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ASSESSMENT AND CONTROL OF ERGONOMIC RISK FACTOR FOR MANUAL HANDLING

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ABSTRACT

Ergonomics is one of the important factors that every organization should be aware of its cause and affects that to the employee. Most of the industries, focus only on the production output but sadly not on the employee's health and safety. This usually happens in small and medium scale industries such as tier 2 & tier 3. It is due to lack of awareness on ergonomic injuries and illness. There may also another reason to neglect ergonomic concern is to address a concern without knowing the right technique or the root cause. An ergonomic illness is a slow process and may result in chronic health issues such as Raynaud's syndrome, Thoracic outlet syndrome, Tendinitis syndrome and tendosynovitis syndrome. Now-a-days awareness on ergonomics are frequently provided and the importance to address an ergonomic concern is also increased. In this report, we can understand the statement of ergonomics, injuries and illness that caused due to poor ergonomics, assessment tools and methods to evaluate the risk and control measure to minimize the ergonomic concerns in the work environment.

Keywords: Ergonomic injury & illness, MSD's, Reba, niosh lifting index.

1. INTRODUCTION

1.1 GENERAL

The ergonomic is the science of adapting product and processes to human characteristics and capabilities to improve well-being and optimize productivity. It also described as the human system and its capability that used for accomplishment of work. The most important aspect of study of the subject is the body linkage and human energy expanded when interacting with human machine system. The efficient way of doing a work, when performed through the natural laws i.e., staying in neutral posture. The knowledge that devises the product which provide the most economic use of human. The ergonomic can be define as study of relation between the man and the environment by anatomical, physiological, psychological aspect to solve the problem arising during man and machine interface. Ergonomic is concerned with the interaction between the workman and the human relationship to work. Ergonomics is the subject of study of relationship of the object with the human with the factors such as i) Comfort, ii) Health and iii) Work efficiency. This can be achieved by understanding the importance and role of human factors such as i) Human anatomy, ii) Physiology, iii) Psychology and iv) Sociology. Now a day's awareness of ergonomics in industries becoming important focus for development. The ergonomic focus on the employee comfort and increase productivity by reducing the work stress through educating the employee & doing continual improvement. Ergonomics is the scientific study of people in their workplace and is the process in which workplaces, products and systems are designed or rearranged so that the people can use them in most

effective way. The aim of ergonomics is to improve workspaces and environments to reduce the work-related injury. The ergonomic focus on the body is stressed by sudden or sustained exposure to force, vibration, awkward posture, extreme temperature, or repeated movement that affects the musculoskeletal system and causes musculoskeletal disorders (MSDs).



Fig 1 Ergonomic Posture

The ergonomics play major role in reducing these work related injuries or illness like computer vision syndrome, neck and back pain, and carpal tunnel syndrome etc. The Recent research has shown that lower back pain is the world's most common work related disability. The common ergonomic illness can be experienced by having symptoms such as fatigue, discomfort, and pain which can be the first signs of a musculoskeletal disorder (MSDs). So, this project is focused to identify the common work-related ergonomic illness, the risk causing factors and we are going to suggesting the right technique tool to control the ergonomics risk.

2. LITERATURE REVIEW

J Dul, WP Neumann Managers usually associate ergonomics with occupational health and safety and related legislation, not with business performance. In many companies, these decision makers seem not to be positively motivated to apply ergonomics for reasons of improving health and safety. In order to strengthen the position of ergonomics and ergonomists in the business and management world, we discuss company strategies and business goals to which ergonomics could contribute. Conceptual models are presented, and examples are given to illustrate: (1) the present situation in which ergonomics is not part of regular planning and control cycles in organizations to ensure business performance; and (2) the desired situation in which ergonomics is an integrated part of strategy formulation and implementation. In order to realize the desired situation, considerable changes must take place within the ergonomics Research, education and practice community by moving from a health ergonomics paradigm to a business ergonomics paradigm, without losing the health and safety goals. [1]

