employees appropriately. All employees must be able to identify energized wires and other electrical apparatuses in the proximity of trees, understand the maximum nominal voltages, and the distances to maintain. When the arborist must work within ten feet of 750 volts or more, there must be a second trained arborist on the crew, maintaining voice or visual communication with the worker exposed to the electrical hazard. OSHA states that employer's shall establish rescue procedures and provide training in first aid, CPR, and aerial rescue. Red Cross or equivalent training shall be provided to at least two people on every crew of two or more. However, only one person on that crew must be certified if training of all employees is initiated within 90 days of hire (EHAP, 2002). More regarding this training is under the aerial rescue section.

Federal OSHA regulations stipulate that employees must be trained in work practices and safety procedures to perform their every day operations that training must

be documented and on-going. Training must establish employee proficiency in the work practices involved and show employees how to comply with OSHA 29 CFR Part 1910.269. There is a critical point of the vertical standard that must not be overlooked: The standard requires that the employer self-certify that each employee has received the training required and must verify and document the employee's proficiency (EHAP, 2002).

The National Arborist Association's Electrical Hazards Awareness program, provides an employee with the knowledge necessary to work around overhead conductors. EHAP is a correspondence course that can be administered by the employer or supervisor, or taken independently by the student. The training is an outstanding hazard recognition study program, but does not replace the need for OJT and proper crew supervision. The requirements for the EHAP certification are very informative and provide the employee with a sense of accomplishment and greater electrical hazard awareness. Once the requirements are met, the EHAP student receives a certificate, wallet card, and helmet decals. The requirements of EHAP, per the National Arborist Association website are as follows:

Table 2 EHAP Requirements

- Study Session 1, Electricity and the Utility Industry, and pass the exam
- Study Session 2, Electrical Hardware Recognition, and pass the exam
- Study Session 3, Recognizing Electrical Hazards, and pass the exam
- Study Session 4, Work Practices around Electrical Hazards, and pass the exam
- Study Session 5, Aerial Rescue Techniques, and pass the exam
- Study Session 6, Safety Standards for Line Clearance Tree Trimming and Tree Care, and pass the exam
- Provide NAA with proof of current, valid First Aid/CPR training
- Perform a practice aerial rescue
- Watch two videos, Electrical Hazards & Trees, and Aerial Rescue

This program is paid for by the company, overseen by supervisors, and highly recommended for all qualifying employees to complete. This program has been very well received by all of the employees, as they feel the training is informative, productive, and very educational. This is justified in the employee questionnaire section. Nearly 40% of the field employees have completed this program and more are currently in progress. Eight foreman, four top climbers, and three climbers are currently EHAP certified. These 15 employees have a greater understanding of many hazards present on jobsites and are a valuable resource to other crewmembers still to complete the program. This knowledge can be relayed to other employees, especially groundmen because of their limited arborist experience.

The company demonstrates their approval of this program by not only providing the materials to the employees, paying for the CPR training and testing materials, but awards a fifty cent an hour pay raise for successful completion. This amounts to $1,000 a year, which is essentially a monetary safety award for the duration of employment. In addition, the company is in the process of reorganizing the safety incentive program. The program will now reward points not only for no write-ups throughout the quarter, but also for attaining and maintaining any safety certifications. This is another incentive to increase training productivity, hazard awareness among arborists, and an active measure to reduce injuries.

Certified Tree Worker Program

In California, the Western Chapter of the International Society of Arboriculture (W.C.I.S.A.) directs a certification program for experienced arborists to promote safer work practices, establish a minimum level of training and knowledge, and to establish a

meaningful standard of skill and work quality consistent with trained and knowledgeable tree workers. Upon completion of the program, the arborist is a registered Certified Tree Worker.

There are numerous requirements that must be satisfied prior to certification making this one of the more stringent and intensive certifications a tree worker can attain. The applicant must have a minimum of 18 months of verifiable experience in arboriculture, sponsorship often from an I.S.A. Certified Arborist, proof of current CPR and first aid, proof of completion of aerial rescue training, pass a written exam, practical exam, and oral exam. It is important to note that the company currently employs three Certified Arborists and five Certified Tree Workers with more expected in the near future. Three quarters of the written exam covers safety, biology, and pruning, while the remainder identifies key areas in cabling and planting. The practical includes proficiency with knots and equipment and various climbing skills.

Even though only a quarter of the exam directly covers safety, the remainder of the certification requires a strong knowledge of the arboriculture industry. This knowledge provides a tremendous understanding of what hazards are present in the industry. Climbing skills, knots, equipment, and pruning understanding, are all valuable for increased awareness and understanding job related risk. In an industry that changes from one jobsite to the next, situational awareness is a valuable asset for an individual's safety and the safety of his crew. The CTW can relay his knowledge to everyone on his crew during daily hazard briefings and through OJT.

The ISA Certified Tree Worker/Climber Specialist designation is valid for three years. In order to maintain the certification, every three years the CTW must have

accumulated the necessary 15 Continuing Education Units (CEUs). CEU's must relate to climbing, safety, removals, pruning, rigging, or tree sciences. Half of the CEU's required must be documented as climbing training (ISA, 2002).

Of the five current CTW's, three are foreman, one top climber, and the other is a climber. This certification similar to the EHAP certification is fully sponsored by the company and upon successful completion entitles the employee to a $1.50 per hour pay raise, which is roughly $3,000 per year. All CTW's are also EHAP certified, which means their certifications are earning them about an extra $4,000 per year. This is a tremendous incentive the company offers in order to promote safety training and general arboricultural knowledge.

CHAPTER IV

RESULTS

Tree Worker Claims Analysis

This section provides a summary of personal data about injured the injured tree workers between January 1991 and July 1, 2002. This includes general personal data about the injured workers such as age and experience at the time of injury or illness, as well as job related data such as job title, activity at the time of accident, equipment used at the time of accident, and inferred cause of the injury or illness. The analysis begins with broad summaries of tree worker activity at the time of the injury or illness and ends with details about specific job categories and working conditions. This includes environmental conditions such as seasonal and weather related factors, as well as correlations between job title, activity, and equipment usage with injuries and illnesses.

The injury and illness summary is followed by results from an employee personal discomfort survey and an employee safety awareness and perception survey. This includes and is followed by a summary of relevant employee safety training information, job safety analysis, and possible contributions of tree workers equipment to injuries and illnesses.

Personal Age Data

The following section contains personal parameters about the 215 tree worker claims reported between January 1, 1991 and July1, 2002. These data are important in

correlating with employee awareness and discomfort surveys, as they specifically describe tree workers. Using this data in combination with other details associated with the injuries and illnesses can lead to more appropriate corrective measures. Table 3 shows the frequency distribution for tree worker age. The mean age of the population of field employees was 31.22 years with a standard deviation of 6.64 years. The distribution of age ranged from a low of 18 years to a high of 60 years. The median age for tree worker claims is 31 and the mode is 33. Just over seventy-six percent of all tree worker claims occurred at 34 years of age or less, while less than ten percent occurred to tree workers 40 years of age and older. Figure 2 depicts the distribution of injuries versus age for tree workers.

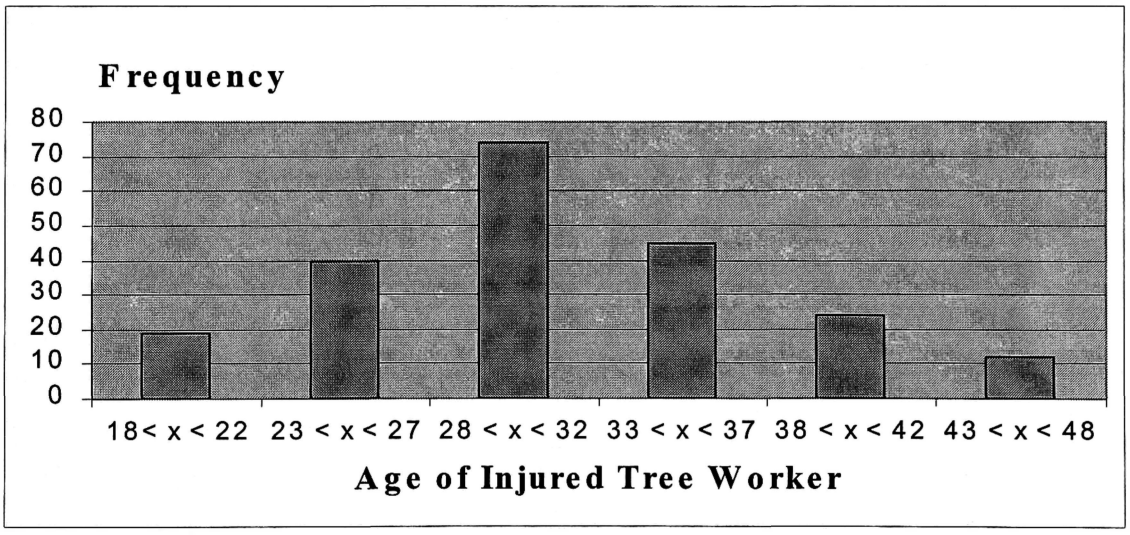


Figure 2. Age of Injured Tree Workers

Table 3 Frequency Distribution of Tree Worker Age

Age of Injured Person	Frequency	Percent	Cumulative Frequency	Cumulative Percent
18	2	0.93	2	0.93
19	1	0.47	3	1.40
20	3	1.40	6	2.79
21	4	1.86	10	4.65
22	9	4.19	19	8.84
23	10	4.65	29	13.49
24	8	3.72	37	17.21
25	7	3.26	44	20.47
26	7	3.26	51	23.72
27	8	3.72	59	27.44
28	12	5.58	71	33.02
29	12	5.58	83	38.60
30	17	7.91	100	46.51
31	21	9.77	121	56.28
32	12	5.58	133	61.86
33	21	9.77	154	71.63
34	11	5.12	165	76.74
35	4	1.86	169	78.60
36	3	1.40	172	80.00
37	6	2.79	178	82.79
38	7	3.26	185	86.05
39	5	2.33	190	88.37
40	5	2.33	195	90.70
41	4	1.86	199	92.56
42	3	1.40	202	93.95
43	3	1.40	205	95.35
44	3	1.40	208	96.74
46	2	0.93	210	97.67
47	2	0.93	212	98.60
48	2	0.93	214	99.53
60	1	0.47	215	100.00

n = 215 Mean Age = 31.22 Standard Deviation = 6.64

Experience

The following section contains experience data about the 215 tree worker claims reported between January 1, 1991 and July1, 2002. This data is important in correlating with employee awareness and discomfort surveys, as they specifically describe tree workers.

The mean experience for the tree worker population was 6.09 years with a standard deviation of 4.46 years. The distribution of experience ranged from less than one year to 21 years at the time of the injury or illness. The median experience is 6 and the mode is 8 years. Just fewer than 50% of the field employees with claims have been there five years or less, while just over 20% have been working for over nine years. Figure 3 presents the distribution of experience among field employees.

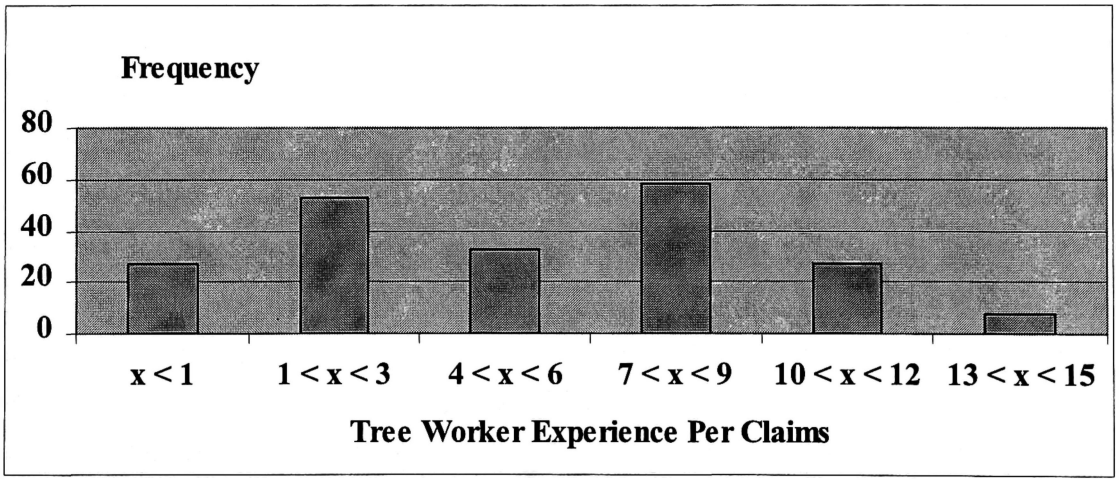


Figure 3. Tree Worker Experience

Table 4 Frequency Distribution of Tree Worker Experience

Years Experience	Frequency	Percent	Cumulative Frequency	Cumulative Percent
< 1	27	12.56	27	12.56
1	17	7.91	44	20.47
2	14	6.51	58	26.98
3	22	10.23	80	37.21
4	8	3.72	88	40.93
5	19	8.84	107	49.77
6	6	2.79	113	52.56
7	20	9.30	133	61.86
8	22	10.23	155	72.09
9	16	7.44	171	79.53
10	11	5.12	182	84.65
11	10	4.65	192	89.30
12	6	2.79	198	92.09
13	5	2.33	203	94.42
14	2	0.93	205	95.35
15	1	0.47	206	95.81
16	4	1.86	210	97.67
17	2	0.93	212	98.60
18	1	0.47	213	99.07
20	1	0.47	214	99.53
21	1	0.47	215	100.00

Mean Experience = 6.09 Standard Deviation = 4.46

Lost Workday Cases

Table 5 presents the frequency of lost work days for the 104 lost time injuries by all employees between January 1, 1991 and July 1, 2002. The number of lost days ranged from 1 to 181. The total lost days over the study period was 1,970. The mean for lost work days was 19.05 and the standard deviation was 28.12. Fifty percent of the lost time injuries had seven or fewer lost days. Two of the lost time injuries involved non-field

employees, which accounted for a combined 17 lost work days. There is no substantial difference in mean lost work days or standard deviation when the two injuries are removed for calculations. The mean remains 19 lost work days and the standard deviation remains 28.

The three lost time injuries involving 100 lost work days or more (102, 103, 181), involved different activities. Two were groundman and one was a foreman. One groundman was pruning, while the other was carrying a ladder. The foreman was lifting wood at the time of his injury. However, there are several similarities involving their injuries. All three employees were 48 years of age or older, with the eldest at 60 years of age. All three injuries occurred before 10:00 a.m., in the first two hours of work. All three injuries were lower back strains and all were caused by losing proper footing, either slips or falls. The sensitive nature of back strains, age, or the impact load associated with the fall may be explanations as to why these three injuries missed over 100 work days, while other back strains may have no lost time at all.

In reviewing the 215 injuries and illnesses during this thesis period, it appears the scenarios for lost time and non-lost time injuries are often similar in terms of equipment, activity, cause, and environmental conditions. Therefore, it is difficult to determine why one injury results in lost time, while another does not. There are several accidents with identical conditions relating to the ones previously described with very different outcomes. Whether the employee slipped while carrying a ladder or was lifting wood at the time of back strain there are claims ranging from no lost time to 181 lost work days.

From the injury and illness prevention viewpoint, lost time and non lost time injuries and illnesses must be treated similarly. Both must be investigated to determine

cause and future prevention, as the same injury could lead to lost time in one instance and not in another. The same work process that leads to both types of injuries and close calls applies to all employees. Data collection on lost time, non lost time, and close calls can usually result in the root cause of the problem. Individual close calls must be examined in addition to non-lost time and lost time cases to help determine the severity of the problem. Factors such as medical diagnosis, treatment, management attitude, employee attitude, and employee pain tolerance all play an important role in determining if the injury or illness will result in lost work days, and how much time will be lost.

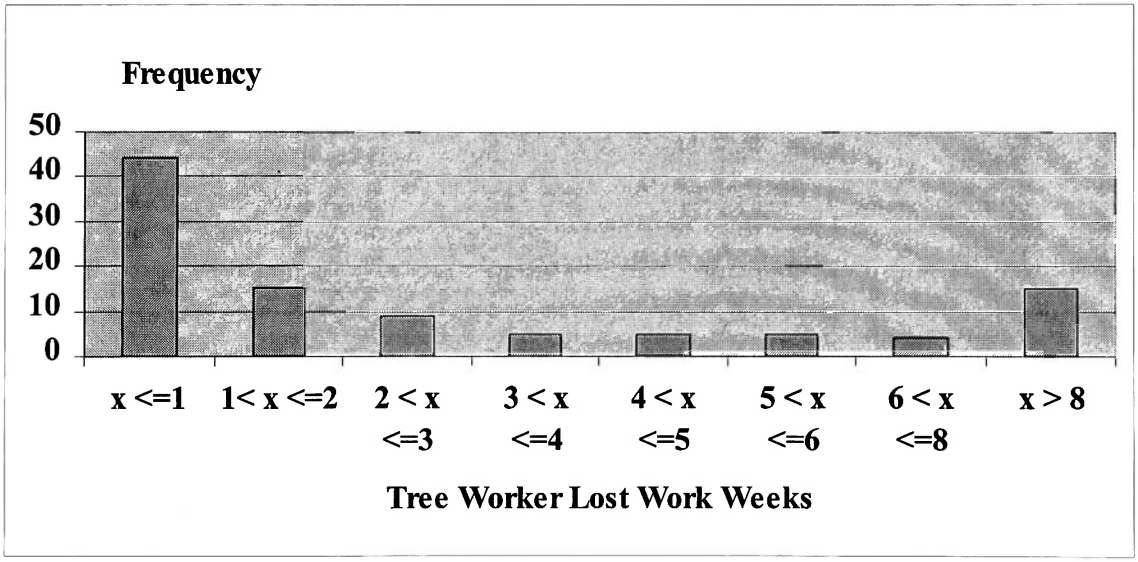


Figure 4. Tree Worker Lost Work Weeks

Table 5 Frequency Distribution of Tree Worker Lost Workdays

Lost Days	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	16	15.69	16	15.69
2	9	8.82	25	24.51
3	3	2.94	28	27.45
4	5	4.90	33	32.35
5	11	10.78	44	43.14
6	3	2.94	47	46.08
7	3	2.94	50	49.02
8	3	2.94	53	51.96
10	6	5.88	59	57.84
11	2	1.96	61	59.80
12	2	1.96	63	61.76
13	2	1.96	65	63.73
14	2	1.96	67	65.69
15	1	0.98	68	66.67
16	1	0.98	69	67.65
17	1	0.98	70	68.63
18	2	1.96	72	70.59
20	1	0.98	73	71.57
21	3	2.94	76	74.51
24	1	0.98	77	75.49
25	1	0.98	78	76.47
26	1	0.98	79	77.45
28	1	0.98	80	78.43
29	1	0.98	81	79.41
30	2	1.96	83	81.37
32	1	0.98	84	82.35
33	2	1.96	86	84.31
40	1	0.98	87	85.29
42	1	0.98	88	86.27
43	1	0.98	89	87.25
55	1	0.98	90	88.24
56	1	0.98	91	89.22
59	1	0.98	92	90.20

Lost Days	Frequency	Percent	Cumulative Frequency	Cumulative Percent
60	4	3.92	96	94.12
63	1	0.98	97	95.10
90	1	0.98	98	96.08
98	1	0.98	99	97.06
102	1	0.98	100	98.04
103	1	0.98	101	99.02
181	1	0.98	102	100.00

n = 102 Mean Lost Days = 19.31 Standard Deviation = 28.33

Restricted Work

Since 1991, there have only been two documented cases in which an injured tree worker returned to work with a medical restriction. In one case, the employee was returned on light duty for one week because of a hand laceration and the other was on light duty for a back strain. The back strain was the only one of the two, which resulted in lost time, with 90 lost days. Although it is a benefit for the employer to bring the tree worker back to work in terms of worker's compensation costs, the nature of the work makes it nearly impossible. A tree worker cannot be asked to go out with his crew on a normal workday and not lift something over twenty pounds. Because of the nature of the work just bending over may re-aggravate an existing back injury. If there is light duty work available around the equipment yard, the injured employee may be brought back so that they can be productive during the rehabilitation process. Even in that case however, the worker is still doing non-revenue related work and is only being productive to the point that he is not at home collecting compensation for no work completed.

