



Seminar Report

On

“Ergonomics”

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1. Title

ERGONOMICS AS A CONCEPT

The term ergonomics was coined from the Greek words *ergon* (meaning "work") and *nomos* (meaning "rules"). So the literal meaning is "the rules of work," Ergonomics is the science of fitting the work-place conditions and job demands to the capabilities of the working population. The goal of ergonomics is to make the work place more comfortable and to improve both health and productivity. To meet these goals, the capabilities and limitations of workers and their tools, equipment and furniture are considered in conjunction with how they relate to particular tasks. Most people have heard of ergonomics and think it is something to do with seating or with the design of car controls and instruments. It is...but it is much more! Ergonomics is the application of scientific information concerning humans to the design of objects, systems and environment for human use. Ergonomics comes into everything which involves people. Work systems, sports and leisure, health and safety should all embody into ergonomics principles if well designed.

DEFINITION

According to International Labour Organization, ergonomics is the application of the human biological sciences in conjunction with engineering sciences to the worker and his working environment, so as to obtain maximum satisfaction for the worker and at the same time enhance productivity.

HISTORY

The foundations of the science of ergonomics appear to have been laid within the context of the culture of Ancient Greece. A good deal of evidence indicates that Greek civilization in the 5th century BC used ergonomic principles in the design of their tools, jobs, and workplaces. One outstanding example of this can be found in the description Hippocrates gave of how a surgeon's workplace should be designed and how the tools he uses should be arranged. The archaeological record also shows that the early Egyptian dynasties made tools and household equipment that illustrated ergonomic principles.

In the 19th century, Frank and Lillian Gilbert expanded Taylor's methods of "SCIENTIFIC MANAGEMENT" in the early 1900s to develop "Time and Motion Studies". They aimed to improve efficiency by eliminating unnecessary steps and actions. By applying this approach, the Gilbert's reduced the number of motions in bricklaying

from 18 to 4.5, allowing bricklayers to increase their productivity from 120 to 350 bricks per hour.

In the decades since the war, ergonomics has continued to flourish and diversify. The Space Age created new human factors issues such as weightlessness and extreme G-forces. How far could environments in space be tolerated, and what effects would they have on the mind and body? The dawn of the Information Age has resulted in the new ergonomics field of human-computer interaction (HCI). Likewise, the growing demand for and competition among consumer goods and electronics has resulted in more companies including human factors in product design.

2. Applications

USING ERGONOMICS

How do we use ergonomics? Ergonomics incorporates elements from many subjects including anatomy, physiology, psychology and design. Ergonomists apply their diverse knowledge to ensure that products and environments are comfortable, safe and efficient for people to use.

Ergonomics can be used in every possible sphere of our lives. But I have tried to focus on some of the important aspects, where ergonomics should not be ignored.

For that purpose I have divided the usability of ergonomics into the following sections:

➤ *Ergonomics at home*

Why is it important?

The opportunity we have in our home that we do not always have in our work area is the ability to create a user-friendly environment. As each room in the house serves a specific function we need to come up with ideas on how we can set up the room to best suit our needs so there is more efficiency and less stress in the activities of the house.

The Living Room

This is the room in which we usually do most of our relaxing in the form of reading, socializing or watching TV. These activities require ergonomically designed couches, recliners and chairs. Watching television is best done from an easy chair or recliner. Directional light should be used while reading that will only illuminate a specific target area.

The Kitchen

The kitchen is where we store, cook and prepare food. It is most practical to use a refrigerator that has a freezer on the bottom with the most commonly used foods on the top or shelf that has the easiest access. Most people have refrigerators that are set up in such a way that they are forced to bend over at the waist to access the much frequently used foods. The most commonly used utensils should be within easy reach. Special kitchen tool designs make chores easier as in opening jars. Professional cooks like professional wood workers know the importance of using only sharp knives. When used skillfully, it is more dangerous to use a dull knife than a sharp one. Using a utensil that is not suited for the task (improvising) is a sure invitation to an accident.