P.H.P. Yeow et al an ergonomic study was conducted to improve the workstations for electrical tests in a printed circuit assembly (PCA) factory in an industrially developing country (IDC). Subjective assessment and direct observation methods were used on the operators to discover the problems in their workstations. The problems found were: (i) poor workstation design, (ii) mix-up of tested and untested boards, (iii) missing or incorrect test steps, and (iv) unclear pass/fail colour inspection criteria. Ergonomic interventions implemented were: (i) an improved workstation with space for resting arms and the oscilloscope and computer keyboards within easy reach of the operators; (ii) clear segregation of tested and untested boards to prevent mix-up; (iii) retraining of operators by more qualified trainers; and (iv) reference colour samples for more effective recognition of different colours in the projection screen. The results were average savings in yearly rejection cost (of US\$574,560), reduction in rejection rate, increase in monthly revenue, improvements in productivity, quality, operators' working conditions and occupational health and safety (OHS) and enhancement in customers' satisfaction. The cost of the interventions was less

than US\$1100. The interventions implemented were simple and inexpensive but resulted in many benefits. [2]

Z.J. Whysall et al - Despite the importance of reducing work-related musculoskeletal disorders, there appears to have been little evaluation of routine ergonomics consultancy interventions aimed at reducing risks leading to these conditions. In many instances, the effectiveness of advice depends on organisations accepting and implementing measures recommended, involving changes of both individual and collective behaviour. Behaviour change theory, developed elsewhere, suggests that if change is to take place, recipients need to hold positive attitudes and beliefs relating to the desirable behaviour. To investigate the extent to which this is accommodated by current ergonomics consultancy practices, 14 ergonomics consultants were interviewed to explore the consultancy process from which recommendations are developed, exploring the factors that are assessed by consultants, perceived barriers to promoting change, and the extent to which evaluation of outcomes takes place. Consultants' recommendations generally focused on physical aspects of the work environment and did not take explicit account of employees' knowledge or attitudes. Little evaluation of outcomes was conducted by the consultants interviewed. Implications of these findings for improving the efficacy of interventions to reduce work-related musculoskeletal disorders within organisations are discussed. [3]

J.R. Wilson - In this paper ergonomics is defined as a discipline in its own right, as the theoretical and fundamental understanding of human behaviour and performance in purposeful interacting socio-technical systems, and the application of that understanding to design of interactions in the context of real settings. This definition is justified in the financial, technical, legal, organisational, social, political and professional contexts in which ergonomists work. On the basis of the history of ergonomics and contemporary contributions, it is proposed that it is one of the modern sciences, drawing as much from the field as from the laboratory, and including elements of an art and a craft as well. Justification for the new definition is provided by examining the interacting systems which are prevalent in the modern world, and which are the domain best understood through the holistic approach of ergonomics. Finally, a number of challenges for ergonomics are identified. [4]

L. McAtamney et al - RULA (rapid upper limb assessment) is a survey method developed for use in ergonomics investigations of workplaces where work-related upper limb disorders are reported. This tool requires no special equipment in providing a quick assessment of the postures of the neck, trunk, and upper limbs along with muscle function and the external loads experienced by the body. A coding system is used to generate an action list which indicates the level of intervention required to reduce the risks of injury due to physical loading on the operator. It is of particular assistance in fulfilling the assessment requirements of both the European Community Directive (90/270/EEC) on the minimum safety and health requirements for work with display screen equipment and the UK Guidelines on the prevention of work-related upper limb disorders. [5]

3. FUNDAMENTAL ERGONOMICS

3.1 PRINCIPLE OF ERGONOMICS:

The purpose of ergonomics is to design the workplace and improve employee effectiveness. This also helps to understanding employee capability to reduce injury and improve operational performance. Ergonomics covers everything which involves people, work design, sports, health and safety of all embodies ergonomic principles. The ability of people to do their job is influenced by the person's capabilities, the job require mental and the conditions under which the person is carrying out the job. The below chart shows how musculoskeletal disorders compare to other hazards based on percentage of injuries and illness using statistics of 2022.

