A Case study on Risk Assessment involved in Manual Handling Operations in a Gear box manufacturing plant

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Abstract: Ergonomics deals with the working posture of a worker in Manual Handling Operations (MHO). The risk level is dependent on the intensity, frequency and duration of the exposure which could fails the science of ergonomics in workplace or to workers. In relation, with the Human Factor Engineering, response to each posture is determined in the health condition of the worker. Henceforth, an ergonomic study ought to be considering in MHO. Three U.S. mining industries partnered with the MSD Prevention Team at the National Institute for Occupational Safety and Health's (NIOSH) Pittsburgh Research Laboratory to demonstrate that an ergonomics process could be systematically implemented and effectively integrated with existing safety and health programs. In this article, above said principles dealing with ergonomics are adopted predominantly. A well-developed checklist was prepared, documented and assessed with the support of Environment Health and Safety (EHS) team of the plant; its assessment was done by discreetly witnessing the points in the checklists and provides a degree of risk factor exposure.
Keywords: Ergonomics study, MHO, MSD, NIOSH, Manufacturing plant

1. Introduction:

The study of the relationship between workers and their environment, especially the equipment they use. The ultimate aim of an ergonomics study process is to ensure that all tasks performed in workplaces can be performed with dynamic and varied movements of all body regions with low to moderate levels of force, comfortable and varied postures, no exposure to whole-body or hand-arm vibration, and breaks taken at appropriate intervals to allow adequate recovery. Also the study of capabilities and limitations of mental and physical work in different settings. Ergonomics applies anatomical, physiological, and psychological knowledge (called human factors) to work and work environments in order to reduce or eliminate factors that causes pain or discomfort. Ergonomic designs of tools and equipment have helped curtail the occurrence of musculoskeletal disorders and repetitive strain injuries. The applied science of equipment design, as for the workplace, intended to maximize productivity by reducing operator fatigue and discomfort. Also called biotechnology, human engineering, human factors engineering. Design factors, as for the workplace, intended to maximize productivity by minimizing operator fatigue and discomfort.

1.1 Need for Ergonomics Study:

Industries increasingly require higher production rates and advances in technology to remain competitive and stay in business. As a result, jobs today can involve:

1. Frequent lifting, carrying, and pushing or pulling loads without help from other workers or devices;
2. Increasing specialization that requires the worker to perform only one function or

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1. movement for a long period of time or day after day;
2. Working more than 8 hours a day;
3. Working at a quicker pace of work, such as faster assembly line speeds.

These factors especially if coupled with poor machine design, tool, and workplace Design or the use of improper tools—create physical stress on workers' bodies, which can lead to injury. A dramatic increase in MSD began in the 1970s when these disorders increasingly appeared on company's injury and illness logs. OSHA cited companies for hazardous workplace conditions that caused problems such as tendinitis, carpal tunnel syndrome, and back injuries. The Bureau of Labour Statistics, an agency of the U.S. Department of Labour, recognizes MSD as a serious workplace health hazard. These injuries now account for more than one third of all lost—workday case.

1.2 What is Ergonomics?

Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance [1]

Ergonomics is commonly known as 'fitting the job to the human'. This definition provides the fundamental directive for ergonomics of matching the requirements of a task or job with the capabilities of the worker [3]. Ergonomics can be defined simply as the study of work. More specifically, ergonomics is the science of designing the job to fit the worker, rather than physically forcing the worker's body to fit the job. Adapting tasks, work stations, tools, and equipment to fit the worker can help reduce physical stress on a worker's body and eliminate many potentially serious, disabling work-related musculoskeletal disorders (MSD). Ergonomics draws on a number of scientific disciplines, including physiology, biomechanics, psychology, anthropometry, industrial hygiene.

1.3 Musculoskeletal Disorders (MSD):

MSD are injuries and disorders of the soft tissues (muscles, tendons, ligaments, joints, and cartilage) and nervous system. They can affect nearly all tissues, including the nerves and tendon sheaths, and most frequently involve the arms and back. Occupational safety and health professionals have called these disorders a variety of names, including cumulative trauma disorders, repeated trauma, repetitive stress injuries, and occupational overexertion syndrome. These painful and often disabling injuries generally develop gradually over weeks, months, and years. MSD usually result from exposure to multiple risk factors that can cause or exacerbate the disorders, not from a single event or trauma such as a fall, collision, or entanglement. MSD can cause a number of conditions, including pain, numbness, tingling, stiff joints, difficulty moving, muscle loss, and sometimes paralysis. Frequently, workers must lose time from work to recover; some never regain full health. These disorders include carpal tunnel syndrome, tendinitis, sciatica, herniated discs, and low back pain. MSD do not include injuries resulting from slips, trips, falls, or similar accidents. The parts of the body affected by MSD are neck, hands, arms, fingers, back, wrists, shoulders and legs.

1.3.1 What causes work-related MSD?

Work-related MSD occur when the physical capabilities of the worker do not match the physical requirements of the job. Prolonged exposure to ergonomic risk factors can cause damage a worker's body and lead to MSD. Conditions that are likely to cause MSD problems include the following:

- Exerting excessive force; repetition of movements that can irritate tendons and increase pressure on nerves;
- Awkward postures, or unsupported positions that stretch physical limits, can compress nerves and irritate tendons;
- Static postures, or positions that a worker must hold for long periods of time, can restrict blood flow and damage muscles;
- Motion, such as increased speed or acceleration when bending and twisting, can increase the amount of force exerted on the body;
- Compression, from grasping sharp edges like tool handles, can concentrate force on small areas of the body, reduce blood flow and nerve transmission, and damage tendons and tendon sheaths;
- Inadequate recovery time due to overtime, lack of breaks, and failure to vary tasks can leave insufficient time for tissue repair;
- Excessive vibration, usually from vibrating tools, can decrease blood flow, damage nerves, and contribute to muscle fatigue.
- Whole-body vibration, from driving trucks or operating subways, can affect skeletal muscles and cause low-back pain; and
- Working in cold temperatures can adversely affect a worker's coordination and manual dexterity and cause a worker to use more force than necessary to perform a task.

