

## Application of Ergonomics to the Safety, Health Quality and Productivity in Industry

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### Abstract—

The present paper deals with the important aspects of concern to every industry i.e. the safety, health quality and productivity. Ergonomics is a system concerned with the relationship between the human beings machines and the work environment. The objective is to obtain an optimum balance between the human characteristics. Capabilities and limitations with demands of the task i.e. to fit the task to the person, This paper relates ergonomics with quality, productivity, safety, health in modern industrial setting and discusses ergonomic risks of injuries, work related limb disorders and work environment.

**Keywords:** Ergonomics, safety, health, efficiency, quality, productivity, work environment.

### I. INTRODUCTION

Ergonomic design is the application of knowledge about human capabilities limitations and characteristics to the design of machines, tools task, systems and environment for safe comfortable and effective human use. Ergonomics when effectively used saving the human (individual) from musculoskeletal disorder (MSD) effecting the reputation of employers and social cost to the society. This paper highlights such problems by:

- Identify and qualifying workplace risk factors for MSDs.
- Identifying how these risks relate to production strategies and
- Developing an approach to integrating ergonomic into a company's regular development work

It has found that low back MSDs were strongly associated with working trunk postures. Operators with high exposure operators, similarly high peak extension velocity increased risk by 3 times [1]

### II. ERGONOMICS IN WELDING

Welding includes following musculoskeletal disorder (WMSD) hazards:

- Awkward body postures
- Lifting heavy equipment or materials
- Static postures for prolonged periods
- Awkward postures of the wrist

Welding introduces some severe ergonomic hazards.

Common hazards found in welding include:

- Inhaling metals fumes

- Eye exposure to welding arc light(UV rays)
- Foreign objects in eyes
- Burns
- Noise

Fig. 1 shows the effect of poor postures on the different parts of human body while Fig. 2 shows the nature of injury on the welders.

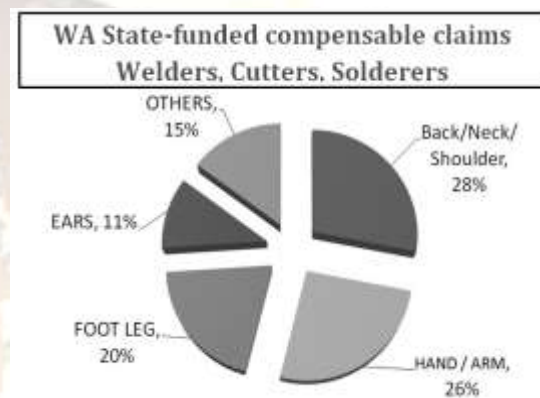


Fig.1

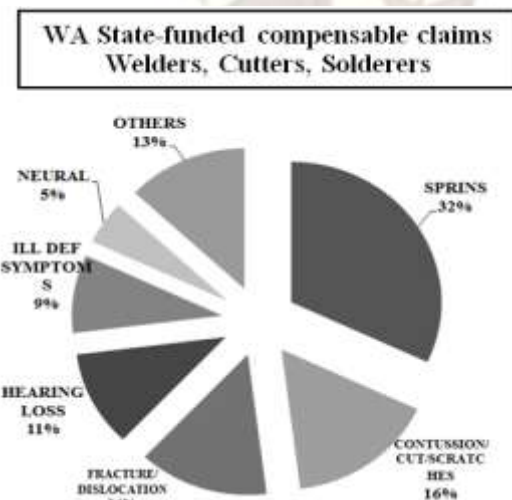


Fig.2

### III. QUALITY PRODUCTIVITY AND SAFETY

#### A. Ergonomics and quality

There are many theoretical reasons for relationships between quality and ergonomics. First, the definitions reveal overlaps. Jurans "Fitness for use" is related to the concept of usability. If quality is defined quality as "the ability of a product or a

service to satisfy the Expectations of the customers". The workforce of the organisation was regarded as internal customers.

When this definition of internal customers is considered, this aspect of Quality becomes close to the definition of ergonomics. New areas such as participatory Ergonomics have developed, which emphasize similarities with the field of quality. The Quality approach emphasizes both management support and employee participation, while Ergonomics has focused the needs of the ergonomics expert and employee participation.

#### B. Ergonomics, Productivity, and Safety

Manufacturers are moving ahead by promoting comfortable work areas and ergonomically designed tools. These results in happy workers, better safety, and improved productivity.

Good ergonomics can give rise to hidden gains that are not immediately visible in the productivity statistics. Efforts to improve productivity that result in poorer ergonomics may not reach their anticipated profits gains.