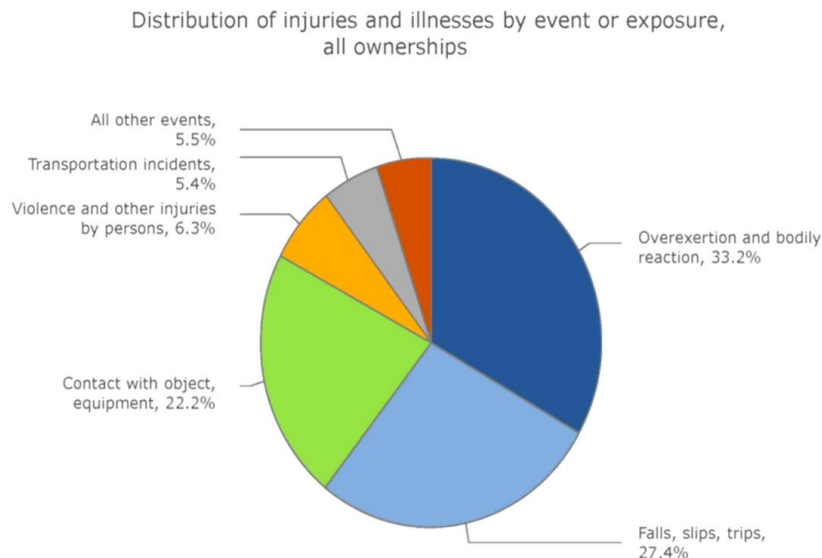


Fig :2 Injuries & Illness pie chart

The work organisation contains a range of tasks and with the multi-skilled workers. It also contains a range of physical and cognitive demands. The reduced risk of occupationally related disorders that is cumulative trauma. There are 4 scopes to reduce ergonomics illness 1) Occupational Biomechanics, 2) Human-Machine system design, 3) Personal and social well-being and 4) Human performance. The workload is a relation between the performance and physical workload, for the better understand a graph is displayed below.

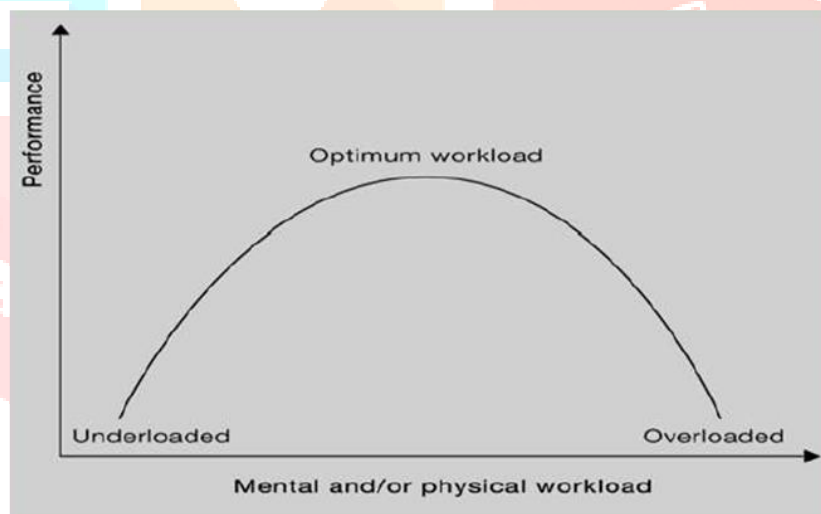


Fig 3. Chart between performance and physical workload

From the worldwide report, the maximum musculoskeletal disorders incident counted in the transportation and warehousing followed by the healthcare and social assistance where the physical and mental stress involved. To understand better ergonomics, one must understand 2 important factors causing workplace musculoskeletal disorders (WMSDs) and they are followed below.

- Understanding Employee Capabilities
- Understanding Work Requirements

3.2 INTERNATIONAL ERGONOMICS ASSOCIATION:



Fig: 4 International Ergonomics Association

The International Ergonomics Association focuses on the law of work. Its works on fitting the workplace conditions and job demands to the capabilities of the working population. The musculoskeletal disorders (MSDs) that include a group of condition that involve the nerves, tendons, muscles and supporting structures which also includes intervertebral discs. The International Ergonomics Association can be divided into 3 major types, they are 1) Physical Ergonomics, 2) Cognitive Ergonomics, and 3) Organizational Ergonomics. In Physical Ergonomics, the human is concerned with anatomical, anthropometric, physiological, and biological characteristics that affected and related to physical activity.