2. Methodology:

2.1 National Institute of Occupational Safety & Health:

Research has shown that an ergonomics process that identifies risk factors, devises solutions to reduce musculoskeletal disorders (MSDs), and evaluates the effectiveness of the solutions can lower worker exposure to risk factors and MSDs and improve productivity. It can be said that MSDs significantly contribute to occupational illnesses and injuries in the U.S. mining industry, few mining companies have implemented an ergonomics process. The mining companies were very different in organization, culture, and size, the ergonomics processes had to be modified to meet the needs of each company, it is common to see effectiveness measured in the number or incidence rate of workdays lost, number or incidence rates of injuries/illnesses, number of near-misses, or workers compensation costs. In these cases, use of survey tools, such as a Musculoskeletal Discomfort Survey form, may be more useful. Another constructive approach may be to quantify exposure levels to risk factors before and after implementing an intervention.
For a lifting task, for example, the amount of weight lifted during a work shift may be measured before and after an intervention has been applied. Other examples include

posture improvements, reducing the distance objects are carried, and reducing the number of repetitions performed. Other more technical tools that could be used to show reduced exposures include Rapid Upper Limb Assessment [McAtamney and Corlett 1993] [4], Rapid Entire Body Assessment [Hignett and McAtamney 2000] [5].

2.2 Ergonomic Tool:
Ergonomic assessment tool for this present work was being developed by considering the merits & demerits of the above mentioned methodology that suits the operation carried out in plant. A well-developed checklist was prepared, documented and assessed with the support of Environment Health and Safety (EHS) team of the plant; its assessment was done by discreetly witnessing the points in the checklists and provides a degree of risk factor exposure.

2.2.1 Advantages of Developed Ergonomic Methodology:
Colour bands technique is used for the easy representation of the Risk Level and to determine which element of task requires attention [2].
Suggestions are given for every operation which has risk.
Priority level is given by measuring the time the employee is exposed to his/her work.

2.3 Study Methods:

- Individual process area wise monitoring done.
- Interaction with co-employees.
- Collection of Data.
- Analysis of individual operations.
- Suggestion derived by EHS team with employees of the plant.

Table 3.1: Analysis of Overall Ergonomics Status of the Plant

S.No	Area	Safe	Low	Medium	High	Very High	Total
1	Housing	3	1	0	0	0	4
2	Planet Carrier/Torque Arm	2	1	0	0	0	3
3	Ring Wheel	1	0	0	0	0	1
4	Wheels Shaft	1	1	0	0	0	2
5	Shaft Soft	1	2	0	0	0	3
6	Shaft Hard/Planet Shaft	3	1	0	0	0	4
7	Wheels Hard	5	0	0	0	0	5
8	Heat Treatment	3	1	0	0	0	4
9	Tool Crib	1	0	0	0	0	1
10	Casting Inspection	1	1	0	0	0	2
11	Ring Wheel Inspection	2	0	0	0	0	2
12	Quality Casting	4	0	0	0	0	4
13	Quality Gear	1	0	0	0	0	1
14	Gear Inspection	1	1	0	0	0	2
15	Logistics	4	0	0	0	0	4
16	Washing/Kitting	3	0	0	0	0	3
17	Pre Assembly	1	3	0	0	0	4
18	Main Assembly	1	1	0	0	0	2
19	Testing	2	1	0	0	0	3
20	End Assembly	1	0	0	0	0	1
21	Service Area	2	0	0	0	0	2
22	Tool Room	2	0	0	0	0	2
23	Industrial Axle (IA)	7	4	0	0	0	11
	Total	52	18	0	0	0	70

Analysis was done for 70 operations using checklist technique, in which 18 comprised of low degree of risk factor. The analysis proved that risk levels of the study designates only 'low level' risk. Therefore, estimation of those low level risks were performed by initiating the method of priority levels say (P1, P2 and P3), these 18 operations were assessed distinctly on the basis of duration of exposure per shift (below 3 hours (P1), from 3 to 5 hours (P2) & above 5 hours (P3)).

4. Conclusions:

The following conclusions were drawn from this experimental study:

- Henceforth, consistent suggestions prior to those operations with low risk degree factor are provided by proper interactions with employees. Also, for getting attention in specific actions, colour bands were implemented with respect to various risks involved.
- Outcomes of the particular assessment showed that around 83% of operations falls in the

- criteria of duration of exposure per shift below 3 hours and 17% of operations falls in the criteria of duration of exposure per shift from 3 to 5 hours.
- The implementation of technical suggestions lead to change the imbalance occurred by the hazards present in the Manual Handling Operations.
- Operator's performance with regard to productivity with the ergonomically smart work area condition is studied and investigated.
- The fully adjustable ergonomically designed work area was preferred by the operators and they adjusted and organized the workstation to their comfort.
- Work area tasks should be designed so that any operator can adjust to his/her comfort to relieve stress and improve performance. The ergonomically designed work area is a solution to ergonomic and productivity problems in the workplace.

5. References:

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