The Bathroom

This is where most accidents in the house occur, usually from slipping. Bath and floor mats that provide good traction are essential for the purpose of preventing slips and falls. Hand bars are also crucial to prevent falls. Common flaws in bathroom design are low bathroom sinks and showerheads. These will tend precipitate low back and neck injuries respectively. All faucets in the house should be fitted with a user-friendly variety in which low force is necessary to turn the water on and off. Turning knobs that are poorly designed can put unnatural stress on the wrists thereby causing injury to wrist tendons.

➤ *Ergonomics and the Computer User*

Why is it Important?

The personal computer is rapidly becoming a common household item and is now a necessary tool for all small businesses. There is a growing segment of the population that uses the computer exclusively for its vocation and it is in this group that we have begun to see the physical effects of spending long hours day after day at the computer. With improvements in technology the computer users are positioned to perform more and more functions without leaving their workstation.

Here are some of the ergonomic ways to ensure that the using of the computer doesn't prove fatal to your health.

Machine Set-up

Visibility: You must be able to see what you are doing easily to avoid eye strain and neck pain. Have adequate amounts of light. Florescent lights are not very good, natural (sun) light is best. Reduce glare as much as possible, not only on your screen but also on the rest of your work areas including the keyboard. Hoods, drapes, glare screens and changing the lights can do wonders. Rearrange things until you can see well and it feels comfortable for you.

Chairs: As with visibility factors, experiment with chair height and/or tilt. Try different chairs. Keep trying until you get it the way **your** body likes.

Keyboards: Be sure to get the height right to prevent too much bend at the wrist and allow the forearm to have some support. The arms should hang loose to prevent the

shoulder muscles from cramping. Many keyboards can tilt; unfortunately, most of them tilt the wrong way.

Mouse: The continual clicking and small, precise motions involved in mouse use are a repetitive action that can be a health hazard. A few basic rules can help make handling this convenient input device safer and more comfortable:

- 1.) Hold the mouse loosely. "White knuckling" the mouse creates too much tension. Use a light touch when you click.
- 2.) Use your whole arm and shoulder to move the mouse, not just your wrist. Don't rest your forearm on the desk while you move the mouse.
- 4.) Keep your wrist relaxed and neutral, not bent. The click button should be about the same height as your keyboard.