The topic of restricted work is confusing for many employers for several reasons. First, is fear that the injured employee may return to work and suffer a re-aggravation of the disabling injury and be off work an even greater period. Second, the lack of understanding of what restricted work means troubles many supervisors. Some supervisors the employees restriction and send them out to do the strenuous work. This is part of the reason that very few cases have been documented with work restrictions. The reason for this is either the employee simply does not return to work until released for full duty or the OSHA injury and illness log is incorrectly completed. This is a substantial issue that is currently being resolved before a serious claim results from these careless acts.

A major problem with not having a developed restricted work program is the lack of supervision over the employee. It is hard to determine when the injury is healed, if off-the-job activities are re-aggravating the injury, or if the employee simply does not want to go to work. For example, two employees suffered similar ankle sprains while both carrying brush. One of the employees was back to work in less than a week, while the other missed several months. A few days or a week off work is consistent with that type of injury, but several months raise many questions about the injury and the employee. This is justification for a program to be implemented emphasizing the importance of early return to work.

Although physical therapy and some chiropractors are utilized, there is no developed work hardening or early return to work program. What has happened historically is the injured employee is asked to perform new job responsibilities that carry less demand on injured regions of their bodies. Although the process is not considered

restricted work, this is the company's method of keeping the employee productive and active. For example, an employee with over twenty years experience is suffering from repetitive strains and sprains. In order to make that employee productive and keep him working, rather than solely collecting compensation, he is offered a new position in a shop with very light duty work and quality hours. This method keeps key employees content with management, allows them fill a void in the system, and keeps overall employee morale high as they feel more necessary and essential to the company.

Daily Claims Analysis

Table 6, 7, and 8 present the field injuries and illnesses for the period of January 1, 1991 through July 1, 2002 in a format to identify days of the week that may be more hazardous than others. Monday (50) and Wednesday (42) are the days with the highest total injuries and also the days with the most severe injuries and illnesses, in terms of lost workdays and total cost. Even though Thursday and Friday each have 42 total claims as well, they are generally not as severe based upon lost workdays and total incurred cost. Wednesday has nine cases of four or more lost work weeks and fourteen claims that have resulted in more than $1,000 in medical and indemnity costs. Monday has nine cases of four or more lost work weeks and fifteen claims that have resulted in excess of $1,000 in medical and indemnity costs. No other workday results in injuries and illnesses as severe as these two days. The reason for these two days to have the highest totals and severity is unknown.

Table 6 Normal Workweek Injury and Illness Case Lost Workday Tabulations

	Monday		Tuesday		Wednesday		Thursday		Friday	
Lost Workdays	**Injury**	**Illness**	**Injury**	**Illness**	**Injury**	**Illness**	**Injury**	**Illness**	**Injury**	**Illness**
0	18	3	17	6	18	2	23	3	13	10
1 to 5	10	1	6	0	10	0	4	2	9	1
6 to 10	5	0	1	1	1	0	4	0	2	0
11 to 15	3	1	0	0	2	0	1	0	2	0
16 to 20	1	0	1	0	1	0	0	0	2	0
21 to 30	3	1	3	0	1	0	1	0	0	0
31 to 181	3	1	0	1	7	0	4	0	2	1
Totals	**43**	**7**	**28**	**8**	**40**	**2**	**37**	**5**	**30**	**12**

Table 7 Normal Workweek Injury and Illness Case Total Cost Tabulations

	Monday		Tuesday		Wednesday		Thursday		Friday	
Total Cost	**Injury**	**Illness**	**Injury**	**Illness**	**Injury**	**Illness**	**Injury**	**Illness**	**Injury**	**Illness**
0 to 250	18	2	18	5	20	2	18	4	13	7
251 to 500	7	2	2	0	3	0	6	0	8	1
501 to 1000	5	1	2	2	3	0	3	0	2	2
1001 to 5000	9	0	4	0	8	0	5	0	5	0
5000 to 85000	4	2	2	1	6	0	5	1	2	2
Totals	**43**	**7**	**28**	**8**	**40**	**2**	**37**	**5**	**30**	**12**

The purpose of including this information in the text is to identify any irregularities than what one might expect. For example, if Friday was to have sixty cases and fifty of those resulted in no lost time the worker may have wanted an extended weekend. As the data turned out, Friday has the fewest number of non-lost time injuries, but on the other hand the highest total for illnesses. These illnesses are best classified as repeated trauma injuries, often associated with the lower back, elbows, and shoulders. The fact that Friday has the highest total of these recurring cases with no full lost

workday provides validity to the assumption that employees are seeking an extended weekend. Because these illness cases are primarily recurring injuries with no substantial lost time, these cases could be reported any day of the week, but just so happen to most frequently occur on Friday.

These tabulations do not show any information that should be examined further or any significant differences throughout the days that may lead to a potential cause. It is also important to note that because the company only offers emergency services on weekends and limited work on Saturday, the numbers of cases are dramatically lower because there is limited exposure. There were two minor injury cases and one Sunday case that was a recurring injury resulting in approximately a month off work and a permanent back disability rating.

Table 8 Workday Claims Tabulations

Workday	Injury Lost Workdays	Illness Lost Workdays	Total Lost Workdays	Medical and Indemnity Total
Monday	392	82	474	$ 124,989
Tuesday	113	40	153	$ 65,015
Wednesday	630	0	630	$ 267,428
Thursday	316	5	321	$ 93,996
Friday	256	95	351	$ 158,970
Saturday	11	0	11	$ 1,306
Sunday	0	30	30	$ 65,160
Totals	**1718**	**252**	**1970**	**$ 776,864**

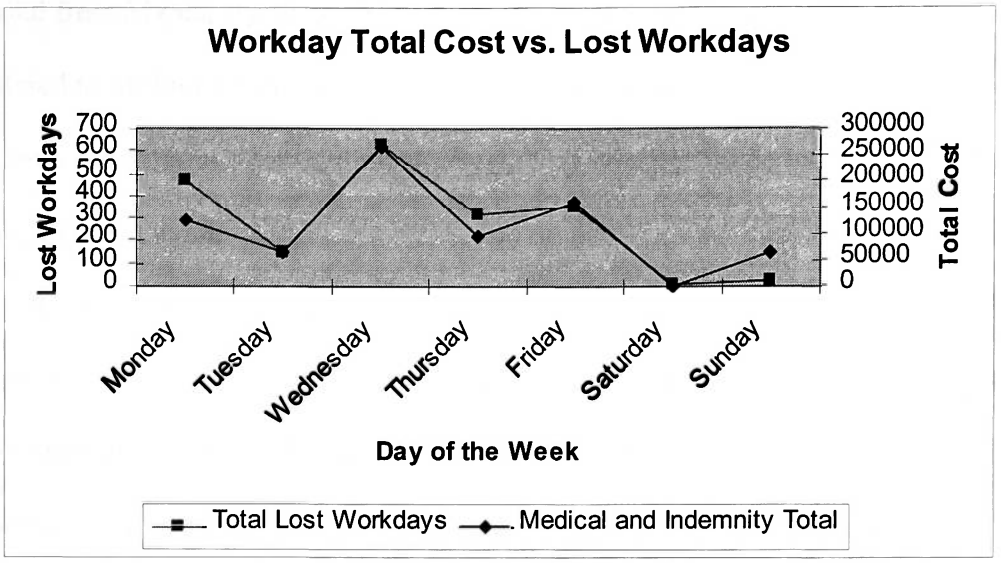


Figure 5. Total Cost vs. Lost Workdays per Day of the Week

Seasonal Claims Analysis

Seasonal conditions are important in the tree care industry because the weather increases the level of risk on any given jobsite. Even though this company is located in the relatively stable climate of the San Francisco Bay Area, there are still variable weather patterns. According to thirty year history data extracted from the National Weather Service, winter is the coldest and wettest season in the Bay Area, at an average of fifty-eight degrees and eleven days per month of precipitation. Fall and spring have comparable average temperatures at sixty-four degrees, but spring has two more days per month of average rainfall with six days per month. Summer is by far the warmest and driest of the seasons at seventy-five degrees and approximately one day of rain per month.

For the purposes of this research, the seasons were broken down into three month increments. Winter is represented by December, January, and February. Spring is

tabulated from March, April, and May. Summer is June, July, and August, while fall is considered to be September, October, and November. These classifications were chosen based on a natural break between months regarding weather trends such as precipitation, temperature, and wind.

If asked what season is the most hazardous or results in more injuries and illnesses the answer is difficult if just examining claims tabulations. Table 9 presents data for the company claims for the last eleven years. This shows that fall has the most claims with about 30% of the total reported. Spring ranks third in total claims, but first in lost workdays with about 34% of the total days. Summer is the most expensive season at about $317,000, which is over $100,000 more than the second highest season, spring. Summer also has 611 lost days spread over fifty-three claims, both second highest in their respective categories. All four seasons have comparable volumes of work, eliminating any misconception of increased work as a root cause of increased injuries.

Table 9 Seasonal Claims Tabulations

Season	Total Claims	Injury Lost Workdays	Illness Lost Workdays	Total Lost Workdays	Medical and Indemnity Total
Fall	63	339	115	454	$ 173,692
Winter	49	247	0	247	$ 79,029
Spring	50	652	6	658	$ 207,181
Summer	53	480	131	611	$ 316,962
Totals	**215**	**1718**	**252**	**1970**	**$ 776,864**

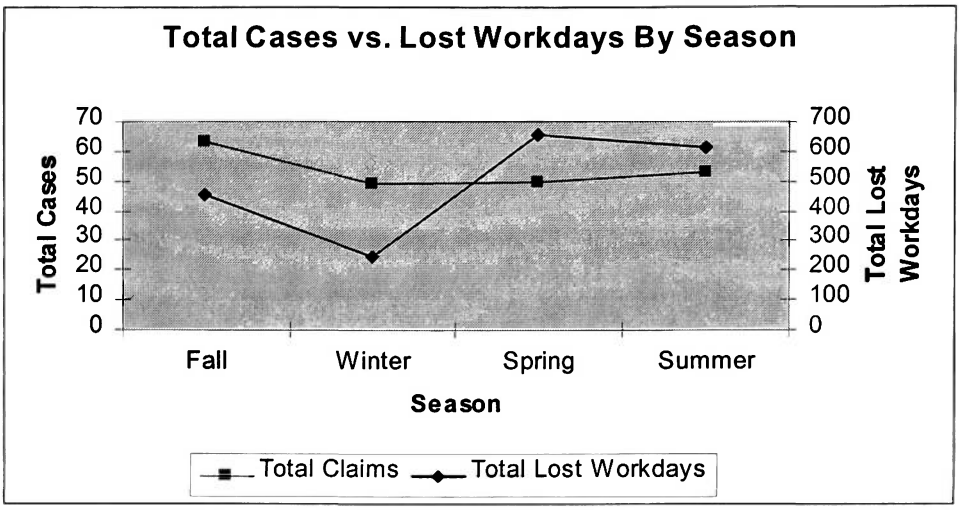


Figure 6. Total Cases vs. Lost Workdays by Season

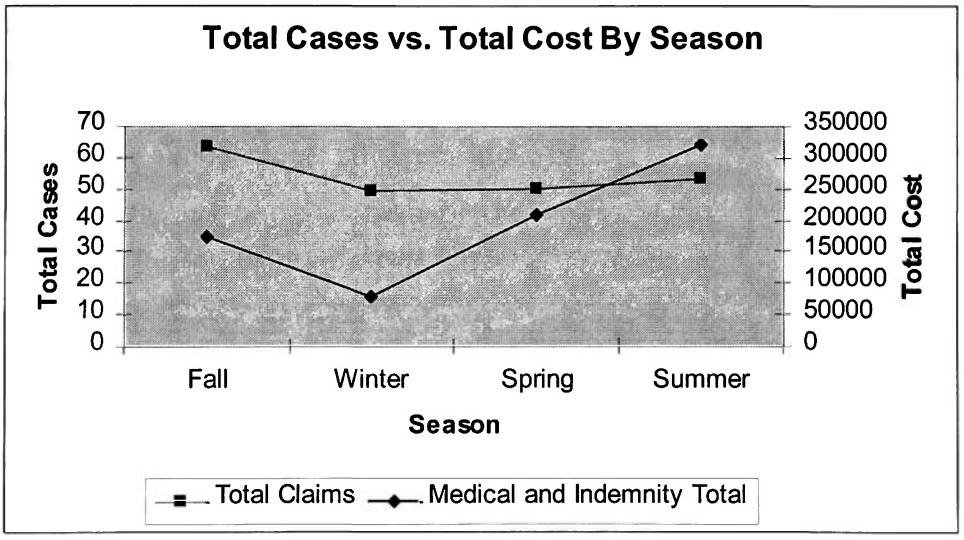


Figure 7. Total Cases vs. Total Cost by Season

Figures 6 and 7 show the relationship between total cases and lost workdays by season and a similar relationship of cost per case by season. An expected relationship exists for fall and winter in that the total lost workdays decrease as the number of cases

decrease. The lost workday line then exceeds the case line during spring and summer meaning on average there are more lost workdays per claim. This conclusion is evident from the tabulations on the seasonal claims table. Figure 8 shows that although the total lost workdays are highest in spring the cost does not increase as rapidly. These figures provide a greater understanding of the tabulations and the importance of aggressive injury and illness prevention during the summer months. They are months that have been problematic for the safety program because of specific injuries. Back strains during the summer months have accounted for 242 lost workdays and almost $177,000 in total cost. Strains and sprains alone during the summer months account for 22 claims resulting in 429 lost workdays and over $275,000 in total medical and indemnity costs. Based on these figures targeting back injuries, fatigue, and poor work practice more aggressively during June, July, and August would be an effective measure to reduce workers compensation costs and increase efficiency in the future.

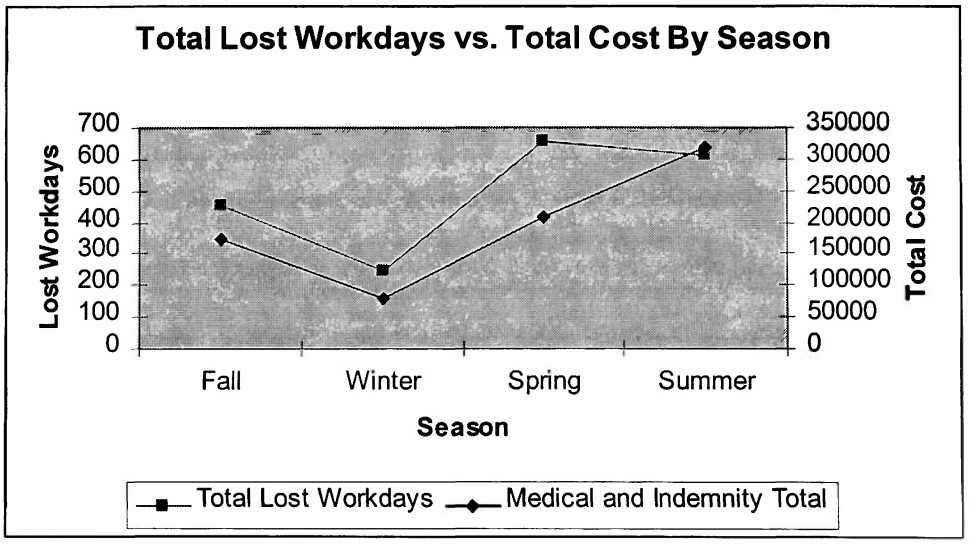


Figure 8. Lost Workdays vs. Total Cost By Season

If looking at rank alone, summer has the greatest severity per claim and winter is the lowest in every category. These tabulations conflict with conventional thought and employee perceptions found later in the text. Winter is the season with the most environmental hazards, considering the presence of ice, precipitation, and colder temperatures. The explanation given by employees and management regarding this inverse relationship of increased hazards and decreased claims is increased hazard awareness. The employees take extra time to complete their work and are always on their guard; therefore complacency is less of a factor.

Job Activity Analysis

Tables 10 through 12 describe the task in progress when the injury occurred. Table 11 presents the totals claims per job activity and provides a broad reference for lost time and non lost time injuries. Pruning is listed as the highest total for injuries and illnesses with twenty-three lost time injuries and sixty-five total cases. Lifting is second with twenty-one lost time cases, but has nearly half the total cases with thirty-five. Carrying brush was found equal to lifting in total cases, but only has fourteen lost time injuries or illnesses.

Table 10 is a tabulation of the frequency of claims based on job activity. This table includes both lost workdays and total cost to describe the severity of claims associated with each job activity. Pruning and lifting remain the leading activities responsible for highest cost and most lost workdays, which is consistent with the highest number of lost time injuries. Climbing and removals, two of the most inherently hazardous aspects of arborist duties, are ranked three and five in total cost. The numbers for carrying a ladder are high because of one injury in which a 48 year old employee

slipped while carrying a ladder and subsequently strained his back. This injury accounted for 181 lost days and an estimated $85,000 in total costs. This is a good example of how some data can be misleading because of unusual injury characteristics. This shows the importance of looking deeper into claims and accident investigation techniques to expose the seriousness of the problem if it is simply a rare occurrence.

Table 12 outlines the frequency of claims by job title based upon their activities. This provides a clear picture of the breakdown of frequency and severity of job activities for the various job descriptions of tree workers. It is important to note that foremen have the highest average number of employees followed by groundman, climber, and finally top climber. The frequency of the injuries is consistent with the primary job responsibilities of each job category because of greater exposure periods. Carrying brush as the highest frequency of claims among groundman, pruning is the highest for climbers, top climbers, and foreman.

Analysis of this table provides evidence that claims result from various aspects of daily duties and there is no single fix that will prevent future claims. It is very difficult from a safety point of view to prevent accidents in a high-hazard working environment. Once proper control measures are in place and all known risk mitigation techniques are used, it is up to the individual, crew, and supervisor to work as safely as possible. Each tree worker is aware of most of the hazards present on any given job site, but the occurrence and severity of such hazards is only known to experienced workers. Safety awareness training, safety certifications, tailgate safety, daily inspections, OJT, and job experience outline many of the methods a tree worker is able to acquire a better understanding of safety.

Many tree worker injuries are cumulative and are a result of years of repetition and strain. This helps to explain why lifting is such an inexpensive injury for groundman and climbers, yet the most expensive overall for foreman. Repeated trauma is a danger to many employees whose work is repetitive, especially to those in their later years of employment.

Another important observation involves the high frequency and cost of pruning related claims for climbers. This is an area in which they may have less experience in relation to foreman and helps to explain the high frequency of claims. Unfortunately, the arboriculture industry relies on OJT to gain primary experience and this results in various injuries.

Further research was done on Table 12, to find the significance of the lost time injuries. Pruning and Lifting Wood are listed with the most lost time injuries and they average 18 and 19 lost days respectively. There is no correlation involving the number of lost time injuries and lost workdays. For example, climbing and cutting debris average 31 and 25 lost days per injury. This can also be concluded by referencing Table 10.

