

## Introduction to Industrial Fatigue

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### Abstract

Fatigue results in slower reactions, reduced ability to process information, memory lapses, absent-mindedness, decreased awareness, lack of attention, underestimation of risk, reduced coordination etc. Fatigue can lead to errors and accidents, ill-health and injury, and reduced productivity.

Fatigue dramatically increases the risk of accidents and injuries in the workplace, and reduces productivity and performance. Prolonged fatigue can cause serious physical and mental health problems.

Fatigue is a lack of energy and motivation. Drowsiness and apathy (a feeling of not caring about what happens) can be symptoms that go along with fatigue. Fatigue can be a normal and important response to physical activity, emotional stress, boredom, or lack of sleep.

Fatigue can also contribute to staff turnover, as employees may feel burnt out or overwhelmed by their workload. By managing fatigue and promoting a culture of safety and well-being, organizations can help retain their employees and reduce staff turnover.

In management, fatigue study refers to the long working hours with sufficient breaks which results in stress, which is also known as fatigue. This has an adverse effect on the health of the employees. Through study of fatigue, one can reduce the level of stress and maintain an optimum operational efficiency.

The main objective of fatigue study is to determine the amount and frequency of rest intervals in completing a task efficiently.

**Keywords:** Nature of Fatigue; Study of Fatigue; Signs of Fatigue; Study programs; Indirect Measures of Fatigue; Direct Measures of Fatigue.

### 1. Management Definition

Management is a procedure for managing available materials and resources (i.e. managing human and material resources) to achieve pre-determined objectives. Management is an essential element in all organized corporations. There are certain limits to the ability of industrial managers to increase production through technology and capital investment alone.

Managers believe that the productivity of the labor force can be increased without forcing it to work longer hours or making its members slaves to their machines. Industrial management deals with human aspects in addition to various other aspects of scientific management. The importance of practical management has increased due to the excessive growth of industrial and social activities.

Fatigue can be described as exhaustion of mental and physical strength resulting from bodily labor or mental exertion. The issue of industrial fatigue needs to be of immense concern to both employers and employees as well because of its alarming consequences when ignored. While occupational safety and health has improved in recent decades, especially across the developed world, fatigue remains a common problem even in the developed countries and if it is a common

problem in the developed countries, what will it be among the developing countries? Fatigue is an important phenomenon in industrial psychology because it creates many problems including stress, weakness, tiredness, exhaustion and of course decreases in productivity. Employees recognize fatigue as a feeling of tiredness or pain; regard it as intrinsically unpleasant and undesirable. Fatigue is considered an internal precondition for unsafe acts because it negatively affects the human operator internal state. It is not an overstatement to say that a great chunk of industrial mishaps is caused by fatigued workers who no longer function in their optimal and natural capacity. Several cases of accidents have taken place in workplaces because the worker was fatigued. Whether it is about plane crashes, train running off the rail, vehicular accidents, machines related mishaps or people falling from high heights; these are accidents that fatigue can induce. For this and many more other reasons, industrial fatigue needs investigation, be it from the physiological, psychological and nervous point of view. Depending on the strength, stamina and preparation of individual, fatigue is manifested at different rates in different individual. It may be difficult to completely eliminate fatigue, but efforts at minimizing its occurrence can be made [1] – [8].

## **2. Fatigue**

Workers' fatigue is a significant problem in modern industry, largely because of high demand jobs, long duty periods, disruption of circadian rhythms, and accumulative sleep debt that are common in many industries. Fatigue is the end result of integration of multiple factors such as time awake, time of day, and workload. Then, the full understanding of circadian biologic clock, dynamics of transient and cumulative sleep loss, and recovery is required for effective management of workplace fatigue. It can be more investigated in a new field of sleep medicine called occupational sleep medicine. Occupational sleep medicine is concerned with maintaining best productivity and safety in the industrial settings. The fatigue risk management system (FRMS) is a comprehensive approach that is based on applying scientific evidence of sleep knowledge to manage workers' fatigue. It is developing rapidly in the highly safety demand jobs; especially truck drivers, pilots, and power plant workers.

Fatigue is one of the important dilemmas for engineers in industry. Fatigue can be defined as a negative appetite for a particular activity. Industrial fatigue affects workers' muscles, nerves and minds. In Nervous Fatigue, the nerve threads end at the muscles and the plate stops transmitting nerve impulses to the muscles, where muscle activity begins. Also, the beginning of nerve impulses in the brain ceases to be questionable if the organs continue to work for a long time. This cessation of sending impulses from the brain saves the organs and their muscles from destruction. Thus, fatigue is defined as a reduction in activity due to previous occupation.

There are several scholars who have different definitions of the term fatigue, which can be listed as follows:

It could be a decreased ability to perform a job or a lack of efficiency in completing a specific job.

A decrease in the desire to perform work or willingness to work (i.e. a feeling of weakness).

A state of mind arising from prolonged mental activity.

Failure to prepare for physical or organic equilibrium.

It is not an entity, but rather an appropriate word to describe various phenomena [1] – [8].

### **2.1 Nature of Fatigue**

The individual's behavior, that is, the individual's ability to deal with the problem, is an important factor in the ability to work, but this cannot be measured physically. The study of fatigue should not be limited only to physical muscular activity, but also to non-specific environmental factors that affect a person's outlook and approach to work. It has become clear that emotional stability and mental health cannot be linked to fatigue. To a certain extent, fatigue involves the sensory and non-sensory organs as a whole, that is, it is a physical and psychological dilemma. Action that results in physical changes in muscle, nerve tissue, and blood is of interest to both the biochemist and the physician.