The physical ergonomics can be easily understandable by focusing on five major work posture and they are 1) Working postures, 2) Material Handling, 3) Repetitive Movements, 4) Work related musculoskeletal & 5) Workplace layout.

The cognitive ergonomics can be understandable by concerned with the mental processes such as perception, memory, reasoning, and motor response. The examples are 1) Mental workload, 2) Decision-making, 3) Skilled performance, 4) Human computer interaction, 5) Work stress & 6) Training.

The organizational ergonomics can be understandable by concerned with the optimizing sociotechnical systems, which a 70% of people suffers. The examples are 1) Communication, 2) Crew resource management, 3) Work design & 4) Teamwork.

4. ERGONOMICS HAZARD

4.1 ERGONOMICS DISORDER

The ergonomics injuries can affect the muscles, bones, tendons, nerves, and tissues. For different conditions, the illness can be varied depending on the work environment. The ergonomics injuries can be described in major three ways. These disorders include several specific diseases that can for a person subjected to poor ergonomic condition such as carpal tunnel syndrome, bursitis, and tendinitis. Our bodies normally recover from the wear and tear of work after a period of rest. If the stresses continue day by day without time to recover, the damage can lead to ergonomic injuries. The Back injuries are the most common ergonomic illness, and many different terms are used to describe these ergonomic injuries and for example

Cumulative trauma disorders (CTDs) - Ergonomic injuries involve strain that may develop, accumulate, over time.

Repetitive strain injuries (RSIs) - Ergonomic injuries are often caused by repeating the same motions over and over.

Musculoskeletal disorders (MSDs) - Ergonomic injuries affect the muscles, bones, tendons, nerves, and tissues.

The symptoms of these disorders are results in pain in most commonly on the back, hands, arms, wrists, elbows, neck, and shoulders. They include 1) Soreness or pain, 2) Stiffness, 3) Swelling, 4) Loss of coordination, 5) Numbness, 6) Tingling & 7) Unexplained weakness.

If your work exposes you to any of the ergonomic risk factors then you may be subjected to these symptoms may be signs that you have a Musculoskeletal disorder. It is important to seek medical care if these symptoms are last for more than a week (or) bothers you so much that you restrict activities or take time off to recover.

4.2 RISK FACTORS FOR ERGONOMIC INJURIES

The ergonomics injuries and illness are defined as workplace musculoskeletal disorders (WMSDs). The injuries can be classified into 2 major types, and they are acute and Chronic. The injuries are acute, and illness are caused and developed by over period of time. The injuries and illnesses are results when the physical requirement of a job exceeds the employee's physical capabilities.

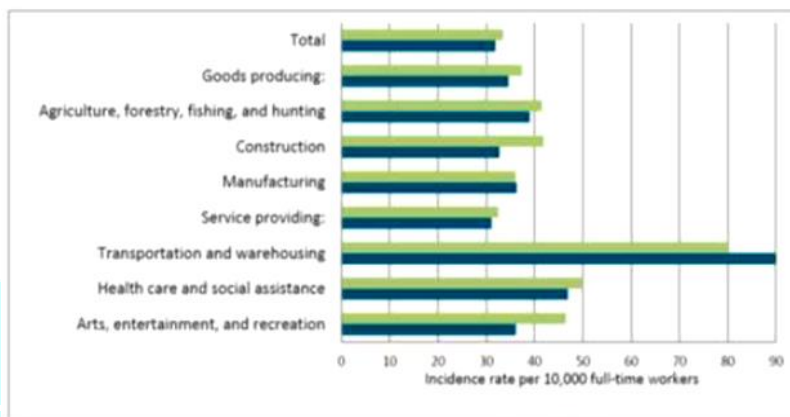


Fig 5 Ergonomics Injury report

The field of ergonomics examines to fill the gap between the employees and their jobs. The goal of ergonomics is to fit workplace conditions and job demands to the capabilities of the individual worker, instead of making the worker fit the job. The ergonomics looks at the below points

- What body movements and positions people use when they work.
- What tools and equipment they use?
- The physical environment (temperature, noise, lighting, etc.).
- The organizational environment (deadlines, teamwork, supervision).
- Whether any of these factors may place an employee at risk of injuries or illnesses.