Table 10 Job Activity Claims Analysis

Job Activity	Frequency	Percent of Claims	Lost Workdays	Total Cost
Pruning	65	30.2	418	195,691
Lifting Wood	35	16.3	409	174,406
Carrying Brush	35	16.3	223	66,265
Climbing	15	7.0	248	114,015
Removal	15	7.0	126	72,444
Cutting Debris	11	5.1	150	29,621
Roping Limb	11	5.1	70	16,937
General	7	3.3	68	11,073
Spraying	6	2.8	5	2,468
Driving	5	2.3	30	2,238
Walking	5	2.3	30	4,657
Carrying Ladder	3	1.4	193	86,761
Repairing	2	0.9	0	288
Totals	**215**	**100.0**	**1970**	**776,864**

Table 11 Job Activity Lost Time Totals

	Lost Time		
Job Activity	**Yes**	**No**	**Total**
Pruning	23	42	65
Lifting Wood	21	14	35
Carrying Brush	14	21	35
Removal	9	6	15
Climbing	8	7	15
Cutting Debris	6	5	11
Roping Limb	6	5	11
General	4	3	7
Walking	4	1	5
Driving	4	1	5
Carrying Ladder	2	1	3
Spraying	1	5	6
Repairing	0	2	2

Table 12 Job Title Claim Tabulations

Job Title	Job Activity	Frequency	Percent of Claims	Lost Workdays	Total Cost
Groundman	Carrying Brush	15	36.6	194	62,223
	Lifting Wood	7	17.1	89	15,083
	Pruning	7	17.1	137	63,436
	Carrying Ladder	2	4.9	193	85,361
	Cutting Debris	2	4.9	56	20,252
	Roping Limb	2	4.9	3	329
	Walking	2	4.9	17	1,622
	Climbing	1	2.4	0	-
	Driving	1	2.4	14	724
	General	1	2.4	24	2,144
	Repairing	1	2.4	0	288
Subtotal		**41**	**100.0**	**727**	**$ 251,462**
Climber	Pruning	19	36.5	127	58,543
	Carrying Brush	10	19.2	17	1,843
	Lifting Wood	9	17.3	50	22,106
	Cutting Debris	3	5.8	45	3,575
	Removal	3	5.8	4	2,257
	Driving	2	3.8	4	226
	Walking	2	3.8	6	1,593
	Climbing	1	1.9	8	979
	General	1	1.9	0	60
	Reparing	1	1.9	0	-
	Roping Limb	1	1.9	2	744
Subtotal		**52**	**100.0**	**263**	**$ 91,926**
Top Climber	Pruning	10	28.6	21	3,746
	Lifting Wood	5	14.3	18	3,189
	Removal	5	14.3	55	44,304
	Cutting Debris	4	11.4	33	4,769
	Carrying Brush	3	8.6	12	1,656
	Climbing	2	5.7	60	57,369
	Driving	2	5.7	12	1,288
	General	2	5.7	20	2,571
	Roping Limb	2	5.7	21	2,953
Subtotal		**35**	**100.0**	**252**	**$ 121,845**

Job Title	Job Activity	Frequency	Percent of Claims	Lost Workdays	Total Cost
Foreman	Pruning	29	33.0	133	69,966
	Lifting Wood	15	17.0	252	134,028
	Climbing	11	12.5	180	55,667
	Carrying Brush	7	8.0	0	543
	Removal	7	8.0	67	25,883
	Roping Limb	6	6.8	44	12,911
	Spraying	6	6.8	5	2,468
	General	3	3.4	24	6,298
	Cutting Debris	2	2.3	16	1,025
	Carrying Ladder	1	1.1	0	1,400
	Walking	1	1.1	7	1,442
Subtotal		**88**	**100.0**	**728**	**$ 311,631**
Field Totals		**215**		**1970**	**$ 776,864**

Injury Type Analysis

Table 13 presents lost time injury types for the 215 tree worker claims. Back strains have four more lost time claims than the twenty-two lost time contusion claims since January 1991. This data provides a benchmark for the leading injury types, which can be used to implement protective measures for future prevention. The majority of the back strain claims involve lifting or carrying, while others result from climbing and removals. Climbing and removals involve climbing gear, chainsaws, and handsaws which all add extra weight and decrease mobility. The nature of trees makes for an awkward work environment and forces the climber to rely on twisting and unsafe footing. This in combination with excess weight increases the risk for back injuries, strains, and sprains.

The injury types associated with the 215 claims with the associated tree worker injury types are listed in Table 14. The tables present a summary of injury type frequency, related mean lost workdays, age and experience. Tree workers suffer contusions more than any other reported claim, just one more than back strains. The top three injury types, which are contusions, back strains, and lacerations, account for nearly

fifty-five percent of the total claims among tree workers. However, contusions and lacerations typically do not require many lost days per injury. The reason why the mean lost day and average cost per claim for contusions is so high, relates to an injury to a top climber in November 1996. The injured employee fell off a ladder and suffered a contusion to his elbow. This resulted in 60 days lost and a total estimated worker's compensation cost of $57,285. A second significant contusion injury, which resulted in 43 lost days and a total cost of nearly $4,000, was a result of a foreman having his hand smashed while moving two logs. There were a total of four contusion claims resulting in 20 or more lost workdays.

The third leading frequency of claims, lacerations, have high averages of lost days and cost because of four significant cases involving 21 or more lost days due to injury. These four laceration claims resulted in a combined 140 lost workdays and a total worker's compensation cost of $37,519. One injury involved a facial laceration from a hand saw, while other three were hand lacerations from chainsaws.

Many tree worker claims are cumulative resulting from years of repetition and strain on the body. The labor is strenuous, difficult, and must be completed in varying environmental conditions. These are all contributing factors to the various injury types and must be taken into consideration by the safety professional working with hazard prevention.

Table 13 Lost Time Injury and Illness Types

	Lost Time		
Injury Type	**Yes**	**No**	**Total Claims**
Back Strain	26	13	39
Contusion	22	18	40
Laceration	16	20	36
Sprain	12	6	18
Other Strain	9	11	20
Poison Oak	2	9	11
Puncture	2	8	10
Irritation	0	10	10
Abrasion	3	5	8
Fracture	7	0	7
Bee Sting	1	5	6
Splinter	0	2	2
Dog Bite	0	2	2
Dislocation	1	0	1
Chest Pain	0	1	1
Callus	0	1	1
Burn	0	1	1
Broken Tooth	0	1	1
Blister	1	0	1

Table 14 Tree Worker Injury Type Analysis

Injury Type	Total Claims	Percent Total Claims	Mean Cost Per Claim	Mean Lost Workdays	Mean Age	Average Experienc
Contusion	40	18.6	$ 2,074.55	6.8	31.5	6.4
Back Strain	39	18.1	$ 9,334.42	18.3	35.5	8.6
Laceration	36	16.7	$ 1,368.42	5.7	31.7	5.5
Other Strain	20	9.3	$ 2,080.60	4.0	32.8	6.8
Sprain	18	8.4	$ 6,480.22	18.1	31.2	7.4
Poison Oak	11	5.1	$ 58.70	0.8	25.7	3.7
Puncture	10	4.7	$ 611.27	1.0	29.6	5.9
Irritation	10	4.7	$ 117.40	0.0	27.8	4.8
Abrasion	8	3.7	$ 122.50	0.5	27.0	3.9
Fracture	7	3.3	$ 10,311.57	36.0	32.4	4.5
Bee Sting	6	2.8	$ 241.00	0.2	35.2	8.2
Splinter	2	0.9	$ 96.70	0.0	42.7	5.7
Dog Bite	2	0.9	$ 55.00	0.0	34.5	14.0
Dislocation	1	0.5	$ 6,356.00	29.0	27.0	8.0
Chest Pain	1	0.5	$ 154.00	0.0	25.0	5.0
Callus	1	0.5	$ 884.00	0.0	43.0	16.0
Burn	1	0.5	$ 288.00	0.0	18.0	0.7
Broken Tooth	1	0.5	$ 87.00	0.0	22.0	3.0
Blister	1	0.5	$ 192.00	2.0	30.0	4.0

Injury or Illness Location Analysis

Table 15 presents the section of body affected by all injuries and illnesses to the field employees since January 1, 1991. It is important to note that some claims involve injuries to multiple body parts, which explain the frequency total of 240, even though there are only 215 claims involving tree workers. If the claim involved multiple sections of the body, the totals were added for each section and not divided. For example, an injury to the hand and knee may result in ten lost days. Ten days were added to both the totals for hand and knee and not five each.

The numbers for back injuries have no extra claims, meaning all of the numbers are results of back injuries and illnesses in the last eleven and a half years. Back injuries are twice as common as the next common location, hand, and result in nearly four times the amount of lost workdays and cost as the next highest parts affected. This information dramatically presents the severity of injuries to certain parts of the body. The amount of lost days for back claims equates to nearly two and a half years. If an employee works five days a week, fifty weeks out of the year, that's 250 workdays per year. If the 871 lost days are divided by the lost workdays, it is equivalent to losing one employee for three and a half years. Not only is losing the three and a half years equivalence distressing, but increased workers compensation costs, plus any permanent disabilities and medical bills must also be considered when determining the financial impact of these claims.

The other significant injured areas of the body are knees, wrists, and elbows. Knee claims are primarily associated with slips, twisting, and fall related injuries. They usually involve climbing and pruning and therefore primarily affect foremen and climbers. Of the 16 knee injuries, 12 or 62%, involve lost time. Wrist injuries occur to all job titles because they are related to carrying brush in addition to using saws for pruning. Of the 13 wrist claims, eight or 61%, involve lost time.

Ninety-two percent of the 12 elbow injuries involve foremen and climbers. This is due to the increasing problem of repeated trauma illnesses from the use of pole saws. Although elbow injuries are endemic for arborists, they only equate to one lost day and just over $1,400 in total cost for this company. The bulk of the lost time and cost listed on the injury location tabulation table is due to a contusion resulting from a fall. If not addressed effectively, elbow repetitive strain could become an epidemic throughout the

industry. This is evident in the discomfort surveys and must be addressed with adequate measures as soon as possible.

Table 15 Injury or Illness Location Analysis

Section of Body	Frequency	Total Lost Workdays	Compensation	Medical	Total
Back	45	871	$ 282,548	$ 137,940	$ 420,488
Hand	22	142	$ 15,640	$ 22,404	$ 38,044
Eye	18	6	$ 57	$ 2,349	$ 2,406
Finger	18	190	$ 15,218	$ 13,443	$ 28,661
Leg	17	41	$ 2,321	$ 3,443	$ 5,764
Knee	16	256	$ 73,979	$ 38,953	$ 112,932
Extensive	13	10	$ 55	$ 1,254	$ 1,309
Wrist	13	245	$ 56,850	$ 62,529	$ 119,379
Elbow	12	104	$ 44,285	$ 22,934	$ 67,219
Shoulder	11	88	$ 12,009	$ 22,515	$ 34,524
Face	10	96	$ 12,249	$ 27,297	$ 39,546
Arm	9	78	$ 8,286	$ 13,787	$ 22,073
Foot	6	87	$ 7,223	$ 6,201	$ 13,424
Hip	6	167	$ 47,565	$ 23,139	$ 70,704
Ankle	5	148	$ 13,423	$ 13,616	$ 27,039
Neck	5	95	$ 10,585	$ 7,499	$ 18,084
Abdomen	4	6	$ 2,022	$ 829	$ 2,851
Head	3	1	$ -	$ 455	$ 455
Chest	2	21	$ 731	$ 2,026	$ 2,757
Rib	2	10	$ 1,356	$ 822	$ 2,178
Ear	1	0	$ -	$ 84	$ 84
Groin	1	0	$ -	$ 128	$ 128
Tooth	1	0	$ -	$ 87	$ 87

Equipment Claims Analysis

The following Table 16 presents the equipment involved at the time of a tree worker injury or illness. The equipment is not necessarily a contributing factor of the

injury, but aids in understanding the hazards confronting the tree worker with the associated equipment.

"Hands" are listed as the leading equipment associated with claims among tree workers. Hands are considered as pieces of equipment because of how instrumental they are for an arborist. They are also listed to differentiate from "none", which relates to injuries while walking or sitting. This inclusion highlights the impact of lifting and carrying in the tree care industry injuries and illnesses. "Hands" have the highest frequency of claims with 24 more than chainsaws the second highest equipment involved claim, most lost days with 69 more than chainsaws, and highest total cost, $33,000 more than chainsaw related injuries. Over 90% of claims with activities associated with using hands involve carrying brush or lifting wood, in which no additional mechanical equipment is involved. The bulk of hand related injuries includes but is not limited to: lacerations, contusions, abrasions, strains, sprains, punctures and fractures. The remaining hand related claims are injuries associated with climbing resulting in 72 lost workdays and approximately $15,000 in total compensation.

Chainsaws comprise the second greatest equipment association with claims at nearly 19%. The 40 chainsaw related claims involve injuries such as strains, sprains, lacerations, irritation, dislocation, contusion, punctures, and abrasions. The most prominent injuries associated with chainsaws are strains likely resulting from the added stressors on the body and chain caused lacerations. Chainsaw-strain related claims resulted in 15 claims, 333 lost days, and nearly $175,000 in total cost. All of these claims involved work off the ground doing various jobs in trees. The bulk of the injuries was back strains and resulted most likely from the hazards unique to tree workers, which were

previously addressed. The combination of heavy climbing gear, hanging chainsaws, awkward positioning, and adverse weather conditions all are contributing factors to the increased risk of working in trees. The chainsaw-laceration related claims resulted in 13 claims, 157 lost days and nearly $30,000 in worker's compensation costs. The majority of these claims involve cutting debris on the ground. Ground operations account for about 134 of the 157 lost days and about $25,000 of the $30,000 in total cost. These injuries primarily affect hands and arms, while four claims involved the face.

Table 16 Equipment Claims Analysis

Equipment	Frequency	Percent Total Claims	Lost Workdays	Percent Total Lost Time	Total Cost	Percent Total Cost
Hands	64	29.8	604	30.7	$ 247,968	31.9
Chainsaw	40	18.6	535	27.2	$ 214,682	27.6
Hand Saw	23	10.7	121	6.1	$ 45,736	5.9
Polesaw	21	9.8	37	1.9	$ 34,589	4.5
Rope	15	7.0	136	6.9	$ 33,293	4.3
Brush Chipper	11	5.1	37	1.9	$ 5,301	0.7
None	9	4.2	106	5.4	$ 26,110	3.4
Other	7	3.3	98	5.0	$ 17,054	2.2
Ladder	6	2.8	255	12.9	$ 144,131	18.6
Spray Equipment	6	2.8	5	0.3	$ 2,468	0.3
Vehicle	5	2.3	30	1.5	$ 2,238	0.3
Hi-Ranger	4	1.9	1	0.1	$ 900	0.1
Hedge Trimmer	4	1.9	5	0.3	$ 2,394	0.3

The ladder related claims are high because two claims resulted in 241 lost days, and $141,696 in total workers compensation. One of those claims involved falling from the ladder, while the other resulted from slipping while carrying a ladder. Ladders are used on most job sites for a variety of purposes. This may include entering a tree with no

low branching limbs, as an instrumental aspect of pruning a tree, and to provide access to elevated structures, such as roofs on many jobsites. The ladder weight is not the problem as much as handling issues, such as lifting, holding, and carrying. The awkward length and design of some ladders make carrying and maneuvering difficult and create a significant impact load on the body in the event of a slip or fall. This added stress is almost certain to result in a strain, sprain, or other serious injury.

Injury and Illness Cause Analysis

Table 17 presents data that expresses the opinions of the author relating to the causes of the claims covered in this thesis. Causes were inferred from accident reports reviewed from each claim. For example, if the arborist was using a piece of equipment and struck his elbow on a tree, the cause would be listed as "impact". Impact injuries could result from both "struck by's" and employee induced contact with an object. The category "slipped" includes claims in which employees lost their footing on the ground and fell, while "fall" refers to a fall from an elevation to a lower level. The only differentiation from slips is that the employee was not standing on the ground at the time of the injury. "Exposure" primarily relates to poison oak and chemical irritation. Twisting injuries, in this case, always result in either a strain or a sprain, and are usually involved with tree work, such as climbing and pruning. Twisting is also a cause for many injuries to groundmen carrying brush because of the increased stress imparted to their back from improper lifts. Airborne debris injuries, in these cases, always involved debris falling into eyes. The troublesome aspect from a safety point of view is that in all of the cases adequate eye protection was worn. "Grabbed blade" and "kick-back" are both causes of claims which result in lacerations. Grabbing saw blades is associated with inadvertently

grabbing the blade of pruning equipment. Kick-back is a negative side effect of chainsaw use for both ground and tree operations.

Table 17 Claim Causal Tabulations

Cause of Claim	Frequency	Injury Lost Workdays	Resticted Workdays	Illness Lost Workdays	Total Lost Workdays		Total
Slipped	48	715	0	0	715	$	218,826
Impact	30	177	0	0	177	$	48,227
Repeated Trauma	24	0	42	243	243	$	187,001
Fall	18	408	0	0	408	$	184,940
Exposure	14	0	0	9	9	$	939
Other	14	41	0	0	41	$	4,934
Twisted	13	242	0	0	242	$	93,900
Airborne Debris	11	1	0	0	1	$	1,597
Unknown	11	38	0	0	38	$	5,502
Lifting	10	35	0	0	35	$	15,148
Bee Sting	6	1	0	0	1	$	1,446
Palm Frond	6	6	0	0	6	$	6,057
Grabbed Blade	5	11	8	0	11	$	2,713
Kick-back	5	43	0	0	43	$	5,634
Totals	**215**	**1718**	**50**	**252**	**1970**	**$**	**776,864**

Nine of the 10 lacerations resulting from the blades of this equipment involved either fingers or hands. Perhaps these could have been prevented with more protective gloves. No significant investigations are done after an accident at this company to determine if the laceration could have been prevented with stronger and more protective equipment. This is an urgent issue that must be closely examined by management and the safety supervisor to determine additional protective equipment implementation. Lifting includes relatively low figures because most of the significant lifting related injuries involved repeated claims for lower back strains. For this reason, many lifting related

claims have repeated trauma listed as the causal factor, as this is the most reasonable cause for this type of claim.

Ground/Airborne Claims Analysis

Table 18 presents ground and tree lost time totals for arborists between January 1991 and July 2002. The ratio of lost time claims to non lost time claims for ground injuries (1.05) is much higher than that for tree related claims (.77). However, the correlation coefficient for ground claim lost workdays and total cost is .833, while, the correlation coefficient for tree claim lost workdays and total cost is .871. This means that tree claims have a higher correlation between cost and lost workdays than ground claims. Because of the small difference between the two correlation coefficients there does not appear to be a substantial difference between ground and airborne claims. Overall, there are 11 more non lost time claims than lost time claims. Although there is a lower lost time percentage for tree operations, this data and the claim comparison tabulations are evidence that the injuries that do occur are more severe.

Table 19 contains data related to claims associated with tree worker activity for ground and tree operations. The tree claims cover activities such as pruning, climbing, removal, and roping limbs. Because of the lack of clarity in accident reporting it is possible for some of the data to be erroneous. For example, an employee may have been standing on the ground using a pole saw to prune at the time of an injury and not in a tree. Also, in the case of a repetitive trauma injury the tree worker would have been working both in trees and on the ground, resulting in the illness. This was a research limitation that forced the author to do personal interviews and draw conclusions from limited accident investigation recordkeeping.

The location claim comparison totals provide descriptive data for lost days and worker's compensation costs. Although there are 246 more lost workdays for ground cases than tree cases, the total cost for tree claims was $21,000 greater. This data shows that the severity of tree claims is much worse than ground injuries. The average cost for ground claims is about $3,465, while the average for tree claims is $3,765. This means that although there are more lost workdays for ground claims than tree claims the severity is greater for tree injuries.

There are a couple possible explanations for this. Personnel injured in trees typically have more experience and different job requirements than those whose primary responsibility is ground work. Employees with more experience historically have a stronger commitment to work because they have more invested in the company and their work is their livelihood. Many employees who have been with the company for a few years prefer to return to work as soon as possible after an injury, understanding that if they are not at work being productive the company will not succeed. According to many employees, if the company does not succeed, they will not get raises, will have to work with poor equipment, and might be released from duty.

Comparing both ground and tree figures, airborne claims have a higher cost per claim ratio, but ground claims have a higher lost day average ratio. Ground claims average 10 lost days per claim, while tree claims average 8 lost days.

Table 18 Tree Worker Ground and Airborne Claim Lost Time Totals

	Lost Time		
Claim Location	**Yes**	**No**	**Total Claims**
Ground	56	53	109
Tree	46	60	106
Totals	**102**	**113**	**215**

Table 19 Tree Worker Ground and Airborne Claim Comparison Totals

Location	**Injury Lost Workdays**	**Illness Lost Workdays**	**Total Lost Workdays**	**Compensation**	**Medical**	**Total**
Ground	1,008	100	1,108	$ 243,653	$ 134,124	$ 377,777
Tree	710	152	862	$ 219,697	$ 179,390	$ 399,087
Totals	**1,718**	**252**	**1,970**	**$ 463,350**	**$ 313,514**	**$ 776,864**

Historical Labor Statistics

One way to measure the performance of a safety program is to look at injury and illness statistics over a period of years. This provides trends and relationships necessary to generate legitimate changes throughout a company. It is possible for a company to overlook very prominent safety issues, while focusing more intensely on other more obvious hazards. This can occur with little known hazards, or not so well know injury types. For example, pole saw and chainsaw use lead to daily discomfort for many employees even though it is rarely reported to management. The pain is assumed to be a result or "side-effect" of being a tree surgeon and something that must be dealt with accordingly. Because of this lack of reporting, little research and development is

performed to prevent future problems in the industry. A lot of time and money is invested on back injuries because of the tremendous cost it imposes industry wide, but because many of the repeated trauma illnesses are left unreported and do not have a significant dollar figure associated with them, little is done for improvements.

The United States Department of Labor compiles statistics, which describe trends and relationships for injuries and illnesses industry wide. With some exceptions, employers with 11 or more employees at any one time in the previous calendar year must keep OSHA records. Tables' 20 and 21 present private industry statistics between 1992 and 2000. This data, in conjunction with other data presented in this text, should be used as a significant part of the company safety program. Even if company loss statistics do not display significant trends, areas of personal discomfort uncovered in this research must be addressed before they become detrimental to many of the tree care firms around the country.