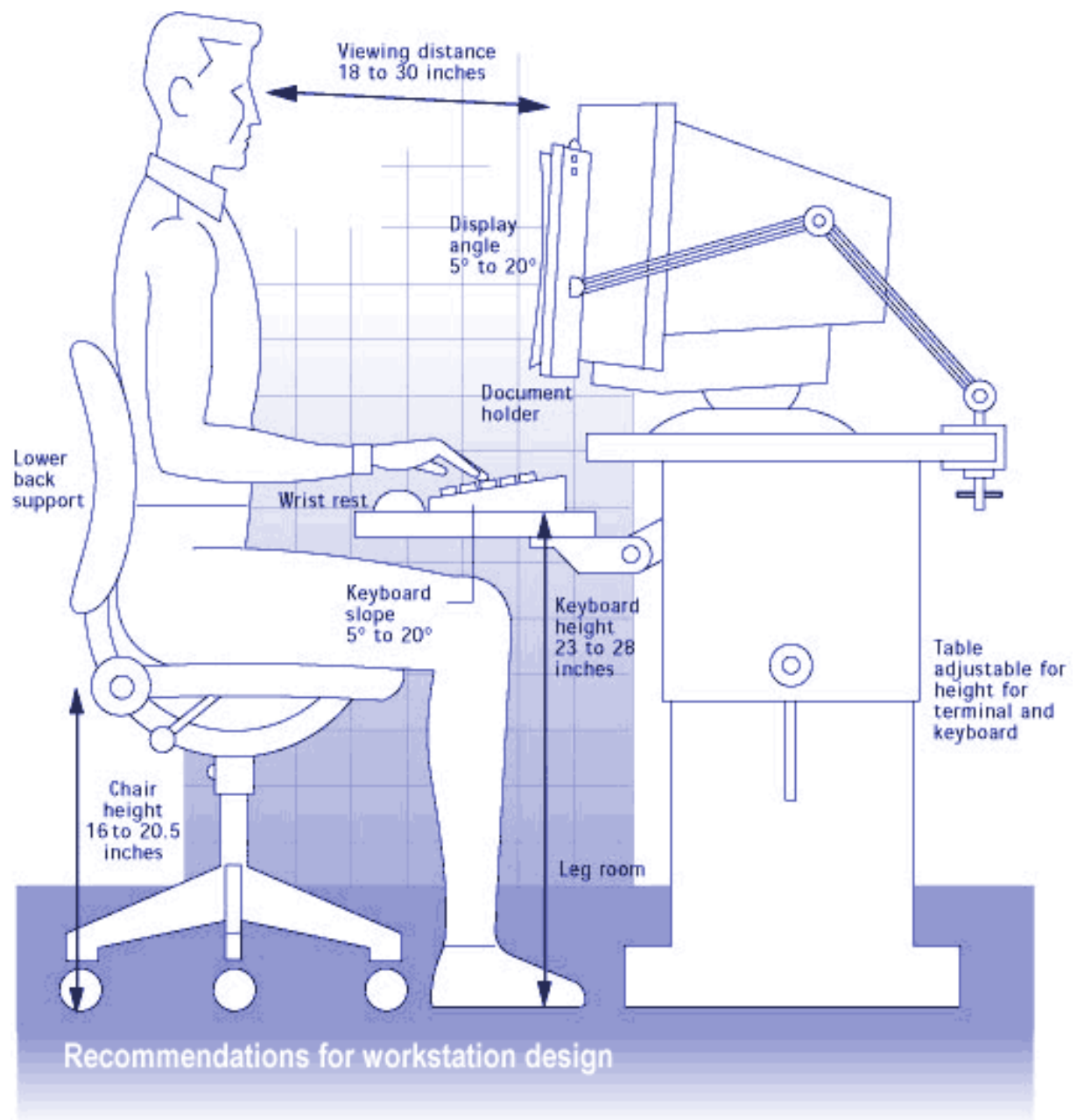
Desks: Make enough space so that you have room to work, especially if you're pushing your mouse around. Use a paper holder to keep letters or books semi-vertical and at eye level. Your work space should be set up so that you need not twist your neck.

HUMAN SET-UP

Posture: No one posture is perfect. You do not have to be "military" but getting comfortable is essential. The most important rule is to avoid prolonged positions. Shake your hands and shoulders now and then. Keep loose.

Eyes: After good lighting and avoiding glare, the most important eye consideration is to look away from the screen occasionally. It really helps. Also, don't forget to blink. Blinking moistens the eyes to prevent burning from dryness.

Warm up: Just as an athlete prepares for the game by stretching and loosening the joints and muscles to prevent injury and enhance performance, you too should prepare for a marathon session surfing the Net. Prevention is better than repair.



➤ *Ergonomics and driving*

Why is it important?

As our reliance on the automobile increases due to long distance job commutes driving has become a significant part of our daily routine. By spending more and more time in cars our driving can now be considered a major source of physical and psychological stress in day-to-day living.

Stressors of Driving

The challenge of the manufacturer is to strike a balance between safety and comfort. With the prime ergonomic elements being posture, force and repetition it is posture that is most important to the driver. Any deficiencies in postural design of the car seat contribute to tension and fatigue on the part of the driver and subsequently detract from performance. There are portable support systems/commuter supports designed to be added to the existing car seating. These compensate for ineffective car seat design.

Neck and Shoulder Pain

With long distance driving aches and pains in the legs, low back, mid, upper back and neck are experienced. With our hands on the steering wheel and the forward posture of the shoulders there is added stress on the shoulders and upper back.

