

# AN OVERVIEW OF THE THEORY OF ERGONOMICS



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## **An Overview of the Theory of Ergonomics**

Ergonomics means the laws of work. It is the study of work habits and the effect on the body of the person doing the work. The study of ergonomics began in World War II, when various governments began studying the safety and productivity of its workers. It was discovered that properly lighting the avionics package in fighter planes gave the pilot better control in his job. The subject has evolved into the science of workplace design to include the safety and productivity of workers. However, ergonomics does not only involve the physical but the cognitive as well. For example, traffic signs are ergonomically designed to be recognized by their shape and color. All are placed at eye level so they are instantly recognizable.

## **The Body at Work**

The core muscle group of the upper and lower abdomen protect the vital organs and systems of the body. From them branch off the other muscle groups of the arms, shoulders, buttocks and legs. The factory worker might use the core muscle group to stretch to work on a piece of equipment on an assembly line, but he also uses the leg and buttock muscles to stand. A secretary might only use arms and wrists to type on a computer, but she will also use the core muscles to turn to answer the phone. In either case, standing or sitting in one position eight hours per day will strain the muscles.

A musculoskeletal injury, or MSI, occurs when a worker strains, sprains or otherwise injures muscles, soft tissue around tendons, or ligaments and joints. Causes of these injuries can include:

- Maintaining a posture for a prolonged time
- Intense and repetitive motions for a prolonged time
- Working in an unnatural pose
- Not taking sufficient time for the muscles to relax
- Force

Recognizing the signs and symptoms of MSIs is imperative for early treatment and, if necessary, rehabilitation. Workers who are educated regarding these signs and symptoms may not have recourse to worker's compensation. Signs and symptoms may not be readily apparent. They may appear at a time long after the injury was sustained. Such signs and symptoms may include:

- Redness
- Tenderness
- Numbness
- A sensation of coldness
- Swelling
- Weakness
- Loss of range of motion

Pain is the first sign an injury has occurred. Muscles, ligaments and joints sustaining damage from work injuries may feel burning or stabbing pain. Swelling occurs when the body packs water around the injured feature to protect it from further damage until it can be treated. If the worker continues working with this damage untreated, the injury will become worse. This could cause the worker to seek workman's compensation help.

Just as important to the body at work is the environment in which it works. The job itself

might be forceful, intense and repetitious. The worker might stand or sit for long periods of time. The height at which the worker is seated or stands as well as the height for which he must reach an item could affect MSIs. The site at which the worker performs could be ill-lit or suffer extremes in temperature. Working on a concrete floor without a pad to stand on could affect MSIs.

The muscles, tendons and ligaments are injured when a body at work does a job with some force. If the job is repetitive and forceful, or if the job is of some duration in addition to the other facets, the musculature suffers. Joints and musculature suffer when a worker performs a job in which the body must work around the shape and size of an object, tilt the head and shoulders to work with something above shoulder-level, stoop or squat to work with something at floor-level, or turning the body while using a tool or machine. Muscles also suffer from extreme heat or cold, causing the worker to overcompensate for the lack by working harder. Poorly lit venues may cause a worker to misjudge distances, sizes or shapes when lifting or moving an item. The effect of all this on the muscles, tendons and ligaments is pain.

Methods of preventing MSIs in the workplace are the responsibility not only of management but of employees as well. An employee performing a highly physical task has the option of learning how to position the body to prevent injury. An employee performing a repetitive task of some duration should be able to stop work for a space of time in order for the muscles to relax before resumption of work. Those working in cold venues, such as warehouses, should be issued well-fitting

gloves so their circulation does not suffer. Some who work in poorly lit areas should report the lack of light so performance of their job does not cause muscle damage. Employees should have a well thought out method of reporting such facts in addition to expecting them to be acted upon promptly.

The onus of these preventive methods falls most heavily on management, who must institute policy regarding safety and health. Recognition of the dangers to employees, establishing rest periods in repetitive or forceful jobs, monitoring the progress of both and educating employees will go far toward the elimination of MSIs. A checklist would be of use to management analyzing the hazards of the job and the health of the employee. Such a checklist would include:

### **1. Force**

When the worker grips an object, is the wrist bent?

Is the temperature cold?

Does the worker wear ill-fitting gloves?

Is there vibration in the object or the environment?

### **2. Lifting and Carrying**

Is the object heavy or oddly shaped?

Is the distance to destination long?

Does the object require an odd posture?

### **3. Pushing and Pulling**

Is this a frequent job?

Are the handles above shoulder or below waist?

Is the distance to destination long?

Is the surface slippery or sloping?

Is the equipment well-maintained?

Is the load heavy or awkward?

#### 4. Time and Repetition

Does the employee stand or sit for a long time?  
Does the employee use force for a long time?