In 2000, there were 5,650,100 recordable cases nationwide and 1,664,000 of those cases involved days away from work. That means 29.5% of the total cases involved days away form work. In that same year, 77.8% of the total recordable injuries and illnesses for the company involved days away from work. Even though this is a broad comparison between a specific high-hazard company and private industry, it clearly represents why safety must play a stronger role in the tree care industry.

Table 20 Private Industry Total Recordable Cases and Cases Involving Days Away From Work (000's)

Private Industry		
	Cases Involving Days Away From Work	Total Recordable Cases
Year	Rate 000's Cases	Rate 000's Cases
1992	2331.1	6799.4
1993	2252.5	6737.4
1994	2236.6	6766.9
1995	2040.9	6575.4
1996	1880.6	6238.9
1997	1833.4	6145.6
1998	1730.5	5922.8
1999	1702.5	5707.2
2000	1664.0	5650.1

Table 21 shows the improving trend in private industry for strains, sprains, back injuries, and falls. Recordable claims declined significantly between 1992 and 2000 for strains and sprains, but this has not been the case for falls. Although the numbers have declined, the trend is not nearly as sharp as the other categories. While training, personal protective equipment, experience, and industry regulations can aid in the prevention of back injuries, strains, and sprains, it is much more difficult to prevent falls. Proper footwear and precautions are two significant measures, which can be implemented relatively easily to prevent workplace falls.

Table 21 Private Industry Injury Case Descriptive Statistics

Private Industry			
	Sprain, Strains, Tears	Back, Spine, Spinal Cord	Total Falls
Year	Total Cases	Total Cases	Total Cases
1992	1,022,746	653,385	374,831
1993	959,163	615,010	370,112
1994	963,496	606,545	393,308
1995	876,792	540,047	343,929
1996	819,658	490,608	330,913
1997	799,012	472,091	313,335
1998	760,024	440,160	292,090
1999	739,742	424,251	297,499
2000	728,202	411,143	303,817

Company Incidence Rates

Table 22 and Figure 9 show the total annual cases and incidence rates for foremen, top climbers, climbers, and groundmen between 1992 and 2000. For reference purposes, foremen have historically had the highest total number of employees, followed by groundmen, climbers, and top climbers. Figure 9 provides a graphical representation of incidence rates for all job titles, showing a gradual decrease in overall claims over the past 11 years. The rates for climbers and top climbers seem are the least consistent. This is possibly due to substantial changes in job responsibilities requiring OJT, which means very little initial experience. All of the physical aspects of a jobsite play an important role for less experienced employees. Difficult trees and adverse weather conditions, in conjunction with poor safety procedures, substantially increase the risk of an accident.

Table 22 Incidence Rates by Job Title per 100 full-time workers

Job Title Incidence Rate 100 ftw								
Year	Foreman		Top Climber		Climber		Groundman	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
1991	8	47.1	4	80.0	12	171.4	7	77.8
1992	8	47.1	4	80.0	9	128.6	1	11.1
1993	12	70.6	3	60.0	3	42.9	2	22.2
1994	12	70.6	8	160.0	0	0.0	3	33.3
1995	14	82.4	4	80.0	9	128.6	4	44.4
1996	10	58.8	2	40.0	10	142.9	4	44.4
1997	5	29.4	3	60.0	1	14.3	7	77.8
1998	3	17.6	3	60.0	0	0.0	1	11.1
1999	4	23.5	0	0.0	0	0.0	3	33.3
2000	4	23.5	2	40.0	4	57.1	6	66.7
2001	7	41.2	1	20.0	3	42.9	1	11.1

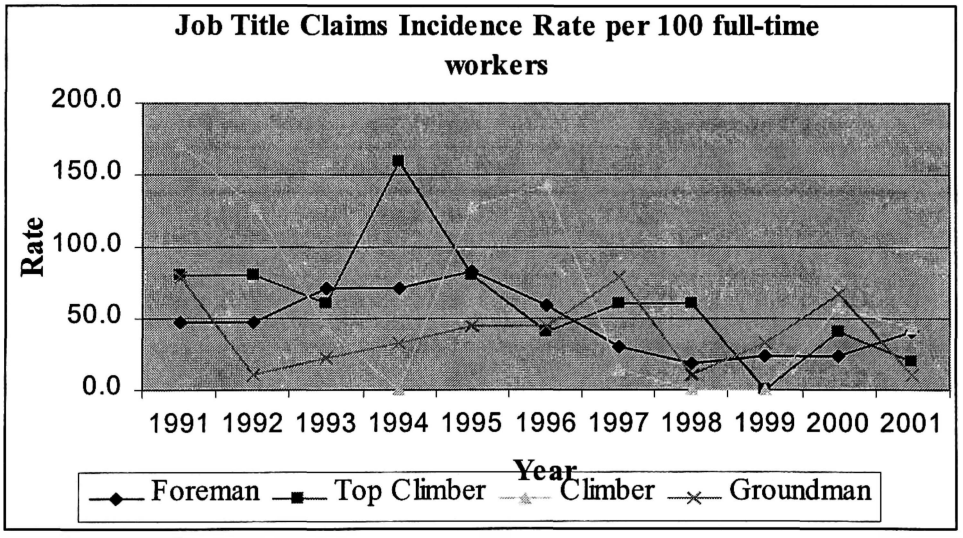


Figure 9. Job Title Incidence Rates per 100 full-time workers

Employee vs. Tree Worker Claims Incidence Rates

Table 23 shows the relationship between the 38 tree surgeons accident statistics and the company wide injury and illness tabulations The tabulations for the entire company include an additional 16 employees in much lower risk positions. The rate for all 54 employees is significantly lower than the tree worker rate because of the significant decrease in on-the-job hazards present with clerical staff, supervisors, and shop employees. Figure 10 presents the employee and tree worker trends linearly over the last 11 years. As expected, the data emphasizes the hazardous nature of tree work compared to all other company job responsibilities.

Table 23 Tree Surgeon vs. Entire Company Incidence Rates

Tree Surgeon vs. Entire Company Incidence Rates

	Tree Surgeon Claims		Employee Claims	
Year	**Total Cases**	**Rate / 100 ftw**	**Total Cases**	**Rate / 100 ftw**
1991	31	81.6	31	57.4
1992	22	57.9	26	48.1
1993	20	52.6	22	40.7
1994	23	60.5	24	44.4
1995	31	81.6	31	57.4
1996	26	68.4	27	50.0
1997	16	42.1	17	31.5
1998	7	18.4	7	13.0
1999	7	18.4	7	13.0
2000	16	42.1	16	29.6
2001	12	31.6	12	22.2

As far as OSHA recordkeeping is concerned, the entire company is included in the year end summary OSHA 300A form and OSHA 300 injury and illness log. The

following tables and figures emphasize not only the high-hazard nature of tree work, but also how inclusion of supervisors and clerical staff for overall rate purposes skews the data tremendously. For example, in 1991 and 1995 the incidence rate per 100 fulltime workers for field employees was nearly 82, but the entire company's rate was only 57. This is not to say that 57 is not a high enough rate, but the lower figures seem to mask the high risk nature of the business. This could be detrimental to the safety program and managements view of safety. It is imperative that management look at the rates for field employees alone in order to determine the effectiveness of the injury and illness prevention program.

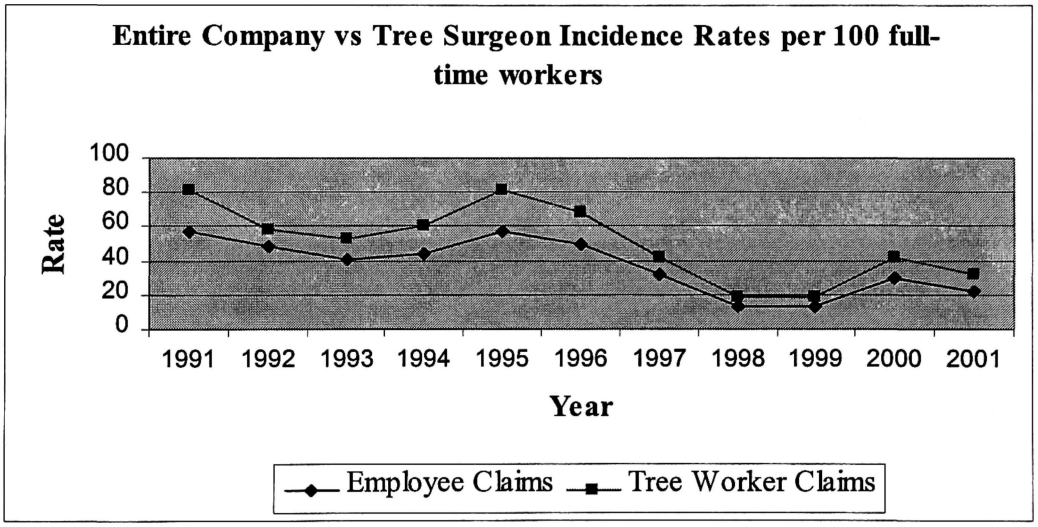


Figure 10. Entire Company vs. Tree Surgeon Claims Incidence Rates per 100 full-time workers

Employee vs. Tree Worker Claims Recordable Rates

The previous section presented company claims accident rate information extracted from OSHA recordkeeping forms and medical care paperwork. Based on

OSHA recordkeeping requirements, not all of the claims listed on the OSHA recordkeeping forms were necessarily recordable. For example, an injured employee received a minor laceration to his arm from a pole saw and was subsequently taken to urgent care to have it looked at. He was given a bandage and sent back to work that same afternoon. This is considered a one-time first aid treatment and does not require lost time, repeated doctor visits, application of sutures, or butterfly adhesive dressings. Because of this, the injury to the tree worker does not need to be recorded on OSHA recordkeeping forms. These cases represent the difference in statistics for claims, accident rates, and recordable rates in this document. The author analyzed each case individually to determine the severity and whether or not the case was actually recordable.

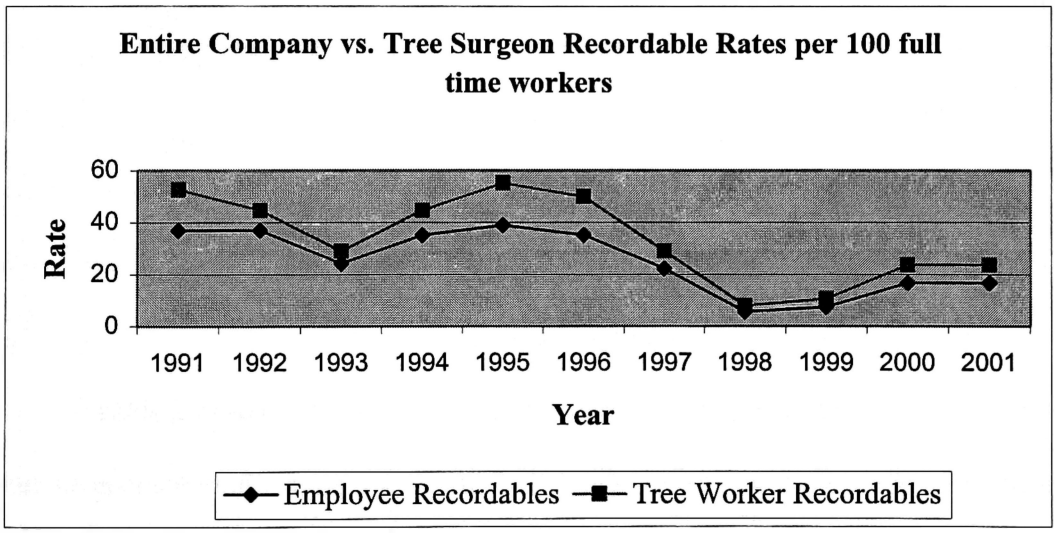


Figure 11. Entire Company vs. Tree Surgeon Recordable Rates per 100 full-time workers

Table 24 lists company wide recordable rates and tree worker recordable rates per 100 full-time workers over the last 11 years. Figure 11 presents data comparable to Figure 10 on page prior, but is most comparable to labor statistics data. This data is

consistent with the total claims data, but is significantly lower because of incorrectly logging entries on OSHA 200 and 300 forms.

Table 24 Tree Surgeon vs. Entire Company Recordable Cases and Rates per 100 full-time workers

Tree Surgeon vs. Entire Company Recordabe Cases and Rates

	Tree Surgeon		Entire Company	
Year	Recordable Cases	Recordable Rate / 100 ftw	Recordable Cases	Recordable Rate / 100 ftw
1991	20	52.6	20	37.0
1992	17	44.7	20	37.0
1993	11	28.9	13	24.1
1994	17	44.7	19	35.2
1995	21	55.3	21	38.9
1996	19	50.0	19	35.2
1997	11	28.9	12	22.2
1998	3	7.9	3	5.6
1999	4	10.5	4	7.4
2000	9	23.7	9	16.7
2001	9	23.7	9	16.7

Lost Workday Rates

Table 25 provides statistics for lost workday rates per 100 full-time workers for tree surgeons with the company. Figure 12 shows that the rates merge into one because of the lack of lost workday cases beyond 1995 for any job title other than tree workers. This data can later be compared to industry data because it is presented with guidelines set forth by the Bureau of Labor Statistics. Once again the decreasing trend is evidence that the number of lost workday cases has decreased over the last 11 years at the company.

Table 25 Company Lost Workday Case Totals and Rates

Lost Workday Rates per 100 full time workers				
	Tree Surgeon		Entire Company	
Year	LW Cases	LW Rate	LW Cases	LW Rate
1991	16	42.1	16	29.6
1992	10	18.5	11	20.4
1993	7	13.0	7	13.0
1994	11	20.4	12	22.2
1995	14	25.9	14	25.9
1996	17	31.5	17	31.5
1997	9	16.7	9	16.7
1998	3	5.6	3	5.6
1999	1	1.9	1	1.9
2000	7	13.0	7	13.0
2001	5	9.3	5	9.3

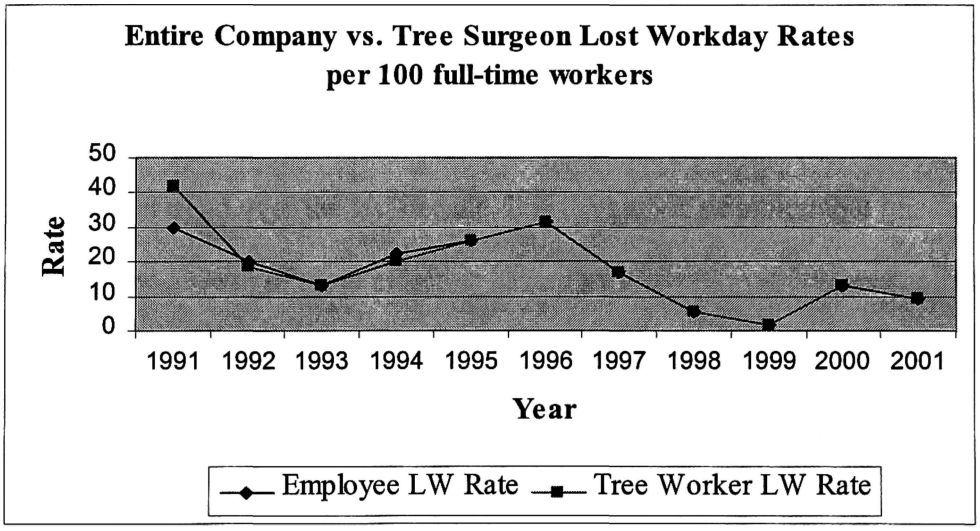


Figure 12. Entire Company vs. Tree Worker Lost Workday Rates per 100 full-time workers

Company vs. Industry Statistical Comparison

Tables 26 and 27 present comparisons of the company with horticultural specialties, landscape and horticultural services, and agricultural specialties as listed by the Bureau of Labor Statistics. Because there is no specific category for tree surgeon defined by the Department of Labor, the author felt it necessary to present the nearest industry disciplines that closely resemble the company for the purposes of better comparisons. The most noteworthy problem for using these categories is the lack of high-hazard work consistent with all three. Many include gardeners and landscapers whose primary responsibilities reside on the ground utilizing few mechanical devices, little heavy lifting, and generally work in less hazardous conditions.

With the exception of 1998 and 1999, the company has a significantly higher rate of both recordable cases and lost workday cases than that of agricultural industries. Figures 13 and 14 demonstrate a sharp downward trend between 1995 and 1999 for the company before increasing slightly again in 2000. Industry data shows evidence of a gradual downward trend over the last decade. It is the author's opinion that this data is consistent with the growth of more effective hazard awareness programs and an industry commitment to reduce repetitive injuries. The trend may be attributed to industry standard revisions, new regulations, and developments in equipment design and protective measures.

Table 26 Company and Industry Total Recordable Rates
per 100 full-time workers

Year	Employee Recordables	Landscape and Horticultural Services	Horticultural Specialties	Agricultural Specialties
	Total Recordable Cases			
	Rate 100 ftw	Rate 100 ftw	Rate 100 ftw	Rate 100 ftw
1992	37.0	11.6	11.7	11.2
1993	24.1	10.7	10.7	11.0
1994	35.2	10.5	10.4	9.8
1995	38.9	10.5	10.2	9.3
1996	35.2	9.0	10.0	8.3
1997	22.2	8.9	9.1	7.9
1998	5.6	9.1	8.2	7.6
1999	7.4	7.0	8.0	7.1
2000	16.7	6.7	7.1	6.8

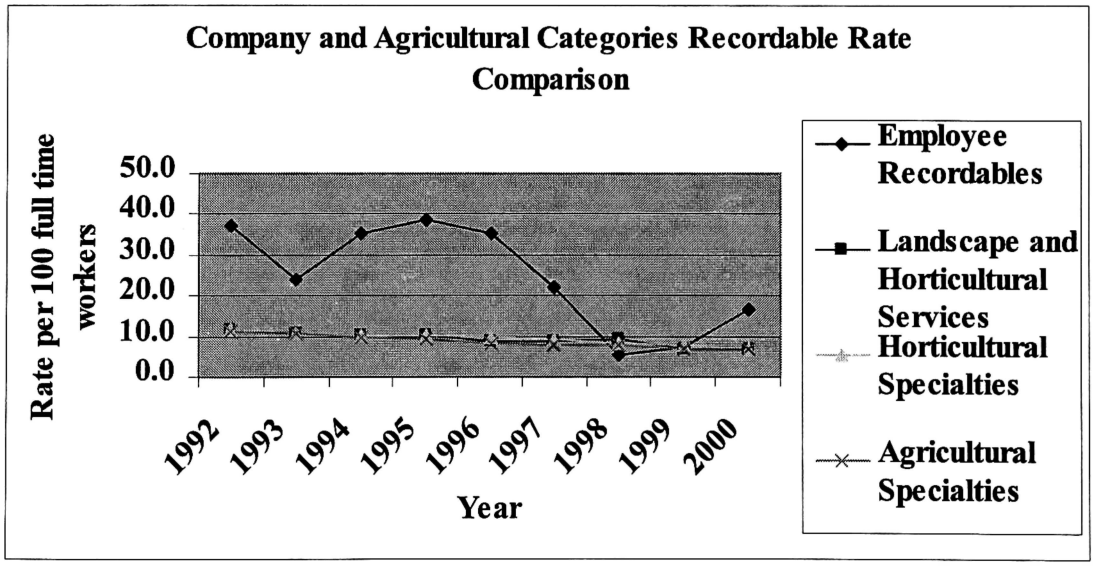


Figure 13. Company and Agricultural Industry Total Recordable Rates
per 100 full-time workers

Table 27 Company and Industry Lost Workday Cases Rates per 100 full-time workers

Year	Employee Recordables	Landscape and Horticultural Services	Horticultural Specialties	Agricultural Specialties
	Lost Workday Cases			
	Rate 100 ftw	Rate 100 ftw	Rate 100 ftw	Rate 100 ftw
1992	20.4	6.2	5.1	5.4
1993	13.0	5.6	4.6	4.7
1994	22.2	5.8	4.4	4.7
1995	25.9	4.6	4.6	4.0
1996	31.5	4.5	4.3	3.7
1997	16.7	4.6	5.0	3.8
1998	5.6	5.2	4.2	3.9
1999	1.9	3.8	3.4	3.3
2000	13.0	3.5	3.6	3.3

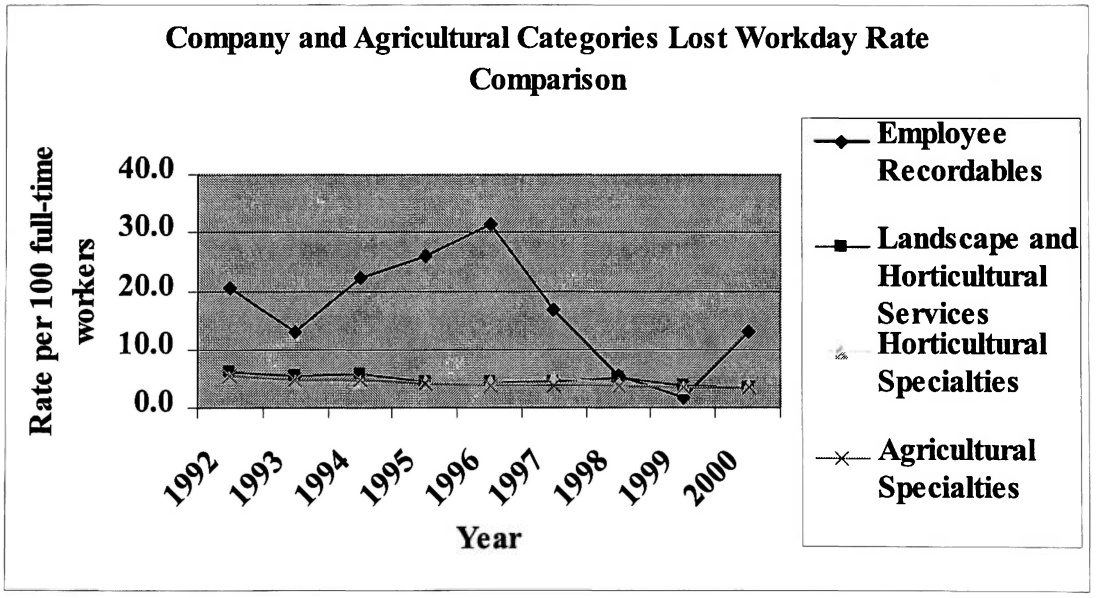


Figure 14. Company and Agricultural Industry Lost Workday Rates per 100 full-time workers

Tree Worker Perception Questionnaire

Claims analysis is a good way to determine trends of lost workdays, injury types, activities, and so on, but does not provide any information regarding employee opinion. Many large tree companies have a safety supervisor talk regularly with crews to find out what hazards they are encountering. Tailgate safety training offers employees a unique, low pressure opportunity to of express their opinions about the safety program. The only problem is that the only way to get direct responses is to ask direct questions. For example, a groundman may not tell a supervisor about certain safety related information. This could include something as simple as equipment that is not functioning properly. This could be for a variety of reasons. One, he may be a new hire and not know how one piece of equipment varies in operation from the next. Secondly, he may feel uncomfortable speaking up for not knowing any repercussions that may affect him or his crew. There are a variety of other reasons, but the main point is that communication is essential for the effectiveness of a safety program. Sometimes the only way to attain that information is to have the safety supervisor ask direct questions and record the answers. Once all the answers are recorded, the data can be compiled and conclusions may be drawn. These conclusions can then be compared to the accident statistics for consistencies and discrepancies, which form the basis for recommendations to improve the safety culture.