To prevent rounding of the shoulders the driver must have easy access to the steering wheel without having to fully extend the arms and at the same time comfortably reach the foot pedals without having to stretch the legs. Compact vehicles are notorious for poorly accommodating tall individuals. If the ceiling is too low for an erect seated position the driver is forced to crunch down in the seat with a forward head posture. Short drivers must be able to slide the seat forward to the extent that they do not have to lean forward and place the head in a forward position.

Low Back Pain

Several studies have shown a relationship between driving and low back pain. Risks of both low back and neck pain tend to increase as daily driving time increases

For people with a history of low back problems it is recommended that they choose a vehicle with a higher curb height so they are not traumatized when getting in and out of the car. The driver should enter the car first by sitting down and then swinging the legs under the wheel. Features that are included in most modern vehicles include automatic

transmissions and power steering. These features lessen any twisting of the spine and strain to the low back.

➤ *Ergonomics and the office*

Why is it important?

By incorporating ergonomic principles into the functional design of a contemporary office, the workers become more productive and efficient. Each worker's tasks center around a workstation and the configuration of the workstation depends on the performance duties of each worker.

Workstation

The goal for each worker should be to maximize productivity and efficiency with minimal stress and injury. In a modern day office the centre of the worker's activity revolves around a computer, desk and chair. The application of ergonomics is most important to the activities that make up the bulk of the workers time.

To prevent the worker from wasting energy by moving in and out of a chair, space must be used efficiently. The working area can be divided into zones. Zone 1 is the area containing materials most frequently accessed and therefore within a 12-inch reach. Those materials less frequently used are in zone 2 or within a 20-inch reach. Those materials that are seldom used are in Zone 3 or greater than 20 inches away from the worker. The idea is to use shelving and cubicles that are compactly designed to organized things into respective zones. Sometimes it is necessary to organize shelving into portable units such as carts with casters. For ease of operation these casters should have low rolling resistance and a centralized locking system. Unnecessary motions interrupt a smooth workflow and expend wasted energy. They also cause cumulative trauma to the back, neck and shoulders. Stretches and exercises can be performed at the workstation without disrupting the work routine.

By taking a proactive role in initiating ergonomic programs the business bottom line is enhanced through worker productivity and decreased healthcare costs.

Ergonomics and factory/assembly work

Factory and assembly line type work is a carryover from the industrial revolution and has evolved over the years as a result of our increasing knowledge of ergonomics. The requirements of the work are extremely varied and the resulting consequences on human health can range from repetitive or cumulative trauma disorders to death. For this reason

it is essential for companies to establish ergonomic programs for ensuring the safety, efficiency, and productivity of various jobs.

It is a natural goal of these companies to minimize job related health costs and personnel turnover and to maximize productivity by workers. To this end it is important for companies to develop an overall ergonomic strategy as an integral part of their business strategy. Specifically these companies must come to understand how human performance issues contribute to production bottlenecks, problems in quality control, injury and turnover rates and how they can find solutions through production layout and tool design.

Work Surfaces

A worker is certain to get neck, upper back and shoulder pain if neck flexion exceeds 20 degrees for prolonged periods of time. The optimal viewing range is between horizontal and 45 degrees. Work surfaces should be round and padded where elbows, forearms and wrists can be rested. Certain work stations aids include ladders, stools and carts with casters ergonomically designed with low rolling resistance which have shock absorbing and noise free characteristics. They should have central locking systems and be equipped with proper push/pull assists.

➤ *Ergonomics and Automotive Mechanics*

Why is it Important?

The work of auto mechanics is particularly awkward and demanding and frequently results in abuse to the wrists, elbows, and spine in general. The worker's body is forced to conform to the various engine configurations and auto design. Automobiles have evolved over the last few years toward smaller and more compact machines and as a result the mechanics tools have had to undergo a refinement in ergonomic design to function in very confined space.