To prevent ergonomic injuries, the ergonomic risk factors must be identified. The ergonomic risk factors are workplace situations that cause wear and tear on the body and can cause injury over a period. Once these have been identified, you can work on finding ways to eliminate the risk. The important key point on the ergonomic injuries is mentioned below.

- The more risk factors you face, the greater your chance of injury.
- The longer you are exposed to a risk factor, the greater your chance of injury.
- By reducing or eliminating risk factors, the chance of injury can be decreased.

4.3 MUSCULOSKELETAL DISORDERS

The Musculoskeletal Disorder ergonomics illness and injuries can be acute and classified into three. They are 1) Strain is the injuries to muscle, 2) Sprains is the injuries to the connected tissues, and 3) Muscle tears can be caused by stress improper lifting of heavy load. This injury / illness can lead to bursitis, tendonitis, tenosynovitis, vibration white finger and carpal tunnel syndrome.

5. ERGONOMIC ASSESSMENT

5.1 PROBLEM STATEMENT

The ergonomic assessment has been done to the process and found an activity causing injuries to the workers who is involved in it. The material store is the location area selected for the ergonomic assessment, in which the material is stored distributed to hydraulic system assembly unit. The major material stored in the store are package of bolts and nuts, gear box, hydraulic oil barrels, coolant barrels, high tension cables, hydraulic hoses, couplings, guide rails, electrical cables, package of sensors such as pressure sensor & magnetic sensor, high tension helical springs, electrical compounds, cabin assemble components, filters, and hydraulic power pack system. The material shifting activity is performed by a contract worker, has been working in the store for 7 years. We found his activity has the ergonomic constrains and he is subjected to shoulder and back pain. In this project, we have analysed the major tasks performed by the person and calculated the risk associated for the activity. For the assessment, we have used the ergonomic risk factor identification form & the REBA tool and found the risk rating for the activity.

5.2 TOOLS INTRODUCTION

5.2.1 ERGONOMIC RISK FACTOR IDENTIFICATION

The ergonomic risk factor identification is the form that contains various body posture with the appropriate rating. During the assessment, by evaluating the task or activity the rating can be given in the sheet. This rating is related to the activity which has appropriate risk score. This sheet contains the different posture of body parts such as hands and wrist, elbows, shoulders, back, Neck and legs. This sheet also contains duration, repetition and force involved in it.

5.2.2 NIOSH LIFTING INDEX

The NIOSH lifting index is a tool that used by the occupational health and safety professionals to assess the manual handling and rate the risk associated with to it. The NIOSH lifting index can be used to assessing the manual handling activity such as lifting & lowering tasks in the workplace. The lifting task is defined as the act of manual holding of material or object with two hands and moving vertically to the desired location.

The NIOSH lifting index is widely used in occupational ergonomics, providing occupational health and safety professional while assessing an ergonomic concern or an issue for manual handling activities. The NIOSH lifting index's equation has shown below.

$$RWL = LC (51) \times HM \times VM \times DM \times AM \times FM \times CM$$

Whereas,

- H – Horizontal location of the object relatively to the body
- V – Vertical location of the object relatively to the floor
- D – Distance the object is moved vertically
- A – Asymmetry angle or twisting requirement
- F – Frequency and duration of lifting activity
- C – Coupling or quality of the workers grip on the object

5.2.3 Rapid Entire Body Assessment (REBA)

The REBA method (Rapid Entire Body Assessment) is used to assess the different body postures required, energetic efforts, the type of movement or action, repetition and difficulty of taking. REBA uses a systematic process to evaluate whole body postural musculoskeletal disorder and risks associated with work. It is a single page worksheet is used to evaluate required or selected body posture, forceful exertions, type of movement or action, repetition, and coupling. The REBA was designed for easy use without need for an advanced degree in ergonomics or expensive equipment. Using the REBA worksheet, the evaluator will assign a score for each of the following body regions such a wrist, forearms, elbows, shoulders, neck, trunk, back, legs and knees. Once the data for each region is collected and scored, the tables on the form are then used to compile the risk factor variables, generating a single score that represents the level of MSD risk.