The purpose of the following questionnaires is to generate consistencies and find discrepancies with industry standards, safety training, actual claims, and personal discomfort. The questions cover several topics directly related to safety including: training, personal protective equipment, impression of management, medical, on-the-job

hazards, and the existing safety program. The questions were asked to all 38 field employees with job titles including: foreman, top climber, climber, and groundman. The three acceptable responses were yes, no, and undecided. In this context, responses in the "both" category should also be viewed the same as undecided. The response "both" was used for the purpose of better employee understanding and to generate more thorough responses. All questions with a significant amount of undecided responses will be explained in the next section.

The questions were generated based on the accident tabulations and personal discomfort surveys completed three months prior. The information collected from these responses is easily comparable to the other data to determine consistencies and shortfalls in the safety culture at the company. The conclusions drawn from Table 28 can be found in the conclusions section. The list of responses based upon job title can be found in Appendix E.

Table 28 Tree Surgeon Perception Questionnaire

Category	Yes	No	Undecided	Total
Training				
Have you received any safety training since you were hired?	38 100%	0	0	38
Do you feel the training is educational?	37 97.4%	1 2.6%	0	38
Is the time spent on the training productive?	19 50.0%	6 15.8%	13 34.2%	38
Do you feel your safety training targets hazards in the field or injuries you may have had in the past?	29 76.3%	9 23.7%	0	38
Do you have any special certifications pertaining to safety training?	18 47.4%	20 52.6%	0	38
Do you feel your safety training makes you more aware of industry hazards?	33 86.8%	0	5 13.2%	38
Personal Protective Equipment				
Is your personal protective equipment accessible?	29 76.3%	0	9 23.7%	38
Is your personal protective equipment adequate?	25 65.8%	4 10.5%	9 23.7%	38
Is your personal protective equipment comfortable?	31 81.6%	2 5.3%	5 13.2%	38
Do you feel your footwear is adequate for your job duties?	34 89.5%	4 10.5%	0	38
Does your footwear aid in injury prevention?	31 81.6%	7 18.4%	0	38

Category	Yes	No	Undecided	Total
Impression of Management				
Do you ever feel pressured by management or your direct boss to complete work at an unsafe rate?	21 55.3%	7 18.4%	10 26.3%	38
Have you ever been pressured to use equipment you feel is unsafe?	15 39.5%	23 60.5%	0	38
Do you feel management cares about your safety?	31 81.6%	7 18.4%	0	38
Medical				
Have you perceived any significant hearing loss in the duration of your employment?	2 5.3%	36 94.7%	0	38
Have you ever been injured on the job?	26 68.4%	12 31.6%	0	38
Are you content with your medical care following an injury?	17 44.7%	2 5.3%	7 18.4%	26
Safety Program				
Are you a significant contributor to the current safety program?	8 21.1%	30 78.9%	0	38
Do you think the current safety incentive program is beneficial for overall company safety morale?	28 73.7%	10 26.3%	0	38
Does the incentive program change your behavior in the field?	11 28.9%	27 71.1%	0	38
Do you feel daily safety inspections are beneficial and help keep you more aware of hazards?	32 84.2%	6 15.8%	0	38

Category	Yes	No	Undecided	Total
Communication				
Do you feel there is adequate communication involving:				
Problems with other employees on a crew?	30 78.9%	8 21.1%	0	38
Hazards associated with their everyday job duties?	38 100.0%	0	0	38
Equipment that is not functioning properly?	25 65.8%	13 34.2%	0	38
Does management supply a positive response to complaints?	20 52.6%	1 2.6%	17 44.7%	38
Are you in favor of a crew brief/walk-around to identify the hazards associated with each jobsite?	38 100.0%	0	0	38
Do you frequently have problems with other crewmembers?	13 34.2%	25 65.8%	0	38

Tree Worker Perception Questionnaire

Training

The first three questions deal directly with the safety training sessions. Every new hire receives a safety briefing before entering the field and then receives the subsequent OJT from his crew. In addition, there are four safety meeting per year, which are mandatory for all field employees. Therefore, as expected, all 38 field employees responded that they have received related safety training. The one negative response about the educational nature of the training was consistent with the rest of his responses. He did not, for his own personal reasons, see the value in a safety program and refused to learn from it. From a productivity standpoint, many felt that certain parts of the training

were productive, but others parts just seemed to take up time during the meeting. For example, most employees feel some of the talks at the meetings are repetitive and the many of the videos do not teach anything new. On the other hand, aerial rescue, CPR, and climbing training are hands on and seem to have more impact on the employees. The personnel with the most experience felt that the safety meetings were not productive. This was not the case for all, but explains the repetitive nature of the training responses. The employees who have been there for many years have seen most of the videos and hear many of the same lectures every year. Up to this point, much of the safety training could be considered a program weakness because of the lack of employee involvement and enthusiasm.

The special safety certifications tree workers maintain at the company include Electrical Hazards Awareness, Certified Tree Worker, and the Qualified Applicator Certificate, relating to pesticide applicators. Approximately 50% of the field employees have at least one certification and six have multiple certifications. This additional expertise is thoroughly explained in the training section of the text.

The two questions regarding field and industry hazards received negative responses for a couple reasons. The undecided employees could not respond "no" because they feel there is some benefit in the hazard awareness program and would prefer to have the program than not. Others responded negatively because of an aerial lift that returned to service with the control mechanism reversed from what the operators were accustomed to using. The employees felt this problem should be fixed or removed from service entirely. The workers believe that training is not an effective fix. This issue is described with more detail in the communication section of the questionnaire.

The other main issue regarding training is the boredom that predominates at many of the meetings. This is a common problem everywhere and is nearly impossible to solve effectively. Active measures to keep employees involved and more hands on training are two ways the company tries to solve this problem. Examples of these measures include employee generated discussion and aerial rescue exercises. The employees with negative responses felt hands on training should be the primary ingredient of all quarterly safety meetings.

Personal Protective Equipment

The first two questions determine if tree worker personal protective equipment (PPE) is adequate and accessible. Nearly 25% responded that they were unsure if the equipment is "accessible" and approximately 35% either were not sure or did not think the company supplied PPE was "adequate". The reason for the lower numbers for accessibility is because of the availability of the equipment. Whereas, the employees felt that adequacy related more to equipment they don't have. These high numbers refer to gloves and quality uniforms, which the company does not supply for all employees. Currently, gloves must purchased by employees and the uniforms are thin, providing little protection. The company reasoning for not purchasing gloves is the high cost of replacement gloves. When taking into account the cost of future claims and injuries over the last few years, the cost of gloves is not that outrageous.

Whether or not gloves are a necessary piece of equipment to protect workers from known hazards is arguable on some jobsites. Gloves can even expose tree workers to more unexpected hazards if they get caught up in brush or pieces of equipment. Because of

this, it is the author's opinion that the general duty clause of the Occupational Safety and Health Act does not apply to all conditions of glove use for tree workers.

Since September 1995, there have been 14 hand injuries, primarily lacerations, which may have been prevented with appropriate gloves. Those 14 injuries have resulted in 111 lost workdays and $13,372 in total worker's compensation cost. Since 1991, the company has suffered 22 hand related claims, resulting in 142 lost days and total worker's compensation cost of $15,640. With over $15,000 in initial injury cost, increased insurance premium, and the lost production for 142 days, it is possible the cost of gloves is not so outrageous and could translate into substantial increases in overall field productivity.

Quality protective gloves, which still allow for positive hand and finger feedback, are reasonably priced and available through many wholesalers. If two pairs of gloves were purchased for all 38 field employees per month for a period of one year, the total cost would be approximately $15,000. From management's perspective the cost may outweigh the problem, for now. What accidents may happen in the future, obviously nobody knows. This is a simple fix to a simple problem and would satisfy many employees. Many leather gloves simply cannot withstand the friction from ropes when used to lower limbs and therefore are ruined quickly. In many cases this is considered typical wear and tear consistent with tree worker responsibilities.

The third question involves the comfort of the protective equipment. Almost 20% of the responses were "no" because of individual discomforts with hardhats and earplugs. According to the employee responses, after short periods, the hardhats cause headaches, and the earplugs are always uncomfortable. The main problem is whether the employees

will consistently wear protective equipment they feel is uncomfortable. If not wearing essential PPE, this particular problem could lead to many future claims and a possible fatality. This is one area which should be examined is whether or not the PPE is being worn correctly, as this would be an immediate cause for discomfort.

The last two questions deal with footwear adequacy. Slips, falls, ankle, and foot injuries occur so frequently, additional examination must be done to reach accurate conclusions. The reason for the "no" responses is that their footwear is in poor condition. They do not understand proper footwear and its role in injury prevention. Therefore, many employees did not know what to look for in quality footwear. They feel it is almost impossible to prevent many slips because of the environmental conditions they encounter everyday. Since 1991, footwear related accidents have accounted for about $250,000. These claims involved foot injuries, slips, and falls. This is an area many researchers in the industry are currently focusing on because of the tremendous costs associated with the injuries. There is a program, which has been implemented, to supply new boots, based on personal comfort and protection, as a part of the employee incentive program.

Impression of Management

The first two questions deal with management pressuring employees to complete work and use equipment they feel is unsafe. A significant amount of tree workers (60%) said they have used unsafe equipment, while 45% felt pressured to complete jobs at an unsafe rate. Nearly half of the 38 field workers had complaints about two specific supervisors who pressured them to get the job done with no regard for safety. When asked if that influenced their work and disregard for increased risk, eight said that management pressures have no effect on them jeopardizing their safety. They will

continue to work at their rate no matter what the circumstance. Nine employees said they felt their jobs would be jeopardized if they continually took extra time on their jobsites. In their opinion, if that wasn't the case they would be placed on bad jobs, with tough trees, in poor conditions. Nonetheless, employees still take all the time they need to finish the job at the company's expense. Although, if this issue becomes a more frequent occurrence, it must be corrected with appropriate mediation because of the high hazard potential of such a condition.

The second question about unsafe equipment received complaints from the majority of employees about an aerial lift with a reversed control mechanism. The truck went to be refurbished and returned to service with controls reversed from what everyone was accustomed to using. The controls are placarded and everyone had been instructed on the proper use of the device, but many have problems using their opposite hand to control the bucket. Most other equipment operates safely and efficiently except for a few brush chippers and flatbeds some dislike because their performance and appearance. A walk through of two jobsites showed a loose blade on a pole saw and the safety shut off on a brush chipper wedged full open. The climber was unaware of the loose blade on the pole saw and a foreman wedged the piece of wood in the brush chipper. These employees were not pressured to use this equipment. They made their own independent decisions to use equipment in a hazardous manner not only endanger their own life, but others on the crew. Employee modified equipment and a lack of understanding of hazardous equipment is another area that needs further examination. These are very serious conditions that must be stopped by the supervisors and management before someone is seriously injured. One of the worst parts about these particular issues is that crew leaders are the source of

the problem. The people who are supposed to be setting the example for others are making poor safety decisions that could very well cost someone their life.

The last question involving managements' concern over employee safety received 18% "no" responses. These responses were due to the reversed aerial lift mechanisms and frustration over their work rate because many supervisors primary concern is making money on their job. Approximately 82% believe management cared about their safety because of the time, money, and manpower that is invested in the safety program. They are also pleased with their equipment and the dedicated shop employees who ensure all equipment runs properly with all safety features on a daily basis.

Medical

The first question in this section involves on-the-job hearing loss. The company does sponsor annual hearing exams to determine significant hearing loss over the course of employment and 2 employees have suffered significant hearing loss. Hearing protection is supplied to all employees, is readily accessible, and is enforced by all crews at all times. The hearing conservation program is extensive and aggressive because of the hazardous nature of long term noise exposure. The two tree workers who have lost part hearing have always worn hearing protection. Two other employees, one groundman and one climber, responded that they thought they might have lost some hearing, but as of the date of this document this year's testing had not yet been completed. As of the year prior, the employees with concerns had not suffered OSHA recordable hearing loss in either ear.

The last two questions involve injuries and the subsequent medical care. The primary medical care complaints are common and expected. The injured employees were

unhappy with the impersonal care and excessive waiting. A couple employees commented on being released to work too early, but this is also a common complaint no matter what industry or company one may examine.

Safety Program

This section is covered in detail in the safety training section, but what sets this apart is the employee perception of the program. According to the survey results, 79% of the employees felt they were not substantial contributors to the safety program. This means they do not provide their input at safety meetings and make recommendations based on what they would feel could make the program better. More than three-quarters of employees don't know or care what topics should be covered at the quarterly meetings. This may be correlated with a lack of knowledge about industry hazards and safety improvement measures. More hands on training and possible testing of the safety material may attract better attention and cooperation.

Questions two and three address the safety incentive program. Approximately three-quarters of employees, 74%, felt the incentive program was beneficial to company safety morale, even though 71% have not altered their behavior in the field for a chance at earning a $35 incentive reward. Everyone is happy to receive a free item every quarter, but few actually change their behavior with safety in mind. The current incentive program is being reorganized to encompass not only safe work practices, but also general work responsibilities and is being put in place immediately.

The last question about daily inspections received 16% negative responses due to employees feeling like they know and understand what they need to do on every jobsite. All but one of these responses came from experienced foreman, the other from an

experienced climber. Perhaps their experience introduces complacency with their daily job responsibilities. On the other hand, work routines and personality conflicts in conjunction with jealousy may all be a factor regarding field employee relations with the safety supervisor.

Communication

The first three questions apply to adequate communication involving crewmembers, hazards, and equipment. The responses show that a few tree workers are problematic, but not to the point that they are hazardous on a jobsite or could present a future homicide scenario. These problems have several possible sources including cultural differences, language barriers, attitude differences, and work ethic.

On-the-job hazard recognition is an important piece of every safety program and is covered in great detail. The safety supervisor, job foremen, management, and risk consultants all work together to communicate hazards on a daily basis.

Hazardous equipment communication is a problem with about a third of the tree workers. The primary complaint involved equipment that goes out with one crew on Monday and a different crew on Tuesday with something wrong with its functionality. There may be a drivability issue or a brush chipper operation issue that is not communicated between crews. A possible remedy for this could be squawk sheets associated with specific pieces of equipment or vehicles, so that all who operate the machinery can see the problems that have been associated with that equipment.

The fourth question regarding management's response to complaints had the highest percentage of undecided responses, 45%, because of the issues associated with the reversed aerial lift control mechanism. Frequent complaints about problems have led

to changes in the past with little delay. As mentioned before, the control mechanism on the aerial lift is in complete compliance, all proper placards are in place, and proper training for all employees has been completed. Other than this issue, employees are happy with how management responds to complaints, which is why so many responded undecided.

All 38 employees are in favor of a crew walk-around prior to starting work at every jobsite. This is a current practice at most sites and should be implemented as standard procedure. This short safety measure can be used to identify hazards specific to each jobsite, which must receive special attention. Whether it's a patch of ice in the middle of a walkway, a hazardous tree, or sprinkler heads in the work vicinity crew-jobsite-hazard-recognition is worth the time spent and is an invaluable resource to every crewmember.

The last question received 66% "no" responses because of a problems associated with a couple employees. Not everyone has problems with these employees, but as described earlier, there are personality differences that are hard to overcome for some employees. This issue is addressed by job schedulers, so employees who don't get along with each other, are rarely are placed on the same crew. Although this number looks very negative in terms of safety, it is rare to have crews work together who have problems with each other and therefore is a hazard easily controlled by management.

Questionnaire Job Title Breakdown

The job title breakdown is also included in the appendix of this document because the responses do vary from one job responsibility to the next. This also allows for further analysis with the claims analysis and personal discomfort surveys. This information can

be used to support the existing program or as a basis for future improvements. In some areas it is important to see the number distribution to better understand the situation. For example, the number of safety certifications looks sub par when examined on the combined data questionnaire. Further examination shows that nearly 60% of foremen, 80% of top climbers, and 43% of climbers have special certifications. The total is skewed because no groundmen have certifications. Appendix E lists the individual job title perception questionnaire results.

Tree Worker Discomfort Surveys

The following two tables present data collected from 38 tree worker discomfort surveys. Table 29 presents data for tree worker discomfort locations. Every current field employee provided their responses based on where they feel pain or discomfort on a daily basis. This information in conjunction with employee perception is a valid method for convincing management to implement changes in the safety program. Company wide complaints and discomforts can result in poor work quality, decreased production, and repeated claims. The consistent responses usually outline the problem, which allow directed control measures to be implemented successfully. The information received from the discomfort location survey shows that elbow pain is almost as common as back pain, with over 50% of the employees suffering from both. Back injuries have been described in various sections of the text, but what is not significantly mentioned because of the lack of claims, are elbow injuries. There have been a total of 12 claims since 1991 involving elbows, which amounts to 5.6% of the total claims over that period. Even though the cost and lost workdays may not be as significant as back injuries, repeated trauma elbow injuries could become a serious problem in the near future. Although only half of the tree

workers reported consistent elbow pain, nearly all who use pole saws regularly suffer from elbow pain every day. The shoulder pain associated with 32% of the field employees is most likely associated with above-the-shoulder work also consistent with regular pole saw use.

Because of the nature of the device, very little design improvements can be done to the saw. This includes weight, leverage, and tooth design of pole saws. Therefore, limiting exposure time and ensuring the tool is operating at its maximum capacity are two of the best options for preventing future shoulder and elbow pain.

Table 30 presents field employee perception of the cause of their individual pains. For example, a foreman responded that his shoulder and elbow hurt everyday. When asked what he thought caused and continues to aggravate this pain, his response was pole saw use. As expected, lifting was the most common response as the source of everyday aches and pains. Pole saws, chainsaws, and twisting associated with climbing and lifting were the rest of the field employee determinations of discomfort causes. Because certain employees gave two answers, there are 43 responses for only 38 field employees.