## 2.2 Studies of Fatigue

Angelo Masso, an Italian scientist, was the first to develop a device known as the ergo graph, which made it possible to investigate the relationship between fatigue and work in a relatively isolated part of the body. He was able to induce fatigue in a muscle group and was able to study the phenomenon without further complicating it with any psychological effects such as monotony and boredom that usually accompany longer periods of work.

The principle of the ergo graph is simple, in which all fingers are fixed except for the middle finger, and then a string is tied to the free finger, which prepares it for work. Place a load on the other end of the string, so that the free finger begins to drag against the load. In Masso's experiment, the rope is placed on a hoop (i.e. a pulley or a drum) or the finger is pulled against a known spring tension. Work is done on the finger by contracting and relaxing the muscles, which in turn raise and lower the weight.

In order to obtain the outline of the workpiece output, a recording device for the moving thread is installed. At each contraction, there is a needle on a circuit that records the number of successive contractions with a series of straight lines.

The use of the ergo graph principle has established a number of important relationships, each of which has a specific application in industry and is discussed as follows:

- i. If the contractions with a given load are distributed as one every two seconds, there will be a gradual decrease in the amplitude of the contractions until it is completely impossible to perform additional contractions.
- ii. If contractions with a given load are distributed every 10 seconds, there will be no obvious occurrence of fatigue.
- iii. If the load is lifted at a rapid pace, it produces greater fatigue than the same load that is lifted at a slower pace.
- iv. The time the person takes to fully restore ability increases as the work period increases.
- v. The activity of other groups of muscles reduces the ability of the finger to perform work.
- vi. The ability of muscles to perform work decreases due to loss of sleep, excessive mental activity, hunger and muscle failure.
- vii. The ability of the muscles to perform work increases by injecting sugar into the bloodstream, resulting in good health and a healthy body.
- viii. The rate of fatigue varies greatly from one person to another, depending on the physical and mental capabilities of each person.

Figure 1 below shows a device that uses the Ergo graph principle.

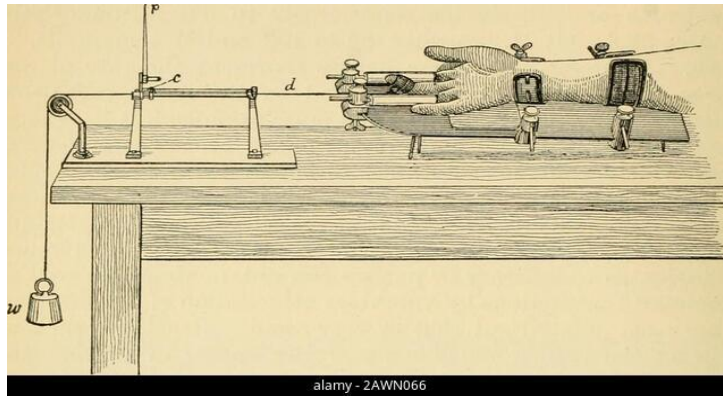


Figure 1 a Device that Uses the Ergo Graph Principle

## 2.3 Signs of Fatigue

It is wrong to express mental fatigue as a phenomenon associated with monotony and boredom.

Monotony is a mental condition that arises from a person performing a repetitive task for long periods of time.

Boredom is lack of desire and is generally described as depression and the desire to change activity. Boredom is affected by personality, a person's style of solving problems, as well as his desires and inclinations.

Boredom and monotony can be distinguished from fatigue because they are a desire for a change in activity, while fatigue is a break from work completely.

Prolonged mental work results in an inability to evaluate or understand what is read. Common symptoms of prolonged mental work are increased errors and an increase in the time necessary to digest written material. This phenomenon is known as brain lock and is avoided by distributing the work over a reasonable period of time and avoiding focusing it over a short period of time.

## 2.4 Indirect Measures of Fatigue

### Environmental Conditions Affecting Fatigue:

Environmental conditions affecting fatigue, such as noise, poor lighting, excessive heat, cold, and dust, all indicate an increase in fatigue.

Improvement in these conditions contributes to reducing fatigue, which results in high morale of the workforce and thus high production rates, lower accident rates and less absenteeism.

Therefore, the indirect conditions affecting fatigue can be limited to the following:

- i. Noise and Industrial Music.
- ii. Illumination Intensity.
- iii. Temperature and Humidity.
- iv. Good Ventilation.

## 2.5 Direct Measures of Fatigue

It results from the person's physical and mental performance in relation to his performance of the work himself.

## 3. Conclusions

Muscle fatigue is a commonly experienced phenomenon that limits athletic performance and other strenuous or prolonged activity. It also increases and restricts daily life under various

pathological conditions, including neurological, muscular and cardiovascular disorders, as well as aging and frailty.

Most of the time fatigue can be traced to one or more lifestyle issues, such as poor sleep habits or lack of exercise. Fatigue can be caused by a medicine or linked to depression. Sometimes fatigue is a symptom of an illness that needs treatment.

One of the most important benefits is that proper fatigue management can lower the rate of accidents that occur by positively impacting the rate of human error and reducing it. It also increases the rate of productivity in several ways. Workers are healthier and happier, resulting in less time off work.

Fatigue is a feeling of constant exhaustion, burnout or lack of energy. It can be physical, mental or a combination of both. Fatigue can affect anyone – most adults experience it at some time in their life.

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