Risk Score	Level of MSD Risk
1	Negligible risk, no action required
2 - 3	Low risk, change may be needed
4 - 7	Medium risk, further investigation, change soon
8 - 10	High risk, investigate and implement change
11 - 15	Very high risk, implement change

Fig: 6 REBA risk score

The REBA method provides a scoring system for muscle activity caused by static, dynamic, changing, or unstable postures. It gives an intervention threshold with an indication of the emergency. The REBA tool is not recommended for evaluating manual handling tasks since it examines the strengths and activity but mainly focuses on the work posture. During the assessment of an activity, there are some few factors that need to be considered such as duration of activity, the recovery period, repetition of task, and the vibrations.

5.3 METHOD OF APPROACH & CONTROL MEASURES:

The proper method for the addressing concerns on ergonomics illness is to go for genba visit interact with the person who suffers from illness and try to understand the activity that he performs. By interacting, you may understand the cause for the ergonomic illness or injury i.e., whether the illness is caused by the work or by his personal work. When it comes to this report, the activity performed by the person is lifting & lowering of material and pushing & pulling of loads. The poor posture and technique in which the activity was performed over the period, resulted in causing an ergonomic illness to the worker. We made genba walk through the unit and found the activity with high probability of ergonomic hazard. As result of the assessment, we got the risk associated to the activity. The risk score that we have got in REBA is 11 and found the risk level is high. Since the activity can't be eliminated & substituted, we made to next step of controls i.e., engineering and administration control. The management accepted to provide a stacker for loading and unloading of material, and rotation of worker for the loading and unloading activity. The management also fabricated a trolley for the material movement. As an administration control, we have provided a training program for all employee on the title of Awareness and Identification of ergonomic hazard. Over 80 people participated on the training program and as a result of training program, we had 15 ergonomic concerns identified by the employees as a part of training program. The organization has formed an ergonomic team to conduct a frequent audit on ergonomic concern and have a track on to closure of the concerns.

6. CONCLUSION

In this project, we have done an assessment for the manual handling activity of unloading of materials in stores. The task which is perform is a repetitive and it causes a fatigue load to the workers. With the REBA and NIOSH lifting index tools, we estimated the risk score for the activity is about 11 which is high. As the result of the assessment, the organization has provided a stacker for the loading & unloading task and as an administration control they have provided a training to the employees involved in manual handling. By implementation of these control measures, the risk associated with the unloading activity has been reduced to level 3 which is low risk. That shows a before and after effects tends on the worker while performing the unloading activity.

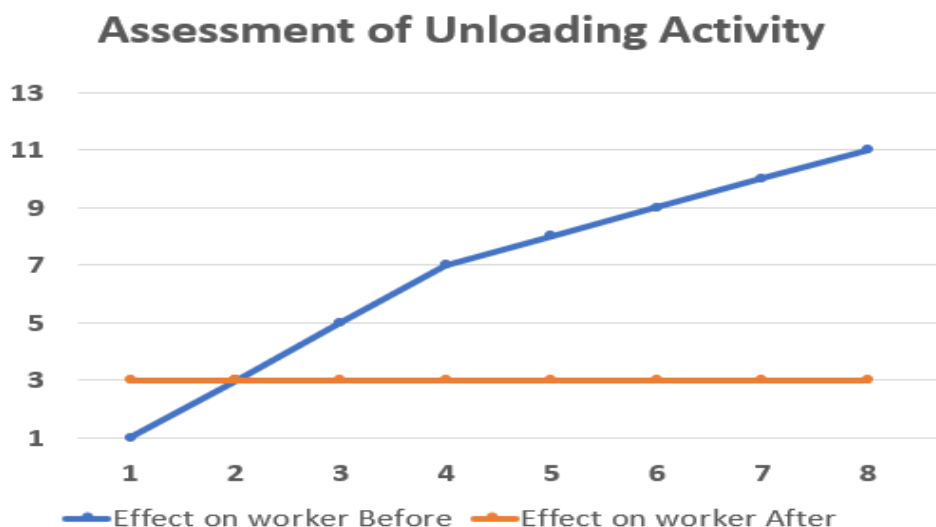


Fig 7 Assessment score sheet

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