Chainsaws are listed as the third leading source of pain among employees. This perception is not only due to the inherently dangerous chain and associated lacerations, but the repercussions of chainsaw operation. These side-effects include noise, vibration, and weight. All three of these injury and illness inducing byproducts have been researched by various chainsaw manufacturers, resulting in remarkable advancements. All chainsaws at the company are equipped with an anti-vibration mechanism, which aids in the reduction of upper body strain. Chainsaws recently manufactured are also much lighter and easier to handle than those manufactured a decade ago. It is important to

remember that not all work done with chainsaws is near the tree workers body. Often times leaning and arm extension is necessary to perform hard to reach cuts. These scenarios highlight the effectiveness of the light weight, improved performance, and chain breaks associated with the new chainsaws.

Table 29 Tree Worker Discomfort Locations

Pain Location	Totals	Percent of Employees
Lower Back	21	55.3
Each Elbow	19	50.0
Each Shoulder	12	31.6
None	12	31.6
Each Knee	7	18.4
Neck	5	13.2
Foot	2	5.3

Table 30 Tree Worker Discomfort Probable Causes

Pain Cause	Totals	Percent of Employees
Lifting	18	47.4
Polesaw	12	31.6
Chainsaw	7	18.4
Twisting	6	15.8

Tree Worker Perception Descriptive Statistics

The following tables are tabulations of responses from questionnaires administered to all 38 tree workers at the company. Table 31 lists the responses to tree worker perception of most dangerous work activities. The most common responses, 21% each, involved removals, lifting, and climbing. These three daily activities have resulted

in a combined $360,340 in direct workers compensation cost since 1991. That is 46% of the total direct cost incurred by work related injures and illnesses over this project period. Carrying brush responses ranked fifth at 10.5% and pruning ranked sixth at 5.3%.

Referencing Table 10, Job Activity Claims Analysis, shows that pruning related claims have the highest frequency, lost workdays, and associated cost. This data is important because of the significance carrying brush and pruning has had over the last 11 years, with regards to claims.

Table 31 Tree Workers Perceived Most Dangerous Activity

Most Dangerous Activity	Frequency	Percent of Field Employees
Removal	8	21.1
Lifting	8	21.1
Climbing	8	21.1
Brush Chipping	6	15.8
Carrying Brush	4	10.5
Pruning	2	5.3
Cutting Debris	1	2.6
Carrying Ladder	1	2.6

Table 32 Tree Worker Perceived Leading Cause of Injuries

Leading Cause of Injuries	Frequency	Percent of Field Employees
Lifting	22	57.9
Slipped	10	26.3
Pruning	5	13.2
Roping Limb	3	7.9

Table 32 shows the tree worker perceived leading cause of injuries. "Lifting" had the highest percentage of responses for cause of injuries with 58%. "Slipping" received the second highest number of responses with 26% of the employees responding. This information is consistent with the claims and also with the discomfort surveys.

Table 33 Tree Workers Perceived Most Dangerous Equipment

Most Dangerous Equipment	Frequency	Percent of Field Employees
Chainsaw	16	42.1
Polesaw	11	28.9
Brush Chipper	7	18.4
Hi-Ranger	3	7.9
Ladder	1	2.6

Table 33 presents the tree worker perceived most dangerous equipment. "Chainsaw" received the highest percentage of responses at 42%, while "pole saw" were second with 29%. This data correlates primarily with climbers and foreman, while the third most significant response "brush chipper", 18.5%, correlates best with groundman. This correlation is based on total number of employees broken down by job title.

Table 34 presents the responses for what tree workers believed were the most common injuries associated with their line of work. The most common response was "back strain". This was the primary response for all four job categories and is the leading lost time injury at the company, with 26 lost time cases. "Laceration" received 16% of the responses and is also the third highest percentage of total claims since 1991. The elbow and shoulder responses are directly related to the use of pole saws, which continue

to play a relatively insignificant role in repeated trauma cases, despite being the leading complaint among employees.

Table 34 Tree Workers Perceived Most Common Injuries

Most Common Injury	Frequency	Percent of Field Employees
Back Strain	28	73.7
Laceration	6	15.8
Elbow Strain	2	5.3
Shoulder	2	5.3

Table 35 Tree Worker Actual Prior Injuries

Prior Injuries	Frequency	Percent of Field Employees
None	27	71.1
Back	8	21.1
Elbow	2	5.3
Knee	2	5.3
Neck	1	2.6
Eye	1	2.6
Hand	1	2.6
Wrist	1	2.6
Ear	1	2.6

Table 35 provides a tabulation of the current employees' history of injury locations and also the employees who have not had an injury. The injuries directly relate to the claims for the current employees. As expected, back injuries, 21%, maintain the highest percentage or reportable claims among the current tree workers. Knees and

elbows, 5%, are the next leading injury locations, which can also be derived from the claims analysis section.

Table 36 shows the tree worker perceived most hazardous seasons. The four seasons in this instance were broken down into three month increments. Winter is defined as the months December, January, and February. Spring includes March, April, and May while summer consists of June, July, and August. Fall includes the months September, October, and November.

Table 36 Field Perception vs. Actual Cases for Most Hazardous Season

	Field Perception 2002		Actual Cases (1991-2002)	
Season	Responses	Percentage of Employees	Total Cases	Total Lost Workdays
Winter	25	65.8	49	247
Spring	5	13.2	50	658
Summer	5	13.2	53	611
Fall	3	7.9	63	454

Winter received 66% of the total responses followed by similar responses for spring, summer, and fall. These responses are expected based on the increased environmental hazards confronting tree workers during the cold and rainy parts of the year. The claims over the last 11 years actually show that winter has the least number of reported claims with 50, and fall has the greatest with 67. One explanation for this discrepancy is the increased awareness and precautions the employees use during periods of inclement weather. It is important to note the question asked what they feel is the most hazardous time of year and not what time of year they feel has the most claims.

Table 37 lists the information received from tree workers for possible safety improvements. The greatest response was in favor of additional personal protective equipment, primarily gloves to be supplied by the company. According to the questionnaire, 29% of the employees felt there was no need for any additional safety improvements and were content with what the existing program has to offer. Four people made reference to new equipment and lifting aids to prevent future back injuries. This recommendation is consistent with their daily duties of lifting and carrying a variety of materials from one place to another with little to no help from mechanical devices.

Table 37 Tree Worker Safety Improvement Recommendations

Safety Improvements	Frequency	Percent of Field Employees
PPE	13	34.2
None	11	28.9
Training	9	23.7
Lifting Devices	3	7.9
Footwear	1	2.6
New Equipment	1	2.6

Table 38 presents the amount of workers who have attained a safety related certification. Nearly half of all tree workers have at least one certification (45%), with a total of 17 employees having at least one certification. It is important to note that none of the 9 groundmen currently retains a safety certification. This is due to both a lack of required experience and knowledge in the science of arboriculture. The greatest percentages of certified employees are top climbers at 80%, while only 59% of foremen

have successfully completed a safety related course. A detailed description of what each certification involves is located in the training section of the text.

Table 38 Tree Worker Safety Certifications

Certifications	Frequency	Percent of Field Employees
None	21	55.3
EHAP	15	39.5
CTW	5	13.2
QAC	3	7.9

CHAPTER V

DISCUSSION

This thesis is a comprehensive examination of the relationship between employee perception, employee discomfort, safety training, industry standards, and just over a decade of actual claims reported at the company. By itself, the descriptive data from the claims analysis section provides a tremendous amount of information, but no concise conclusions can be drawn from the information until it is related to the other data in the text.

Without safety conscious management, there will be little safety culture in the organization because the support will not be present. Safety must start from the top and all employees must play a valuable role in the program. Training reduces the likelihood of an accident because it increases hazard awareness, motivates employees, and provides knowledge of the risks present in the industry. Safety training will continue to be productive if it builds on existing employee knowledge and experience.

In order to fully understand a safety program it is necessary to understand all aspects of the organization. Claims must be analyzed to determine consistencies and discrepancies for which a proper research direction can be established. The employees must be surveyed to determine their perceptions of the safety program, field hazards, impressions of management, training, and there own personal discomforts. This data can then be used to highlight inconsistencies and inadequacies with safety training and hazard prevention. Next, industry standards and existing regulations should be analyzed to

determine if the organization is doing everything required of them to protect the workers and if the current standards are adequate. Finally, this will determine if management is fulfilling their role in establishing an effective, productive, and efficient injury and illness prevention program. This was the general, procedural approach throughout the research and findings of this thesis.

Employee Discomfort Surveys

Perhaps the best way to examine this material is to look at the claims data with respect to each of the other disciplines covered in the text. Employee discomfort surveys provide data that extends beyond claims because they give reference to poorly designed equipment, improper work techniques, and lack of sufficient training. Of the 38 employees surveyed, 12 stated that they were free of pain on a regular basis, while the remaining 26 reported a combined 78 locations of personal discomfort. This equates to an average of three different discomfort locations for each employee who reported at least one problem. This means that the vast majority of employees go to work everyday uncomfortable, which could have numerous adverse effects on their work performance.

The most commonly reported discomfort is lower back pain, with over half of the employees suffering from it on a daily basis. This data is consistent with the claims analysis information and is supported by the high frequency of back related claims. A close examination of the discomfort locations reveals two key locations not highlighted by claims data tabulations. These locations are elbows and shoulders. Elbows have been identified in 12 claims and shoulders in 11 total claims over the thesis research period. The combined lost workdays of elbow and shoulder related claims only totals 192, which equates to only a fifth, 22%, of the total back related claims. In addition, eight other body

parts have a higher frequency of claims and seven have greater numbers of lost workdays than each of them. This means that historically elbow and shoulder injuries have not been a substantial source of lost workdays and high worker's compensation costs.

However, the discomfort surveys tell a different story than what the claims data provides. Half of the field employees report consistent elbow pain. Over 65% of the employees, excluding groundmen, have significant pain they contribute to pruning equipment. This equipment includes pole saws, pole pruners, and chainsaws. By design pole saws and pole pruners require arms to be extended and raised for extended periods, while exerting a force on the equipment. This is also the reason why 32% of the field employees have shoulder pain on a regular basis.

Lifting and using pole saws and chainsaws were the two main employee responses regarding their perception of the source of their pain. Chainsaws have been redesigned in many ways over the last few decades to greater protect the worker. This includes chain-breaks to prevent lacerations, anti-vibration equipment to reduce the stressors on the arms, shoulders, back, and neck, in addition to being lighter and easier to operate. Pole saws on the other hand, have the same general design as when they were initially developed. The only difference is the engineering of the cutting surface. Something must be done to improve the operation of the pole devices or many companies will have several employees out on disability leave. As it stands now, pole saws and pole pruners are not a significant contributor to worker's compensation costs and therefore are not targeted as they should, an industry pain inducer.

Employee Safety Perception Survey

This survey provided valuable information about the industry from people who experience it everyday. The field employees, unlike supervisors, are able to observe everything going on around them because they are the ones facing all of the hazards. They are the ones who must be questioned to determine any hazard awareness deficiencies within the safety program. This is the primary reason field employees were surveyed and not the supervisors or office staff. The interviews with the workers presented many barriers, which had to be overcome in order to be successful. One was the use of an interpreter to overcome a language barrier. Another was relating the questions in way they would have an easier time understanding and responding. And lastly, they had to understand I was there to help them, which was necessary to gain their trust in order to receive the most accurate responses possible.

The five sections covered in the survey all relate to hazards that can either be increased or decreased based on employee and management involvement. The sections are safety training, personal protective equipment, impressions of management, medical, safety program, and hazard recognition.

Hazard Recognition

In terms of hazard recognition, all of the employees have a very good understanding of what to do and this is reflected in the claims analysis. No one is getting hurt from equipment or on jobsites as a result of a supervisor or fellow employee not communicating appropriate hazard information. There are occasional problems between certain crewmembers, but this problem is avoided by keeping them on separate crews. The communication questions also brought up concerns about an aerial lift the operators

had concerns about. This problem was described in the text and is currently being rectified. This is an example of management hearing consistent complaints about the safety of equipment and responding with appropriate measures to standardize the equipment.

Medical

Quality medical care is essential for returning employees to work as soon as possible without threatening a re-aggravation. Good, honest occupational physicians must be relied on to release an injured employee to work at the right time. This makes doctors an extension of the safety program. A doctor, who allows an injured employee to return to work before he is ready, increases the risk for not only that employee, but everyone else on his crew.

Hearing loss is not addressed in much detail, but is an issue which must be examined in the safety program. Currently two field employees suffer from hearing loss and the numbers will most likely increase over the next few years. Studies have shown that hearing loss can be a significant contributor to work related accidents because of a substantial communication barrier. This is an area that is adequately addressed with hearing protection, but could be responsible for many future claims.

Impression of Management

There are many mixed opinions about management pressuring employees to get jobs done quickly. This obviously jeopardizes safety if the workers do what they are told, but according to some responses they continue to work at the same rate no matter what they are told. Management pressure is obviously not listed as a cause on any claims, but

could be responsible for several including strains, sprains, laceration, and contusions. Many of these could be the result of an unsafe work rate.

Even though many employees are unhappy with a couple supervisors, their overall impression is that management cares about their safety. The safety training, company sponsored certification programs, incentive program, and dedicated safety personnel are all measures management has taken to convince employees that their safety is the primary concern.

Personal Protective Equipment

There were many mixed responses about the adequacy and accessibility of PPE because of issues over gloves, boots, and uniforms. Currently the company does not supply gloves to its employees because of cost and necessity. What the claims analysis uncovered, however, is that hand related injuries carry the second highest frequency of claims. Lacerations, contusions, and punctures may be prevented with the use of quality gloves and arm covering uniforms supplied by management. With the nature of their work tree surgeons would not be able to use bulky, non-tactile gloves, so it is hard to say if any of the accidents could have been prevented with more appropriate equipment. The protective equipment and safety apparel discussion at the end of this section provides more insight into this matter from both an industry and company point of view.

Footwear is a topic most employees are content with, but this conflicts with the outrageous number of slip and fall related claims. The varying environmental conditions the employees must work in cannot be controlled, but more stable footwear should aid in injury prevention. As a part of the current incentive program, employees will be given the option of receiving new boots if they have gone through the year with no write-ups. This

particular incentive is being awarded to 21 employees, which represent approximately 55% of the field workforce. This is a significant step taken by the company in attempt to satisfy workers and reduce the number of related injuries.

Safety Program Training

Consistent with what was found and listed under the training section, most employees feel quarterly safety meetings are not as educational and productive as they should be. Some field employees go to meetings and don't know nor care what is talked about, while other employees, who have attained certifications, all feel their additional training is highly beneficial because they were directly involved. With regards to safety training programs, employee involvement is crucial for it to be a success. This is why the aerial rescue training and climbing demonstration at the safety meetings receive so many positive responses. That particular training is hands on and can be specifically applied much better than a video or lecture.

The safety training at the company goes above and beyond requirements and has been complemented by all who have seen or been involved with it. The quality of their safety program has been justified the last three years by the California Landscape Contractors Association (CLCA). This association includes several thousand member companies across the sate of California and places them into divisions based on worker's compensation premiums and company size. For three years straight, the company has earned the award for the lowest loss ratio per premium dollars paid of all division one companies. In addition, the company currently has the lowest experience modification rating in the State of California for tree surgery. The tree surgery average is over 100, while this company's rating is currently at 65. This identifies a discrepancy with the

Bureau of Labor Statistics' information because it includes landscape specialties and gardeners under their distinction, which carries much less risk and fewer hazards than the tree surgery industry.

Even with such a quality program the current incidence rate is still triple the private industry rate. The main reason for this is the high-hazard nature of tree work. Currently, the Department of Labor does not maintain statistics for tree surgeons, but many of the trade organizations, including the National Arborist Association, have begun to build an accident database from companies nationwide.

Employee Hazard Perception Survey

In conjunction with the perception questionnaire, a hazard survey was administered to all field employees. This survey gathered data on employee perceptions of the most hazardous job activity, equipment, season, prior injuries, leading cause of injuries, most common injuries, safety improvement recommendations, and tree work certifications. This data can be directly correlated with claims tabulations, industry standards, and training to determine if employees understand what is causing them to get hurt. Standards and training do their part to inform employees of what hazards are present, but if the information conveyed is not what is consistently resulting in injuries and illnesses there is a failure in the safety system. This failure would not just be at the company level, but with the industry as a whole.

Dangerous Activity

"Removals", "lifting", and "climbing" are listed as the top three responses from the field regarding most dangerous job activities. Removals have inherent dangers because of all the equipment involved, which must be utilized in a variety of positions

and locations both in trees and on the ground. Although it does have many dangerous aspects, removals are ranked fifth in job activity related claims. Pruning on the other hand, is the activity most often associated with claims because of the equipment involved as well. Some of this equipment is used in removals, such as chainsaws; therefore this may be the link between actual claims and employee perception. Employees may relate the use of equipment with a hazardous situation.

Lifting is identified as a dangerous activity by eight employees in the survey. Lifting is involved in the second highest frequency of claims, second most lost workdays and second in total medical and compensation cost. Lifting is also what the employees believe to be the leading cause of injuries.

Most Common Injuries

Back injuries are in a league of their own in terms of lost days, frequency and total cost. The employee perception data supports their knowledge of this fact. Slips and falls, resulting in back injuries are historically a substantial aspect of all accidents and also with the employee responses.

Perception, Training, and Claims Relationship

The point that needs to be reached is how the field employees derive their responses to the questions asked in the surveys. Is it a result of training, personal safety certifications, industry standards, or their own experiences and injuries? Based on this research and analysis, it is the opinion of the author that few of the employees believe that the ANSI standards are protective. That is to say if they know about the ANSI standards at all. Many employees respond based on what their training tells them. Quarterly safety meetings always talk about back injuries, climbing, and other closely

related issues. Many of the responses to questions such as most dangerous activity, leading cause of injuries, most common injury, and most dangerous equipment are a direct result of what they are told by management to be the answers. Their responses, which are listed in the text, are the areas primarily covered during the safety meetings.

Even though their responses may correlate with the information presented about the claims, when asked about their own discomforts and pains there are some inconsistencies. The employees respond based upon what is taught at the meetings. The meetings are based on what is recommended through understanding of ANSI standards, the NAA, California Code of Regulations, and OSHA regulations. These regulations don't mention much information, if any, about exposure to certain pieces of equipment. Safety training does not make any implications or correlations between equipment and employee discomfort. Despite all this, nearly half of the field employees and the majority of climbers and foreman suffer from elbow and shoulder pain everyday.

This pain is clearly associated with the use of pole saws and pole pruners because of the body positioning and motion. Chainsaw vibration is also a significant contributing factor. These equipment issues are considered by most in the industry to be the nature of the job. There is only one reason for this. Elbow and shoulder problems have not yet reached the endemic level of back injuries. As shown in the analysis section, elbow and shoulder related injuries combined don't even amount to one quarter of the back injury costs.

Even though the safety program at the company is regarded as one of the best in the industry, there is much more that could be done to prevent employee discomforts even though they have not yet resulted in costly claims. Better implementation of

appropriate protective clothing, equipment redesign, and limiting exposure time are just a few examples of what could be done to control employee discomforts. If the company does not address this issue, these discomforts in one way or another, will cost the company in the long run, whether it's the result of a repeated trauma illness or a decrease in work production. Preventative measures which could be implemented with ease and at a very low cost could save this company and all others substantial amounts in the future.

Protective Equipment and Safety Apparel

The function of protective equipment for tree workers is to reduce the severity of injury in the event of contact with a chain saw, pole saw, hand saw, or debris. Chain saw safety apparel is specifically designed to reduce the risk of injury in the event a saw has contact with the body. It is recommended by ANSI and all safety programs that everyone who operates a chain saw should wear PPE such as leg devices; gloves; shirts; boots; head, face, and eye protection; and hearing protection.

Occupational Safety and Health Administration 29 CFR 1910.226 Logging operations rule states that anyone who uses a chainsaw in the workplace, including for purpose of demonstration and training, must wear PPE. According to the regulation, the employer must supply the protective equipment.

According to the US Consumer Products Safety Commission, in 1994 there were 42,786 reported chain saw-related accidents (see Table 39).