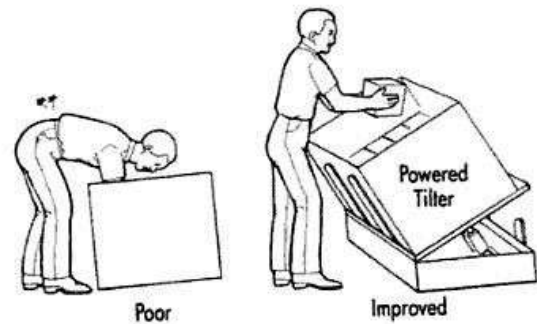
Because of the increasing number of injuries caused by repetitive motion, excessive force, awkward postures, and the use of tools, ergonomics has become a critical factor in workplace safety. Therefore, ergonomics is the science that seeks to adapt tasks and tools to fit the physiology and psychology of the person. It's a way of looking at the overall system of the design of tasks, tools, equipment, and workplace layouts, to fit the job to the worker, rather than the worker to the job.

Injuries from poor ergonomic conditions typically involve the bones, muscles, joints, tendons, and nerves. Even with many of the newly developed and ergonomically designed hand/power tools, some chronic or cumulative trauma injuries are still being caused necessitating redesigning.



Equipment such as tote pans or trays is often designed without adequate grips this requires that stressful pinch grips be used a solution as simple as providing totes with good handles can reduce needless exertion

Fig.3



In the work place reaching down into tubes and bins is a common source of back injuries. Possible solutions include a hydraulic tilter as illustrated here

Fig.4

Many companies have experienced the cost savings associated with preventing musculoskeletal disorders (MSDs) in the work place. The savings these companies have made have been due to their focus on reduced workers' compensation claims, lower insurance premiums, high employee retention, and possibly avoiding regulatory fines. What some companies haven't realised is that improving ergonomics almost always can improve a company's productivity.

Any ergonomics intervention must be viewed in light of its effect on productivity, and the best ergonomics solutions will most often improve productivity. Simply put, reducing unnecessary or awkward postures and exertions almost necessarily reduces the time it takes to complete a given task, thus improving productivity.

Body motions, visibility, workload, and other important ergonomic parameters will also affect the quality of work, and the quality of work product. When a task is matched with the ability of the people that will perform it, they will make fewer errors and produce less waste. Ergonomic design considerations have also been found to influence employee recruitment and retention.

#### C. Improved productivity.

It is common for ergonomic improvements to increase productivity 10 – 15%. In fact, one of the more rigorous studies showed a 25% increase in output at computer workstations when using ergonomic furniture, while concurrently improving employee well-being. The book on which this summary is based contains an example from a printing facility where productivity increased 300%, simultaneously with reducing physical demands on employees.

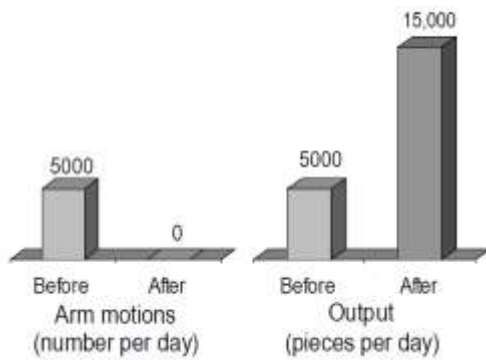


Fig.5

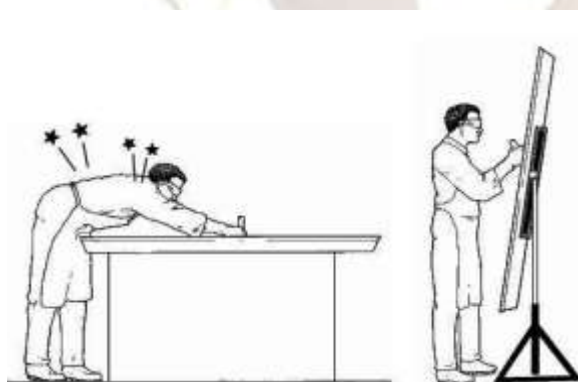
D. Improved efficiency with better working posture.

Working in awkward postures can directly reduce efficiency in three ways that ergonomics can help remedy:

- **Reduced strength** — Think of bending at the waist and reaching out across a large object and then trying to exert. You have little or no strength in an outstretched position like this. Consequently it takes you longer to complete a task than it would be if you were working in a proper position.

- **Less accuracy** in your motions — Again, think of reaching out across a large object and trying to do something intricate. You make a lot of mistakes and it takes a lot longer time, if indeed you can do it at all.

- **Faster fatigue** — When you work in an awkward posture, you tire much more easily, which slows you down. You end up losing productivity for that reason[8]



Awkward working positions reduce efficiency.