Working under the Hood

In applying ergonomics to work us normally think of "fitting the task to the human" but unfortunately in mechanic work we tend to "fit the human to the task." The result is cumulative trauma from long hours of awkward static postures. The mechanic is forced to lean forward while working under the hood of the vehicle and this leads to low back strain.

One way to work on engine parts under the hood that are particularly difficult to reach is by utilizing a special overhead creeper which consists of a padded chest board that is supported on top of a ladder-like apparatus.

The Mechanic Workstation

The mechanic's job is facilitated by setting up the workstation in a way that tools can be accessed quickly and without an unnecessary expenditure of energy. To minimize the low back strain that results from manual lifting and carrying heavy engine parts and tools, sturdy utility carts with casters should be used as a means of transport. The casters should have low rolling resistance with shock dampening and noise free characteristics. Tool carts with trays should be organized into a system which arranges the most frequently used tools within easy reach. The tools should be easily modified and portable depending on the nature of the job at hand.

3. Affects of Poor Ergonomics

Risk Factors that Cause Injuries

A risk factor is a working condition that increases the chance of developing a RSI. Each of the risk factors described here can cause problems. However, it is usually the case that workers are exposed to more than one risk factor at a time.

- ***Repetitive motion:*** This refers to performing the same motion or motion pattern every few seconds or on a continuous basis for hours at a time.
- ***Awkward posture:*** Whether standing or sitting, there is a neutral position for the back, neck, arms and hands. This is the position that puts the least amount of physical strain on the particular part of the body. Postures that differ from the neutral position increase stress on the body.
- ***Long periods of repetitive activity (duration):*** This is the amount of time workers perform a motion or movement pattern during the workday.
- ***Lack of recovery time:*** Recovery is rest or a break from a risk factor.
- ***Forceful movement:*** This is the effort or pressure workers need to perform various tasks. Forceful movements include lifting a heavy object, unscrewing a rusted bolt, or squeezing an object in your hand. Another type of force, known as **contact** stress, comes from pressure against part of the body. For example, resting the wrists against the sharp edge of a desk while working at a computer puts pressure on the wrists.
- ***Vibration:*** Exposure to vibration can affect particular parts of body, such as the hands, when using power tools. This is known as localized vibration. Workers who drive trucks or work with jackhammers are exposed to **whole body** vibration.
- ***Uncomfortable environmental conditions:*** An uncomfortable environment can be dangerous as well as unpleasant. High temperature and humidity can make workers drowsy and less alert. Excessive noise damages hearing. Glare and bright lighting while working with computers can cause headaches and vision problems.
- ***Stressful work organization:*** This refers to the way jobs are organized. These factors include staffing levels, scheduling workload and job pacing, electronic monitoring, performing monotonous tasks, and the amount of control workers have over how they perform their jobs. These are sometimes called psychosocial factors.

MUSCULOSKELETAL DISORDERS: Musculoskeletal Disorders (MSD) can range from general aches and pains to more serious Problems. Medical practitioners do recommend that all the users who use computers regularly should report signs and symptoms as early as possible to prevent serious injury or permanent damage.

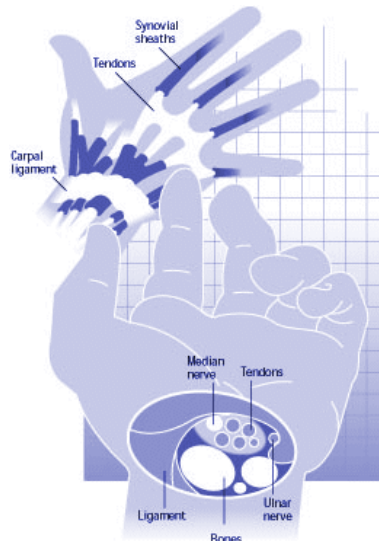
The different types of Musculoskeletal Disorders are as follows:

- Repetitive Stain Injury
- Carpal Tunnel Syndrome

CARPAL TUNNEL SYNDROME:

Carpal Tunnel Syndrome is a pinched nerve (called the Median nerve) in the wrist. *Carpal Tunnel Syndrome* (CTS) is the inflammatory disorder that is caused due to repetitive stress, physical injury or any other condition that causes the tissues around the median nerve to inflate. Carpal tunnel is a small canal or tunnel runs from the forearm through the wrist. Bones form three walls of the tunnel, which are bridged by strong, broad ligament. The median nerve passes through this tunnel, which actually supplies feeling to the thumb, index, and ring fingers, the nine tendons that flex the fingers and also provides function for the thinner muscles, which are actually the muscles at the base of the thumb.

When the protective lining of the tendons within the carpal tunnel inflamed and swell or when the ligament that forms the roof becomes thicker and broader leads to Carpal Tunnel Syndrome. This ultimately results in pain, numbness, and tingling sensation in the wrist, hand, and fingers leaving the little finger, as it not affected by the median nerve which is nothing but the Carpal Tunnel Syndrome.



Risk factors: The major causes of carpal tunnel syndrome are:

- Working with wrists that are bent;
- A high rate of repetition using the hands;
- A lack of rest for the hands and wrists; and
- Forceful hand motions.

REPETITIVE STRAIN INJURY:

Repetitive Strain Injury (RSI) is the general word that is used to describe the prolonged pain experienced in shoulders or hands or neck or arms. Repetitive Strain Injury occurs when the movable parts of the limbs are injured. Repetitive Strain Injury usually caused due to repetitive tasks, incorrect posture, stress and bad ergonomics. Repetitive Strain Injury generally causes numbness, tingling, weakness, stiffing, and swelling and even nerve damage. The chief complaint is the constant pain in the upper limbs, neck, shoulder and back. The Repetitive Stress Injury generally effects the group of workers who generally use excessive and repetitive motion of the neck and head are at high risk.

USE ERGONOMICS TO AVOID MUSCULOSKELETAL DISORDERS.

- ☐ Taking regular breaks from working at your computer - a few minutes at least once an hour
- ☐ Alternating work tasks like mixing computer tasks with non computer tasks alternately to avoid strain
- ☐ Using comfort equipment such as footrests, wrist/palm rests, and document holders if required
- ☐ Avoiding gripping your mouse too tightly – it is always recommended to hold the mouse lightly and click gently.
- Establish healthcare management to emphasize the importance of early detection and treatment of musculoskeletal system disorders for preventing impairment and disability.
- Identify effective controls for tasks that pose a risk of musculoskeletal system injury and evaluate these approaches once they have been instituted to see if they have reduced or eliminated the problem.
- Gather data to identify jobs or work conditions that are most problematic, using sources such as injury and illness logs, medical records, and job analyses.

The table below lists common ergonomic injuries of the hands, arms and shoulders.

Common Repetitive Strain Injuries

Repetitive Strain Injury	Symptoms	Risk Factors
Carpal Tunnel Syndrome	pain, numbness, tingling in the hands, weakness and clumsiness of the hands	repetition, working with wrists bent, and/or forceful hand movements
Ganglion Cysts (“Bible Bumps”)	swelling that forms a lump on the wrist	repetition and working with wrists bent
DeQuervain’s Disease	pain and inflammation at the base of the thumb	repetition of a “clothes-wringing” motion
Raynaud’s Syndrome “white finger”	loss of control and feeling in fingers and hands, numbness or tingling in the fingers	forceful gripping, vibration, cold and/or wet environment
Trigger Finger	pain and inflammation on the palm side of index finger	forceful gripping of hard/sharp edges, repetition
Tendinitis	pain and inflammation in any joint such as elbow, wrist, knee, etc.	repetition and awkward posture
Tennis Elbow (epicondylitis)	pain and inflammation in elbow	repetition, rotation of forearm, or force
Rotator Cuff/Tendinitis	pain and restricted motion in shoulder, may lead to arthritis	repetition, overhead work, or working with arms in a "winging motion"

4. Things To Do.

Factors Of Consideration:

To produce a workplace that will minimum amount of strain to the worker, ergonomics takes into account the following three factors

- Anthropometric data

Anthropometry is the study of measurement of physical features of human beings. It studies the strength of various muscles and ranges of body movement.