Table 39 Chain Saw-Related Accidents: 1994

US Consumer Products Safety Commission 1994 Chain Saw-related Accidents		
Injury Location	**Injury Total**	**Injury Percentage**
Arms/ Hands	17,994	42.6%
Legs	16,348	38.7%
Head	3,418	8.1%
Feet	2,885	6.8%
Upper Body	2,141	5.1%

Solid protective material is the most essential piece of PPE. The first essential component is deflective material, which is usually comprised of ballistic nylon fiber and fabrics of aramide fibers. These materials allow the chain saw operator time to react, but were not designed to stop the chain in motion. Similar to bulletproof vests, these materials work best when used to deflect (Bernosky, 2000).

The second component is a jamming or clogging material, which is made of fabric such as polyester and polypropylene fibers. The special structure of the fabric enables the moving chain to draw the fibers into the drive sprocket of the chain saw forcing the chain saw to stop, thereby reducing the severity of the injury (Bernosky, 2000).

Chaps, the most effective of all leg protection, are mentioned in this text as recommended protective gear, but impede movement in trees, are cumbersome, and expensive. According to the 1994 study referenced prior, approximately 39% of all chain saw accidents are leg related. However, analysis of the claims between 1991 and 2001 provides evidence that saw related injuries to legs are somewhat insignificant.

Table 40 Company Chain Saw-related Accidents: 1991-2001

Company Chain Saw-related Laceration Accidents 1991-2001				
Injury Location	**Injury Total**	**Percent of Total**	**Lost Workdays**	**Medical/Indemnity Total Cost**
Arms/ Hands	11	73.3%	155	$31,356
Legs	0	0.0%	0	$0
Head	4	26.7%	2	$922
Feet	0	0.0%	0	$0
Upper Body	0	0.0%	0	$0

Table 41 shows that leg lacerations from saws represent only 3% of overall saw-related lacerations, 13 lost days, and only $750 in total medical and indemnity cost. For a ten-year period, these figures are staggering considering the type of work done. These data support management's opinion that chaps are not necessary for the protection of their employees. In fact, if additional leg protective equipment was implemented it may create more problems and hazards for those employees that would have to readjust to new work equipment.

The ANSI standards specifically target chap use for all tree worker ground operations. In this particular company, consistent with many other tree companies, ground operations are a fairly insignificant aspect of employee daily routines.

Denim protective pants are the most common with this company and have done an effective job of deflecting saw chains and blades, while giving the operator time to gain control over the saw. Another alternative to conventional chaps are bib style chaps, which resemble a pair of bib style overalls popular with hunting enthusiasts (Bernosky, 2000). The mobility problem, however, still exists with this version of leg protection.

Table 41 Chain Saw, Pole Saw, and Hand Saw-related Laceration Accidents 1991-2001

Company Chain Saw, Pole Saw, Hand Saw-related Laceration Accidents 1991-2001				
Injury Location	**Injury Total**	**Percent of Total**	**Lost Workdays**	**Medical/Indemnity Total Cost**
Arms/ Hands	23	74.2%	167	$35,350
Legs	1	3.2%	13	$750
Head Injuries	6	19.4%	24	$11,480
Feet	0	0.0%	0	$0
Upper body	1	3.2%	0	$176

Chain saw protective mitts are available that not only are sewn with cut retardant material and water resistant, but have goatskin for comfort. The cut retardant material is sewn into the left mitt, while the left mitt has a trigger finger for easy throttle actuation. The extended cuffs on these mitts not only provide additional protection, but prevent saw dust and wood chips from entering the gloves (Bernosky, 2000). This protective measure, unlike additional leg protection is warranted based on the history of hand and finger injuries. Although prior tables list 11 hand and arm injuries, 9 of those directly involve glove protected areas. All 9 accidents involved employees not wearing gloves at all. These 9 claims resulted in 155 lost workdays and over $31,000 in combined medical and indemnity cost.

The protective tree shirt is another option as part of a protective equipment uniform. While still maintaining its lightweight and versatility, the shirt has protective material sewn into sleeves, shoulder, and collars, which are all critical areas for chain saw kick- backs. Foot, head, and hearing protection are all key protective components for general work and chain saw operations that are addressed well at the company.

Worksite Equipment Safety Training

Whether a worker specializes in logging, trimming, planting, or plant health care, it is likely they will be exposed to the same dangers of large equipment and chain saws responsible for numerous injuries and fatalities throughout tree care industry. Because of this reason many safety professionals and state governments feel it is imperative for tree companies to incorporate a powered industrial operator training program.

Historical Statistics

The Health and Safety Executive completed an analysis of injuries reported from the forestry and arboriculture industries between 1990 and 1996. During those six years, 38 people were killed an average of six per year. Within the same time period were 1,800 major injuries, averaging 300 per year. In this case, a major injury is defined as fracture other than to fingers, thumbs, or toes; amputation; dislocation of shoulder, hip, knee, or spine; and any other injury requiring admittance to the hospital for more than 24 hours. There were also 4,800 minor injuries, averaging 800 per year, which resulted in workers having to take three or more days off of work.

This company has averaged one major injury per year between 1991 and 2001, although there has only been one since 1997. The significance of these 10 claims are evidenced in the total lost workdays and total worker's compensation costs. Even though the 10 claims account for only 4% of the total accident claims, the 400 lost workdays account for 20% of the total lost workdays for all 215 claims. This amounts to approximately two months off work for each of the 10 accidents. As far as total cost, the $114,644 accounts for 15% of the total expense over that period. The only reason these figures are not higher is that in this case, by definition, major injury does not include back

strains and other sprains. As mentioned prior, back injuries are by far the most substantial of all claims.

This company has also averaged approximately seven minor injuries per year between 1991 and 2001. The criterion for a minor injury according to the study was taking three or more days off of work. The problem with this differentiation of major and minor injuries can easily be found examining the claims. All three accidents with over 100 lost workdays are considered minor injuries because they do not fit the criteria of a major injury. For example, all three of these particular claims were back injuries not resulting in a fracture or a hospital stay. This data not only shows how hard it is to quantify this aspect of claims data, but also the severity of this high hazard industry.

Powered Equipment Training

Because of the variation in operating characteristics for each type of powered industrial equipment, a solid training program should be in place for all impacted employees. The training should emphasize jobsite irregularities mentioned earlier in the text including steep or uneven terrain, heavy underbrush, poor visibility, hazard trees, and the effects of adverse weather on equipment operation. The training should also highlight the general safety rules applicable to all powered equipment, which are available from the manufacture and required by government regulation (Logan 2000).

The safety training associated with powered equipment must be clear, concise, and most importantly effective. A combination of formal instruction and practical training must be used to emphasize the importance of operator safety. The initial training should be an efficient use of lecture material, pictures, or video. The primary training

must be hands-on, emphasizing proper procedures beginning with initial inspections and start-up through to shut-down and stowage.

Following the training program the employer must evaluate the trainee's knowledge and skills to determine if the employee is competent to not only operate, but work around equipment safely. A certification training record should be maintained annually for every employee containing the date of training and evaluation and management's approval for successful completion. This information should be kept in the employee's safety file for any future reference. According to the OSHA standard, an evaluation of the operator's performance must be conducted at least once every three years.

Upon every observed occurrence of an employee operating equipment in an unsafe manner, the supervisor must point out the incorrect manner of operation constructively and provide recommendations on how perform the duty safely. This could be done verbally after the first occurrence, but should be in writing thereafter. These equipment safety violations include, but are not limited to operations of brush chippers, chain saws, spray rigs, aerial lifts, vehicles, blowers, boom trucks, lifting aids, and stump grinders.

If analysis of safety violations shows evidence of repeat problems in a similar realm, the employer should highlight the issues in a structured safety meeting to all employees. This revised training should include the nature of the hazard, the unsafe acts or methods used to encounter the hazardous situation, and the end result of the scenario. This should be followed up with the appropriate methods to perform the task safely,

reinforcing the need for constant attentiveness, and the importance of situational awareness including a thorough understanding of equipment operation.

CHAPTER VI

CONCLUSIONS

It is very difficult from a safety point of view to prevent accidents in a hazardous working environment. Once proper control measures are safely in place and all risk mitigation techniques are used, it is up to the employee to work as safe as possible. Many tree workers are aware of the hazards present on any given job site, but the occurrence and severity of such hazards are only known to experienced workers. Safety awareness training, safety certifications, tailgate safety, daily inspections, OJT, and job experience outline some of the methods a tree worker is able to acquire a better understanding of safety.

Many tree worker injuries are cumulative resulting from years of repetition and strain. This helps to explain why lifting is such an inexpensive injury for groundman and climbers, yet the most expensive overall for foreman.

As employees gain more experience and are promoted at the company, they are required to use their body in varying ways. After two or three years of being a groundman, lifting begins to hurt the back more and more because of poor technique and repetition. At that point, the groundman moves up to climber and later foreman responsibilities utilizing more elbow and shoulder movements. Many employees develop cumulative trauma disorders after only a year or two, but promotions change their job requirements. The change in responsibilities results in a brief delay before the repeated trauma affects another part of the body or in many cases the same area. For example,

employee back pain is consistent for all job titles throughout the company. Eventually, the repetition catches up to the arborist and they are uncomfortable everyday. This is evident from the discomfort survey tabulations, which show the correlation of pain and job responsibility. The few employees that have stayed with the company long enough have moved to office or shop related jobs because their bodies will not allow them to perform tree work anymore. Many will live the rest of their lives with discomfort because of years of repetition as an arborist.

Safety Training

Safety training has not adequately addressed the issues of cumulative trauma disorders among tree workers, even though CTDs have been a problem for decades. This is the main deficiency in the company safety training program. Preventative measures such as decreasing exposure, mechanical lifting devices, and redesigning equipment, are possibilities the safety program and management should explore in the near future.

The company does an effective job encouraging employees to engage in self-study certification programs resulting in greater hazard awareness and industry knowledge. The company has never had an accident involving electrical hazards and there has only been one aerial rescue in the last decade. There is substantial exposure to these hazards on most jobsites, yet training and knowledge play a prominent preventative role. The certification training does an effective job of preparing arborists for the hazards they will encounter on various jobsites.

There have been numerous cases involving a climber losing footing in a tree and getting injured, but no claims resulting from incorrect climbing procedures. The climbing

techniques associated with knots, saddles, climbing spurs, safety lines, and ropes are covered extensively through quarterly safety training and OJT for the less experienced.

Accident Rates

The company accident rates are far above what is listed in this text for industry rates because of the differing job responsibilities. According to the California Landscape Contractors Association, the company has had the lowest loss ratio of all division one companies for three years straight. This ratio and division classification is based on factors such as premium dollars, number of employees, and type of work. This is also more apparent with the decreasing trend of incidence rates for all job titles since 1997.

It is the author's opinion the greatest contributing factor is management's commitment to safety. The mid-1990's nearly destroyed the business because of the tremendous number of claims. Worker's compensation premiums skyrocketed and many employees were off work because of injuries. The safety culture changed when a new safety supervisor took over in 1997. He was promoted from the field, bringing with him more than a decade of experience. His ambitious attitude brought about immediate field results. He brought with him to the position the respect and admiration of his fellow employees, but most importantly he had the ability to communicate effectively with everyone. He is able to conduct the training in both English and Spanish, and because of his extensive field experience, performs many of the demonstrations himself. He is also responsible for implementing many of the current safety related programs and compliance measures. For example, the safety incentive program, OSHA compliance program, daily jobsite inspections, and employee write-up system are a result of his work efforts and management support.

Of course his job would not be successful without the complete support from management. Management's renewed sense of care for the employees must continue to improve and develop with the pace of the industry. The industry standards will always provide minimum guidelines, so it is essential for the safety program to be proactive and not passive with their safety mentality.

Management Involvement

Based on the current safety program at the company, it is clear management meets the standard and far exceeds what is required. There is a genuine care for the safety of their employees and a commitment to keep them as healthy as possible. Thousands of dollars are spent every quarter on incentive awards for the employees. Pay increases for the seventeen employees with safety certifications total approximately $40,000 annually. This combined with the incentive program amounts to nearly $60,000 committed to rewarding safety achievements on an annual basis. For only 38 field employees, this is a good indicator of management's commitment to the continued safety of its employees.

The areas somewhat deficient result from a lack of control measures and the high-hazard nature of the business. This is a rigorous industry that can be very grueling on the body. There are hazards everywhere and few are controllable. This company has done an outstanding job the last four years training their employees to be more aware and increase their hazard recognition. This is evident in the company's decreasing injury rate, lower experience modification figures and loss ratio statistics as compared to tree surgeons across the state of California.

CHAPTER VII

RECOMMENDATIONS

Safety is an evolving practice that must always be revised to meet the current industry hazards. As more mechanical devices have been implemented in general industry, they have resulted in numerous injuries and fatalities. Mechanical processes outgrew safety measures in many instances, as evidenced by guards, personal protective equipment, and ergonomic design criteria. In many cases, these safety problems have been remedied. The tree care industry has made several advances in this respect, but there are still many yet to accomplish.

Cumulative trauma disorders, personal protective equipment, and general work equipment are examples of areas which are not extensively targeted by standards and regulations. Therefore, it is the individual safety professional's responsibility to implement control measures to mitigate the daily hazard exposure of tree surgeons.

Training

The safety training in general is very effective at the company with the exception of a few areas pointed out in the employee questionnaires. The safety training must be more interactive, and hands-on to gain employee involvement. The possibility of having team safety leaders for individual job titles could be explored. These leaders would have safety responsibility for others with their same title and would be instrumental for tailgate sessions, OJT, and quarterly safety meetings. This takes some of the pressure off the safety supervisor and allows employees to have a more active role in the safety program.

This would also allow for group training sessions, in which job specific hazards could be targeted more applicably than the current system allows. This measure would also utilize time previously spent on unnecessary videos and lectures.

Safety Program Management

The current safety program has roots in many areas including industry standards, regulations, active measures, and historical prevalence. It is important that the company not rely on the inadequate standards to dictate the safety program. The safety supervisor and future safety leaders should be active, not passive with safety initiatives. "Anticipate and implement" is a phrase all employees could follow in a more active safety conscious role within the company. All lines of communication should be simplified, so everyone in the company can understand what needs to be accomplished in order to be successful.

As stated earlier in the discussion section of the text, a powered industrial operator training program must be streamlined into the safety program highlighting deficiencies which must be corrected. Poor driving techniques, incorrect boom operation, poor chainsaw technique, and proper aerial lift operation are just some of the areas that should be targeted by the new training program. This training program must also be written in with the main injury and illness prevention program and have employee documentation that the training was completed.

Incentive Program

The current quarterly incentive program should be restructured to a point system better utilizing and encouraging certifications and safe behavior. The incentives should benefit the company safety program. For example, points could be redeemed for gloves, protective clothing, climbing equipment, or boots. This could be more costly than the

existing program, but it ensures employees will be better protected in the field, not just have a cold lunch in the safety incentive cooler bag. With the points being awarded quarterly and more valuable incentives available, write-ups should be more stringent and common. Most employees were in favor of such a program and would be further motivated to use more caution in their work habits than with the current system.

Management

The management at the company invests extensive amounts of time and money in their safety program and this is reflected in the demeanor of the employees. Annually, thousands in bonus pay are awarded to certified employees and a tremendous amount is invested in the incentive program. All of the compliance measures and risk mitigation techniques are put in place with the employee in mind. Management's genuine care and respect for the well-being of employees is reflected in the quality of their work in the field.

The problematic supervisors identified in the text must be confronted and offered compromises on the side of safety. They must be reminded of the need for safety in the organization and identified as a potential breakdown in the safety system. Employee complaints must be formally addressed in such a manner that everyone knows. For example, if one employee complains about a certain brush chipper and the complaint is verified, this should be documented and posted for all employees to see. This will keep everyone knowledgeable about potential problems that may exist.

Supervisors should be required to visit every jobsite prior to crews engaging in work for a site specific job briefing. This briefing is required under the industry regulations, but not to this extent. The supervisor shall walk around the site with the crew

and identify any hazards that they will encounter. If it is a large job or even "a day for two guys" the supervisor must visit the site as a matter of good work practice. This should provide extra motivation for the employees to put in a full eight hours, increase hazard awareness, and help identify any problems at the jobsite. A simple measure of oversight will not only benefit the safety program, but general work practice as well. This safety measure should be effective in increasing situational awareness and limiting the complacency of employees because they will be constantly reminded of hazards at every jobsite.

OSHA Recordkeeping

The company must be more proficient at recording what is necessary on the OSHA 300 forms. The OSHA 200 forms referenced for this text are riddled with incorrect entries, clearly demonstrating a lack of understanding of what needs to be accomplished. This should be addressed and remedied with the clerical staff and safety supervisor. An injury and illness database should be maintained in accordance with what this thesis has provided. This will allow for better tracking and understanding of the claims and appropriate guidance for future hazard control implementation.

Injury Analysis

Lacerations are the third leading injury type resulting in 16 lost time injuries. Many tree workers receive cuts to their hands on a daily basis, some more serious than others. Adequate gloves would be an effective measure to prevent many lacerations resulting from saw blades and tree brush. Gloves made of high-tech fibers such as Kevlar®, Spectra®, silicon fiber, and other high quality, durable materials can provide outstanding cut protection for a multitude of applications, while still providing tactile

sensitivity. These gloves can be engineered for specific job applications at a cost under fifteen dollars. Depending on the puncture rating of the gloves, price may increase or decrease. Gloves should be used for specific tasks. For example, the use of pole saws and chainsaws should require a glove fit to withstand a serrated edge. Whereas, climbing or roping gloves must require a glove resistant to friction and heat. Quality, durable gloves are an easy solution to a troublesome problem in the tree care industry.

Because of the extra cost associated with durable gloves, they are currently not supplied by management. This is also the case with uniforms and protective wear. There are many brands available that supply outstanding leg and arm protection, while still being mobile and comfortable. The primary drawback is the outstanding cost associated with such clothing. As previously mentioned, gloves and protective clothing could be issued as safety incentives based on point accumulation. Not only are they valuable incentives encouraging employees to work as safe as possible, but they keep with the safety theme more than wrist watches and coffee cups.

In general head protection is not required by law for tree work as long as the employee is in the tree and no one is working above them. Because of this many tree workers go without hardhats when they prune and on removal jobs. Even though this is not a regulation, full-time hard hat use should become company safety policy as soon as possible. A simple bump on a limb or a falling light branch could be enough to cause the tree worker to lose consciousness. Hard hats are supplied to everyone, they are required for all other job tasks, and are always worn for hazard prevention. Therefore, they should always stay on in the tree.

Footwear has been analyzed in many industries and several quality boots are available at reasonable costs for tree workers. This is also an item which should be covered under the new safety incentive program. Slips and falls are significant causes of injuries for tree workers, which could be the result of insufficient footwear. However, close examination of employee boots showed very little worn surfaces. All boots were in good condition and according to the workers, provided adequate protection. Most of them however, commented on how little they paid for their boots. They do not understand what difference a quality boot could have on their work performance and on-the-job stability.

Arborist Equipment Issues

Standardization of all equipment must be a safety measure that is scrutinized at every level of the company. Currently, there is an aerial lift with controls on the opposite side of the bucket than employees are accustomed to. This has resulted in one property damage case and several near misses in just under a month of operation. Brush chipper operation must be consistent from one machine to the next. Inconsistent control locations are a leading cause of accidents in many industries.

Pole saws, pole pruners, and chainsaws must keep optimum cutting edges limiting effort and exertion on employees. Employees have identified a specific brand pole saw blade they feel is the best because of the 6 cutting edges as opposed to the standard 3 edge design. The problem from management's prospective is inappropriate blade use. For example, using the blade on oak trees, which in most cases have a higher percentage of hardwood than many other trees, dulls the blade faster than that of a tree with less percentage of hardwood. The blades are disposable, meaning they cannot be re-sharpened, and at an average cost of about fifteen dollars they become a major expense.

The average lifespan of the blade is only two weeks, putting the annual price tag for the blades at about $25,000. The bottom line is the better the equipment, the more efficient and effective the production, and the safer the work.

Repeated Trauma

The most effective control measure for eliminating repetitive strain illnesses is to stop the motion all together. This is obviously not possible in any industry, especially tree work. On the other hand, limiting exposure to the equipment that is the source of the repeated trauma is an effective measure that should ease the discomfort of most workers. This could be accomplished very easily in their work environment.

The job scheduler must not place the same employee on the same type of job everyday for weeks. For example, one foreman may possess outstanding pruning skills, while another removes a tree very efficiently. Since the object of the business is to make money, the employee with the best skill is placed on the job in which he will perform the best and complete the job the fastest. This is not to say that they can't effectively do each others job, they just specialize in one area.