Fig.6

E. Improved efficiency with better heights and reaches.

Poor heights and reaches can affect productivity in a couple of different ways. If you can't reach an

object at all, you may need to stop productive work and fetch a step stool or take time to remove an obstruction. If the inappropriate height or the long reach causes you to work in an awkward posture,[8]

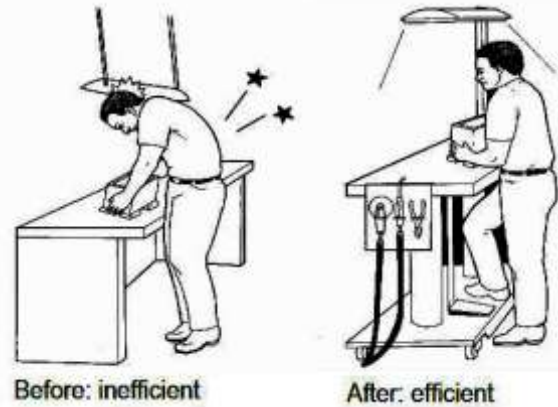


Fig.7

F. Re-designing system time saving at a distribution center

Fig.8 shows how a standard pallet lift reduced cycle time by 14 – 20%, Plus reduced the load on the spine by 66%

Fig.9 compares lifting a series of eight boxes onto the conveyor, first with the pallet on the

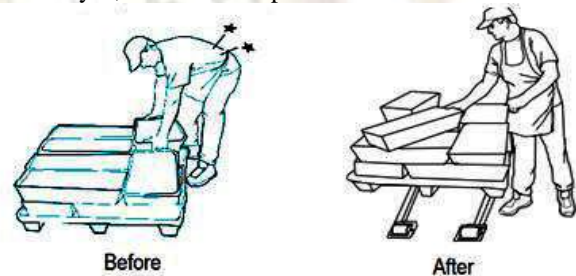


Fig.8

floor and then with the pallet lift. The only difference was the height. The results are superimposed to help highlight the differences.

The horizontal axis of the graph is time and the vertical axis is strain on the back (specifically, Compression force on the discs in Kg.) Each peak represents one lift. Lower the peak and the less area in the peak, the less strain on the back. The less horizontal distance at the base of each peak, the less time needed to complete the task.

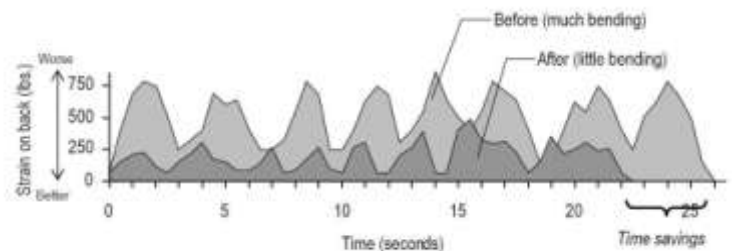


Fig.9

#### IV. ERGONOMICS EFFORTS, ADMINISTRATIVE AND ENGINEERING TO CONTROL DISORDER

There are a numbers of methods of carrying out risk assessments. One method, known as The Rule of TEN [croner's health and safety briefing, 1997], provides an illustrative example of how such assessments can be applied to prevent work related limb disorders.[3]



**Fig.10**

Each stage is further sub divided as follows:

Target	Evaluate	Negate
Understanding	Position	Ergonomics
Observations	Lay outs	Regulate
Consultations	Task cycles	Monitor
	Task frequency	Educate
	Task rotations	Encourage
	Rest and recovery	Involve
	Work organisation	Respond
	Suitability of employees	

#### V. QUANTIFICATION OF ERGONOMIC RISK CONDITIONS

Once the presence of risk factors is established, the degree of risk associated with those factors is evaluated. This is done through the application of analytical ergonomic tools and the utilization of specific guidelines.

##### *Ergonomic Analytical Tools*

There are a great variety of analytical tools. The tools are frequently orientated to a specific type of work (e.g., manual material handling) or a particular body part (e.g., wrist, low back).

Analytical tools also vary greatly in their style of conclusions. They may provide job prioritization for intervention, quantification of activities associated with increased risk of injury, or recommendation for a load weight limit for lifting. The examiner determines which analytical tool is best for evaluation of the identified risks based on an understanding of the tool's applications, strengths, and weaknesses.

An analytical tool can, at best, provide an approximation of the degree of risk. Variation in individual physiology, history of injury, work methods, and numerous other factors influence whether a person will sustain an injury. Further, many tools have not been tested adequately for reliability and validity. This status reflects the status of

development of this method. Despite these shortcomings, tools still offer a standard method of analysis for a reasonable assessment of risk.