The data on human body dimensions are of two types

- Structural dimensions

These are body dimensions of a person in a static condition. There are two static positions, namely sitting and standing.

- Functional dimensions

These are the body dimensions of a person in motion. This is more important than the structural dimensions as most of the working conditions are dynamic in nature.

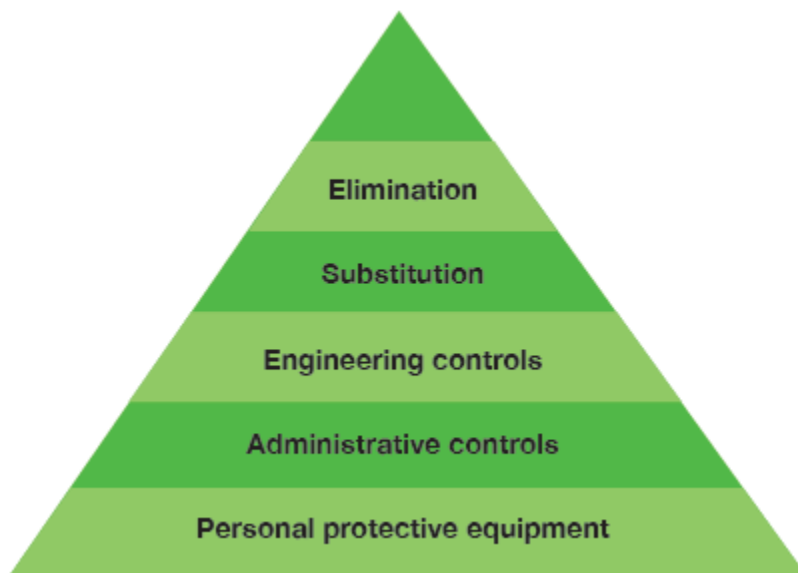
- Human activity analysis

Movements

Human strength and endurance

Speed and accuracy

Hierarchy of Controls:



- **Eliminate** – If there is a piece of equipment that represents a danger to employees or the facility, consider getting rid of it. If that particular item is not necessary, it should be removed completely. Of course, it is not always possible to completely eliminate a hazard.
- **Reduce** – The next best option is to substitute the accident prone equipment out with something less dangerous. If a fire hazard exists that can combust at 110 degrees Fahrenheit, for example, and it's possible to replace it with something that combusts at 250 degrees, the hazard can be dramatically reduced.
- **Engineering Controls** – Take the above example of a combustible material. It may be impossible to eliminate the use of that material or replace it with something less combustible. If that's the case, it may be possible to build a fire containment room around the area where this material is used. This way, if there is a fire, it is confined to one area and the rest of the facility will be safe.
- **Administrative Controls** – The next option is to use administrative controls. These are essentially rules and regulations put in place to minimize the risk. When working with combustible materials, an administrative control might be prohibiting smoking in the area. Another good administrative control is to ensure all welding is done at least 100 feet away from areas where the combustible material is in use. While the risk is still present, administrative controls help reduce the chances that a dangerous incident will occur.
- **Personal Protective Equipment** – Finally, requiring employees to use personal protective equipment (PPE). When a hazard exists and other options can't completely mitigate the danger, PPE can protect employees if/when a dangerous situation arises.

5. Conclusion

Ergonomics is the concept which comes into existence with the implementation of prevention, as we know prevention is better than repair so ergonomics play very important role in a workplace or is it home to design the environment. Ergonomics is the application of scientific information concerning humans to the design of objects, systems and environment for human use. Ergonomics as a result helps to obtain maximum satisfaction for the worker and at the same time enhance productivity.