#### 5. Posture

Does the worker stand on a concrete floor with poor posture and without a foot rest?  
Does the worker sit for long periods with no back rest and with poor posture?  
Is the torso of the employee twisted, reaching or bending?  
Do the shoulders reach above the head or behind the body?  
Is the neck twisted or held in an odd position for a long time?

#### 6. Environment

Is the lighting too bright or too dark?  
Is adequate padding placed upon concrete floors?  
Are adequate break times scheduled for highly physical jobs?

### Ergonomics at Work

Worker's compensation costs are rising. Legislation is on the books regarding ergonomic practices in such industries as meatpacking, poultry processing plants, nursing homes and retail stores. Employers in other industries are expected by the Occupational Safety and Health Administration, or OSHA, to comply with existing ergonomics programs. In a 1993 Ergonomics Program Management Guidelines For Meatpacking Plants proposal OSHA laid out **guidelines** for the establishment of an ergonomics program. In these guidelines management, employees and health care practitioners were the ergonomics engineers. The subject of the guidelines was

the recognition, documentation and elimination of cumulative trauma disorders, or CTDs, caused by improper work habits and ill-designed workstations. The thesis of the guidelines was that the ergonomics program should be designed so the job fits the employee and not to force the employee to fit the job. The workstation should be designed so that range of motion is facilitated and exertion and awkward postures are eliminated.

When the word ergonomics is mentioned, a picture in the mind appears of a secretary seated in an ergonomically correct chair at a computer table of the correct height. Her arms are extended within the proper ratio of body to keyboard and her legs are bent at the knee commensurate with their relation to the hips. Her back is straight and her head slightly tilted. But what about other industries? How shall the automobile mechanic or the pizza maker work in an ergonomically correct manner?

The auto mechanic is the perfect example of ergonomics at work. If a car is on the lift, the mechanic is working on a component of the auto with his arms extended upward. His shoulders and arms are twisting while using a tool to work on the car. If the car is on the floor of the garage, the mechanic's body is extended over the motor. His arms and shoulders are engaged in loosening or tightening a component of the car.

When the muscles are hyper-extended, they tear. If the component of the car were tightly attached, the mechanic would exert force to loosen the part. Working on a car until it is repaired properly requires time. This means the mechanic is working at length during

intense or forceful movements. Since the car cannot be placed at an ergonomically safe level for the mechanic to reach, other measures to prevent injury are necessary. For example, if the owner of the garage were to give the mechanics a break in which to do stretches or other exercises to keep the musculature loose and relaxed, the auto mechanic would not have recourse to worker's compensation claims. Ergonomics in this case would prevent injury.

Those persons in bakeries or pizza making shops have the same problem. The counters they work on are generally at an ergonomically correct height. The cook's movements, however, invite injury. Consider the baker who pounds bread dough down as she is kneading it before allowing it to rise. These movements heavily involve the shoulders and arms. Even if the work table is at the proper height, the movements required to make the bread are intense, forceful and of some duration. This alone makes the baker susceptible to injury.

The pizza maker also uses the arms and shoulders to round out the pizza crust. While the pizza maker is standing for long periods of time, this impacts not only the arms and shoulders but the small of the back as well. Considering the sheer volume of the pizza maker's business, the cook is susceptible to injury. The boxes of sauce and other pizza ingredients, such as cheese, are heavy. These are required to be on supports six inches off the floor. If the pizza maker lifts these boxes the wrong way, a back injury is in the cards. How can the cook become ergonomically correct? Perhaps placing heavy boxes of ingredients at waist level would help. If the pizza shop owner gave the maker a rest while another did the work, worker's compensation

claims would not be so high.

In most restaurant work, the cooks and prep people in addition to the wait staff are moving at lightning speeds to get the food out hot and on time. There is little room for injury. Their ingredients are not heavy. The ingredients generally repose in refrigerated units at waist level. Only in specialty shops such as bakeries and pizza do the workers need ergonomic aid.

Home garden centers are another field in which workers lift and carry during long hours of a shift. Soil and mulch come in fifty pound bags and must be stacked from the pallet onto the floor of the garden center. They must then be carried to the customer's car after a sale. There are garden tools such as lawnmowers and blowers that need to be stacked on shelves or on the sales floor. Heavy deck furniture, paving stones for garden walkways and gravel for flower-garden borders need to be unpacked and placed on the sales floor. These heavy things will impact the workers unpacking and carrying them. Since these items cannot be placed on shelving at ergonomically safe levels, workers must be taught how to lift properly. Flatbeds or hand-trucks can be used to safely transport the items to the customer's car. Giving workers rest breaks will go far toward letting tired muscles regain their former health.