#### VI. ECONOMY ASPECTS OF BACK INJURIES

Healthcare has recognized the potential risk for injuries caused by lifting since the data on this aspect is available from US only.it has been used for the present example, The National Institute of Occupational Safety & Health (NIOSH) tracks the economic aspects of back injuries and the associated medical, worker compensation and lost time associated with them:

- Back-related injuries cost about \$52 billion in direct medical and lost time expenses.
- Musculoskeletal Disorders (MSD) result in 16 Million lost workdays (\$50 billion) per year.
- 30% of all workers' compensation claims are related MSD costing \$18 billion per year.
- The average MSD claim is over \$18,000.
- Carpal Tunnel surgery is now among the most frequently performed procedures in the US — average cost

\$50,000 per wrist. Sources: US Bureau of Labor Statistics & NIOSH the untapped potential for ergonomics in healthcare is addressing musculoskeletal disorders (MSD) that affect activities beyond patient transport. Improperly or inappropriately adjusted and configured workplaces contribute

to MSDs such as those associated with computer use (e.g. carpal tunnel syndrome) and constrained postures (neck, shoulder, leg and back problems). Ergonomics can reduce the incidence and costs associated with these health and safety issues.

#### VII. THE WORK ENVIRONMENT INTERACTIONS

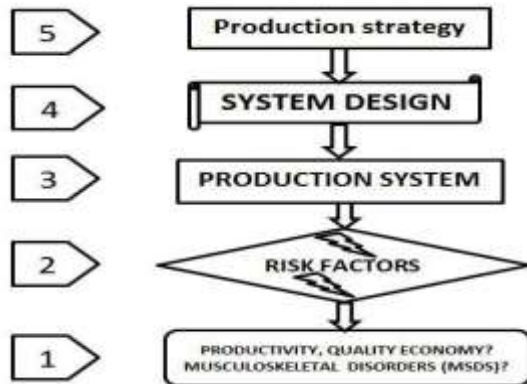
The work environment is characterized by the interaction between the following elements

1. *The WORKER:* With the attributes of width, height, strength, intellect, range of motion, education, expectations and many other physical and mental characteristics.
2. *The WORKSTATION:* Including furniture, tools, display and control panels, and other items required for work.
3. *The WORKING ENVIRONMENT:* Including lighting, temperature, vibration, noise, and other atmospheric qualities

##### *Risk factors of work*

There are certain characteristics of workplace injuries that have been associated with some features that are called risk factors of work. They include: Physical characteristics of the task, which is the primary interaction between the worker and the workplace and includes:

- Positions
- or force
- or repetitions
- or velocity / acceleration
- or duration
- or recovery time
- or dynamic load
- or vibration in segments.



Simplified systems model for analysing the development of musculoskeletal disorder (MSDs) in a work system. The company's development process can be seen to begin with conceptual choices of production strategy (5) followed by the design stage (4) to the eventual implementation of the production system (3) production system operators are then exposed to the physical loads and psychosocial working conditions within the system that determine risk for MSD (2) the system output (1) which gives, productivity and quality and also, as a side effect, MSDs)

Fig.11

Environmental characteristics are also primary interaction between the worker and the workplace that include:

- heat stress
- or cold stress
- or vibration to the body
- or lighting
- or noise

### VIII. EMPLOYEE ENGAGEMENT & EMPOWERMENT

Managers in all industries have made employee engagement a hot button issue because of growing evidence that engagement has a positive correlation with individual, group, and organizational performance in areas such as productivity, retention, turnover, customer service, and loyalty [8]. The health care industry is no exception to this phenomenon in human resource management theory and practice. Nursing shortages in particular have helped make engagement an important topic in this industry.

With regard to health care specifically, research has frequently uncovered a lack of loyalty to the organization and the nursing profession [7]. Brown noted that nurse administrators face the challenge of repairing "broken" relationships with

nurses because of changes in management policies over time. During the 1990s, health care organizations tried to adopt cost cutting strategies employed by many other industries, thereby taking the focus away from the quality of care to patients. This conflict ultimately left nurses feeling disengaged and un-empowered in their roles in delivering patient care and at odds with the financial performance initiatives of health care administrators [15]. Research has shown, as expected, that when employees are disengaged in their jobs they are more likely to leave because they feel unappreciated

Further compounding this issue, surveys with nurses have indicated that they exhibit loyalty to patients but often do not feel the same level of loyalty to their employer because they feel hospital executives are not in touch with the demands of patient care. These findings highlight the importance of creating engaged employees and the important role of administrators and other leaders in this process.

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