Ornamental pruning jobs require the use of hand saws, pole saws, and pole pruners all of which have been identified to cause repeated trauma illnesses to the elbows, shoulders, neck and back. Removal jobs primarily require chainsaws and are much less tedious by nature. Chainsaws utilize different sets of muscles and apply stress to different parts of the body than does the use of the pruning equipment. This is not to say that removal jobs would not cause repetitive strain problems, but that different equipment with its own, somewhat different set of problems are utilized.

This is where the job scheduler part becomes essential to the safety program. Employees must be rotated throughout the week to various job requirements. Rather than keeping the worker using a pole saw all week, he must be sent to sites using chainsaws, no equipment at all, or on pest control jobs. When this is not possible, there is still another alternative because of the abundance of experience among the tree workers at the company.

If the same crew must be on at the same type of job for extended periods the crew has the ability to rotate their job responsibilities. Under the foreman and supervisor discretion, the climber should be allowed to do foreman work and vise versa. This would limit exposure on all sites and is possible because of the versatility of many of the employees.

In summary, everyone must work together to keep employees on a revolving system limiting their exposure to repetitive motion. During the peak pest control season, this can easily be accomplished by rotating many of the tree workers to spray equipment. When that is not possible, tasks should be varied from large oak jobs to more ornamental pruning. This varies the type of equipment that must be used on each jobsite.

Back Injuries

Back injuries have plagued nearly every company and their safety professionals for years and will continue to do so, as long as extensive lifting is required. In the tree care industry, back injuries are the leading cause of lost workdays and total cost, and have troubled the industry for years. The awkward and repetitive lifting that is required makes back injuries nearly impossible to prevent. If the wood is cut into smaller, easier to handle pieces, the quantity of lifting will increase. This company has implemented the

use of several boom trucks to aid the lifting of several large logs and is an example of a mechanical lifting device in the tree care industry. However, this measure is only effective when there is adequate space on the jobsite. Other measures, which could be effective include dump wagons and Bobcat style mobile equipment, but not only is this expensive to purchase and maintain, it requires additional training and introduces new hazards to the jobsite. This measure would be very difficult to implement and maintain, but is an example of a mechanical lifting device that could dramatically reduce the number of back claims.

Clerical Staff

Although nothing was mentioned in the text, the author would like to make a special note of the conditions the clerical staff works in each day. Many of the workstations need more space and must meet better ergonomic design criteria. Windows cause shadows and glare on work surfaces and computer screens and fluorescent lighting does not provide adequate illumination of their work surfaces. The entire staff should be trained and briefed on the prevention of cumulative trauma disorders. Discomfort surveys of the office staff uncovered many problems, which must be dealt with in a timely matter before the issues result in lost workday cases.

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APPENDIX A.

Arboricultural Standards Reference

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• Western Chapter, International Society of Arboriculture Certification Committee 1988. Pruning Standards, W.C. I.S.A.

• CA Code of Regulations: Title 8, Subchapter 7. General Industry Safety Orders, Group 3. General Plant Equipment and Special Operations, Article 12. Tree Work, Maintenance or Removal.

APPENDIX B.

Job Classification Requirements

The following job requirements are base upon the guidelines set forth by the National Arborist Association and implemented at the company.

Foreman/Crew Leader

Qualifications:

A. Meets qualifications of subordinate positions on the crew.

B. Must be able to follow written or verbal orders.

C. Must be able to delegate work and accept responsibility.

Responsibilities:

A. Reports to the office each day prepared to work a full day.

B. Receives daily job assignment from supervisor or sales representative and discusses any special instructions that may apply.

C. Directs crewmembers to prepare equipment, tools and supplies necessary for the day's work.

D. Upon arrival at the job site, directs crew in safe professional performance or work to be done, organizes the job assignments and their progression so that work is completed as efficiently as possible.

E. The crew leader's on-the-job responsibilities consist of:

    1. Notifying client of presence on property.

    2. Assigning specific tasks to crewmembers and supervises performance.

3. Insisting that crewmembers wear personal safety equipment and practice proper safe conduct on the job.
4. Designating break and lunch time.
5. Directing cleanup of the job site and making sure all equipment and supplies are secured on the truck.
6. Inspecting the work performed to be sure it is done to job specifications then notifying client that work, has been completed.
7. Keeping accurate records of time, equipment and materials used. Making notes on the job order for the representative.

F. Re-stocks needed supplies on truck and performs routine maintenance on equipment or informs supervisor of damaged equipment and needed supplies.

Top Climber

Qualifications:

A. Knowledgeable about the daily maintenance and safe operations of all equipment commonly used in tree care.
B. Must possess a valid driver's license.
C. Must be able to demonstrate a working knowledge of all knots, ropes and rigging devices used in tree trimming and removal operations.
D. Must be familiar with electrical hazards, appropriate operating procedures when in proximity to electrical conductors, and aerial rescue techniques in the event of an emergency aloft.
E. Must be able to work and maneuver at considerable heights under varying and sometimes adverse weather conditions.

F. Must possess physical strength and agility, good balance, good depth perception, and the ability to hear verbal instructions from a distance.

G. Must be able to climb and descend trees using rope and safety saddle; to learn, administer, and implement emergency rescue techniques; must be able to quickly remove him/herself from a potential danger area.

Responsibilities:

A. Report to office punctually each day prepared to work a full day.

B. Assist in preparing truck and materials needed for day's work at crew leader's direction.

C. Shall perform professional tree maintenance activities as directed by crew leader.

D. Shall help to maintain and keep track of all tools and/or equipment used in daily operations.

E. Shall constantly observe and practice climbing and tree maintenance skills in a continued effort to improve his own professional skills.

F. Shall use all safety equipment and perform all jobs safely, making accident prevention a part of daily conduct.

G. Shall be ready and willing to assist other crew members in all aspects of daily activities, and shall be capable of taking a leadership role when required.

General Tree Work (Climber)

Qualifications:

A. Must possess a valid driver's license.

B. Must be able to demonstrate a working knowledge of all knots, ropes and rigging devices used in tree trimming and removal operations.

C. Must be familiar with electrical hazards, appropriate operating procedures when in proximity to electrical conductors, and aerial rescue techniques in the event of an emergency aloft.

D. Must be able to work and maneuver at considerable heights under varying and sometimes adverse weather conditions.

E. Must possess physical strength and agility, good balance, good depth perception and the ability to hear verbal instructions from a distance.

F. Must be able to or be trained to climb and descend trees using rope and safety saddle; to learn, administer, and implement emergency rescue techniques, including tree rescue and all applicable first aid techniques; must be able to quickly remove him/herself from a potential danger area.

Responsibilities:

A. Trims or removes trees by climbing or with the aid of an aerial lift device, but only under the direct supervision of a crew leader.

B. Loads and unloads trucks with logs, brush and debris often weighing 25 pounds or more; lifts and feeds brush into brush chipper.

C. Works using hand saws, pole saws and pruners, hand pruners, and gasoline-powered chain saws.

D. Drives trucks or operates other equipment as assigned.

E. Responsible for the inspection and proper working condition of all tools and equipment assigned to him or her.

F. Safeguards employees and public from hazards in an around the work area.

G. Helps enforce on-the-job safety practices.

H. Performs other related work as assigned.

General Tree Work (Groundman)

Qualifications:

A. Must possess a valid California driver's license.

B. Must pass Company driving test.

C. Must be able to work outdoors under varying and sometimes adverse weather conditions.

D. Must be able to hear verbal instructions from a distance.

Responsibilities:

A. Loads and unloads trucks with logs, brush and debris often weighing 25 pounds or more; feeds brush into brush chipper.

B. Uses hand lines to lower limbs and equipment.

C. Keeps work area picked up and orderly.

D. Prepares and stows materials, tools and equipment at work site.

E. Works from the ground using handsaws, pole saws and pruners; hand pruners, and gasoline-powered chain saws.

F. Drives trucks or operates other equipment as assigned.

G. Services trucks and equipment. Keeps trucks and other assigned equipment in a neat and orderly fashion. Reports the need for repairs to truck and equipment crew leader.

H. Safeguards employees and public from hazards in and around the work area, staying in frequent voice communication with workers aloft.

I. Helps enforce on-the-job safety practices.

APPENDIX C.

Thesis Research Parameters

Main Database Parameters

Job Title
Experience
Recurrence of Previous Injury
Activity at Time of Injury
Primary Cause
Medical and Indemnity Costs
Day of the Week
Season
Age at Accident
Nature of Injury/Illness
Primary and Secondary Injury Locations
Equipment Used
Lost Workdays
Time of Day
Geographic Location

Research Parameters

Job Title:
Groundman
Climber
Top Climber
Foreman
Pesticide Applicator
Shop
Supervisor

Nature of Injury/Illness

Back Strain	Abrasion
Contusion	Fracture
Laceration	Bee Sting
Other Strain	Splinter
Sprain	Dog Bite
Poison Oak	Dislocation
Puncture	Degenerative Disk
Irritation	Burn
Chest Pain	Broken Tooth
Callus	Blister

Equipment Used at Time of Accident

Chainsaw	Hedge Trimmers
Pole saw	Vehicle
Hi-Ranger	Ladder
Hand Saw	Battery
Rope	Chisel
Brush Chipper	Knuckle Boom
Spray Equipment	Prybar
Hands	Saddle
Spurs	Wheel Barrow
Pipe Support	None

Activity at Time of Accident

Carrying Brush	Carrying Ladder
Climbing	Cutting Debris
Driving	General
Lifting	Lifting Wood
Pruning	Removal
Repairing	Roping Limb
Spraying	Walking

Cause of Accident

Airborne Debris	Bee Sting
Blow Out	Burn
Dog Bite	Exposure
Fall	Grabbed Blade
Kick-back	Lifting
Out Rigger	Palm Frond
Pushing	Rear-ended
Repeated Trauma	Rolled
Slipped	Struck By
Thorn	Twisted
Unknown	

APPENDIX D.

State Run OSHA Programs

AK	IN	NJ	TN
AZ	KY	NM	UT
CA	MD	NV	VA
HI	MI	OR	VT
IA	MN	RI	WA
IL	NC	SC	WY

APPENDIX E.

Employee Perception Questionnaires by Job Title

Foreman Perception Questionnaire

Category	Yes	No	Both	Total
Training				
Have you received any safety training since you were hired?	17 100.0%	0	0	17
Do you feel the training is educational?	16 94.1%	1 5.9%	0	17
Is the time spent on the training productive?	8 47.1%	2 11.8%	7 41.2%	17
Do you feel your safety training targets hazards in the field or injuries you may have had in the past?	15 88.2%	2 11.8%	0	17
Do you have any special certifications pertaining to safety training?	10 58.8%	7 41.2%	0	17
Do you feel your safety training makes you more aware of industry hazards?	15 88.2%	0	2 11.8%	17
Personal Protective Equipment				
Is your personal protective equipment accessible?	10 58.8%	0	7 41.2%	17
Is your personal protective equipment adequate?	7 41.2%	4 23.5%	6 35.3%	17
Is your personal protective equipment comfortable?	14 82.4%	2 11.8%	1 5.9%	17
Do you feel your footwear is adequate for your job duties?	16 94.1%	1 5.9%	0	17
Does your footwear aid in injury prevention?	14 82.4%	3 17.6%	0	17

Category	Yes	No	Both	Total
Impression of Management				
Do you ever feel pressured by management or your direct boss to complete work at an unsafe rate?	13 76.5%	2 11.8%	2 11.8%	17
Have you ever been pressured to use equipment you feel is unsafe?	9 52.9%	8 47.1%	0	17
Do you feel management cares about your safety?	15 88.2%	2 11.8%	0	17
Medical				
Have you perceived any significant hearing loss in the duration of your employment?	2 11.8%	15 88.2%	0	17
Have you ever been injured on the job?	15 88.2%	2 11.8%	0	17
Are you content with your medical care following an injury?	10 58.8%	1 5.9%	4 23.5%	15
Safety Program				
Are you a significant contributor to the current safety program?	4 23.5%	13 76.5%	0	17
Do you think the current safety incentive program is beneficial for overall company safety morale?	13 76.5%	4 23.5%	0	17
Does the incentive program change your behavior in the field?	5 29.4%	12 70.6%	0	17
Do you feel daily safety inspections are beneficial and help keep you more aware of hazards?	12 70.6%	5 29.4%	0	17

Category	Yes	No	Both	Total
Communication				
Do you feel there is adequate communication involving:				
Problems with other employees on a crew?	13 76.5%	4 23.5%	0	17
Hazards associated with their everyday job duties?	17 100.0%	0	0	17
Equipment that is not functioning properly?	8 47.1%	9 52.9%	0	17
Does management supply a positive response to complaints?	10 58.8%	0	7 41.2%	17
Are you in favor of a crew brief/walk-around to identify the hazards associated with each jobsite?	17 100.0%	0	0	17
Do you frequently have problems with other crewmembers?	8 47.1%	9 52.9%	0	17

Top Climber Perception Questionnaire

Category	Yes	No	Both	Total
Training				
Have you received any safety training since you were hired?	5 100.0%	0	0	5
Do you feel the training is educational?	5 100.0%	0	0	5
Is the time spent on the training productive?	3 60.0%	1 20.0%	1 20.0%	5
Do you feel your safety training targets hazards in the field or injuries you may have had in the past?	3 60.0%	2 40.0%	0	5
Do you have any special certifications pertaining to safety training?	4 80.0%	1 20.0%	0	5
Do you feel your safety training makes you more aware of industry hazards?	5 100.0%	0	0	5
Personal Protective Equipment				
Is your personal protective equipment accessible?	3 60.0%	0	2 40.0%	5
Is your personal protective equipment adequate?	2 40.0%	0	3 60.0%	5
Is your personal protective equipment comfortable?	5 100.0%	0	0	5
Do you feel your footwear is adequate for your job duties?	5 100.0%	0	0	5
Does your footwear aid in injury prevention?	5 100.0%	0	0	5

Category	Yes	No	Both	Total
Impression of Management				
Do you ever feel pressured by management or your direct boss to complete work at an unsafe rate?	3 60.0%	0	2 40.0%	5
Have you ever been pressured to use equipment you feel is unsafe?	3 60.0%	2 40.0%	0	5
Do you feel management cares about your safety?	4 80.0%	1	0	5
Medical				
Have you perceived any significant hearing loss in the duration of your employment?	0	5 100.0%	0	5
Have you ever been injured on the job?	3 60.0%	2 40.0%	0	5
Are you content with your medical care following an injury?	1 20.0%	0	2 40.0%	3
Safety Program				
Are you a significant contributor to the current safety program?	2 40.0%	3 60.0%	0	5
Do you think the current safety incentive program is beneficial for overall company safety morale?	4 80.0%	1 20.0%	0	5
Does the incentive program change your behavior in the field?	1 20.0%	4 80.0%	0	5
Do you feel daily safety inspections are beneficial and help keep you more aware of hazards?	5 100.0%	0	0	5

Category	Yes	No	Both	Total
Communication				
Do you feel there is adequate communication involving:				
Problems with other employees on a crew?	4 80.0%	1	0	5
Hazards associated with their everyday job duties?	5 100.0%	0	0	5
Equipment that is not functioning properly?	2 40.0%	3 60.0%	0	5
Does management supply a positive response to complaints?	1 20.0%	1 20.0%	3 60.0%	5
Are you in favor of a crew brief/walk-around to identify the hazards associated with each jobsite?	5 100.0%	0	0	5
Do you frequently have problems with other crewmembers?	1 20.0%	4 80.0%	0	5

Climber Perception Questionnaire

Category	Yes	No	Both	Total
Training				
Have you received any safety training since you were hired?	7 100.0%	0	0	7
Do you feel the training is educational?	7 100.0%	0	0	7
Is the time spent on the training productive?	3 42.9%	2 28.6%	2 28.6%	7
Do you feel your safety training targets hazards in the field or injuries you may have had in the past?	4 57.1%	3 42.9%	0	7
Do you have any special certifications pertaining to safety training?	3 42.9%	4 57.1%	0	7
Do you feel your safety training makes you more aware of industry hazards?	5 71.4%	0	2 28.6%	7
Personal Protective Equipment				
Is your personal protective equipment accessible?	7 100.0%	0	0	7
Is your personal protective equipment adequate?	7 100.0%	0	0	7
Is your personal protective equipment comfortable?	5 71.4%	0	2 28.6%	7
Do you feel your footwear is adequate for your job duties?	6 85.7%	1 14.3%	0	7
Does your footwear aid in injury prevention?	6 85.7%	1 14.3%	0	7

Category	Yes	No	Both	Total
Impression of Management				
Do you ever feel pressured by management or your direct boss to complete work at an unsafe rate?	4 57.1%	1 14.3%	2 28.6%	7
Have you ever been pressured to use equipment you feel is unsafe?	2 28.6%	5 71.4%	0	7
Do you feel management cares about your safety?	5 71.4%	2 28.6%	0	7
Medical				
Have you perceived any significant hearing loss in the duration of your employment?	0	7 100.0%	0	7
Have you ever been injured on the job?	4 57.1%	3 42.9%	0	7
Are you content with your medical care following an injury?	3 42.9%	1 14.3%	0	4
Safety Program				
Are you a significant contributor to the current safety program?	2 28.6%	5 71.4%	0	7
Do you think the current safety incentive program is beneficial for overall company safety morale?	5 71.4%	2 28.6%	0	7
Does the incentive program change your behavior in the field?	2 28.6%	5 71.4%	0	7
Do you feel daily safety inspections are beneficial and help keep you more aware of hazards?	6 85.7%	1 14.3%	0	7

Category	Yes	No	Both	Total
Communication				
Do you feel there is adequate communication involving:				
Problems with other employees on a crew?	5 71.4%	2 28.6%	0	7
Hazards associated with their everyday job duties?	7 100.0%	0	0	7
Equipment that is not functioning properly?	6 85.7%	1 14.3%	0	7
Does management supply a positive response to complaints?	3 42.9%	0	4 57.1%	7
Are you in favor of a crew brief/walk-around to identify the hazards associated with each jobsite?	7 100.0%	0	0	7
Do you frequently have problems with other crewmembers?	2 28.6%	5 71.4%	0	7

Groundman Perception Questionnaire

Category	Yes	No	Both	Total
Training				
Have you received any safety training since you were hired?	9 100.0%	0	0	9
Do you feel the training is educational?	9 100.0%	0	0	9
Is the time spent on the training productive?	5 55.6%	1 11.1%	3 33.3%	9
Do you feel your safety training targets hazards in the field or injuries you may have had in the past?	7 77.8%	2 22.2%	0	9
Do you have any special certifications pertaining to safety training?	0	9 100.0%	0	9
Do you feel your safety training makes you more aware of industry hazards?	8 88.9%	0	1 11.1%	9
Personal Protective Equipment				
Is your personal protective equipment accessible?	9 100.0%	0	0	9
Is your personal protective equipment adequate?	9 100.0%	0	0	9
Is your personal protective equipment comfortable?	7 77.8%	0	2 22.2%	9
Do you feel your footwear is adequate for your job duties?	7 77.8%	2 22.2%	0	9
Does your footwear aid in injury prevention?	6 66.7%	3 33.3%	0	9

Category	Yes	No	Both	Total
Impression of Management				
Do you ever feel pressured by management or your direct boss to complete work at an unsafe rate?	1 11.1%	4 44.4%	4 44.4%	9
Have you ever been pressured to use equipment you feel is unsafe?	1 11.1%	8 88.9%	0	9
Do you feel management cares about your safety?	7 77.8%	2 22.2%	0	9
Medical				
Have you perceived any significant hearing loss in the duration of your employment?	0 0.0%	9 100.0%	0	9
Have you ever been injured on the job?	4 44.4%	5 55.6%	0	9
Are you content with your medical care following an injury?	3 33.3%	0	1 11.1%	4
Safety Program				
Are you a significant contributor to the current safety program?	0	9 100.0%	0	9
Do you think the current safety incentive program is beneficial for overall company safety morale?	6 66.7%	3 33.3%	0	9
Does the incentive program change your behavior in the field?	3 33.3%	6 66.7%	0	9
Do you feel daily safety inspections are beneficial and help keep you more aware of hazards?	9 100.0%	0	0	9

Category	Yes	No	Both	Total
Communication				
Do you feel there is adequate communication involving:				
Problems with other employees on a crew?	8 88.9%	1 11.1%	0	9
Hazards associated with their everyday job duties?	9 100.0%	0	0	9
Equipment that is not functioning properly?	9 100.0%	0	0	9
Does management supply a positive response to complaints?	6 66.7%	0	3 33.3%	9
Are you in favor of a crew brief/walk-around to identify the hazards associated with each jobsite?	9 100.0%	0	0	9
Do you frequently have problems with other crewmembers?	2 22.2%	7 77.8%	0	9