### **Ergonomics and Worker's Compensation**

American employers pay an insurance premium for workers compensation. If the employer is self-insured, the employer pays expenses directly for any employee injured on the job. Many companies view this as simply the cost of doing business. Those employers



who recognize ergonomics as a solution to the problem and have implemented it have seen a sharp decline in workers compensation claims. A January 2012 OSHA white paper [details](#) how compliance with existing injury prevention laws or implementing their own improves bottom line as well as reducing workers compensation claims.

In the forty years since OSHA's birth, workplace illness, injuries and deaths have been down by 60%. However, each year 4 million preventable injuries occur. The National Academy of Social Insurance reports that the total costs paid by employers for workers compensation increased from \$60 billion in 2000 to \$74 billion in 2009. This is in addition to the costs paid to injured employees such as wages due to time lost from workplace injury, the cost of hiring and training replacement employees, down time from employee loss and replacement employee learning the job and lost sales due to lost productivity when the employee was injured.

OSHA's studies have found that employers who presently have no ergonomic program in place would cut workplace injuries by 15% to 35%. This represents a total corporate savings in workers compensation costs of \$9 billion dollars per year at the 15% category and \$23 billion per year at the 35% category. Companies in states compliant with injury prevention laws saw a decrease in workplace injuries by 9% to over 60%. This is compelling evidence that injury prevention programs work.

Oregon OSHA, or OROSHA, brings up a good point. Suppose management thinks ergonomics [costs](#) too much. OSHA

demonstrates a few cost-efficient ergonomic steps that will save much time lost from work and workers compensation claims:

- In the office, place the document stand close to the computer monitor so only the eyes move instead of the whole head
- Wrap tape around pens so the fingers and wrists don't ache from intense pressure
- Adjust office chairs before workers begin their day and after lunch. The body changes during the day, so office furniture should fit the new changes
- If the chair doesn't adjust, use a pillow for lumbar support
- Use a headset to answer phones instead of holding the phone between shoulder and neck. This is an invitation to a neck injury.

Ergonomic techniques costing little to implement would save money from workers compensation claims and lost time at work:

- Train each employee in every job so no one employee sustains injury doing one job
- Switch up on one job to avoid stress or injury. For example, type for two hours, then run errands
- Have each employee list the MSI risks of each job along with possible solutions
- Analyze and evaluate the risks and solutions for management to establish an ergonomics program.

OROSHA made another good point in their paper. What if the employees don't care for ergonomics programs one way or another? Employees who recognize management's care of them tend to be more productive. They know management recognizes their worth to the company and will protect them from harm.

Moreover, employees who voice opinions and ideas to management and see them taken seriously will show a loyalty to the company that can't be bought. Employee relations among themselves will improve because everyone is working together for the good of all. Communications will improve, which will indicate growing morale among employees. There will be less time lost from work and lower injury levels added to higher productivity.

Small businesses struggling to survive will face the most difficult times implementing ergonomics programs. The mechanic working at a small automotive garage or the pastry chef at a bakery will be glad to know that their companies can receive grants from state and federal levels with which to implement injury prevention programs or to comply with laws already in place in their state.

The grant information will detail the requirements for business owners, in addition to time limits in which to purchase ergonomic equipment or implement ergonomics programs. The grant literature will explain what matching funds, if any, the state or federal insurance agency will contribute to the grant award. OSHA has also awarded grants to organizations who develop and teach training in ergonomics. Small business owners will contact their state or federal OSHA reps for further information. Business owners have resources in the private sector for funding for ergonomics programs. Insurance companies funding workers compensation as well as non-profit insurance entities will have information on funding ergonomics programs. Business owners will contact their state insurance board for further information.

## Conclusion

Ergonomics is the science of fitting the job to the human instead of forcing the human to fit the job. This science takes into account the human body, what it is safely designed to do and how to safely continue its performance. The musculature is designed to stretch to facilitate the person's movements when performing a job. If the musculature does not have sufficient time to relax or be toned for further energy expenditure, musculoskeletal injuries occur. This costs employers time lost from work, workers compensation claims in addition to money spent training new workers to perform a job until the original worker can return to work.

Workers compensation cases cost billions of dollars to corporations plus pain and financial loss to employees. This can be avoided by implementing ergonomics programs in the workplace. These programs include teaching employees how to work safely and economically. They include proper workstation equipment and tools. These programs involve employees and management for the furtherance of employee safety and health. Working together, employees and management gain more than simply safety and health. They gain mutual trust and understanding, which will increase loyalty and productivity.

Ergonomics programs don't have to cost the sky. Insurance agencies and OSHA will provide funding for the establishment of ergonomics programs and the purchase of ergonomic equipment. Small and large businesses will profit from these programs.



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