A Constructive Ergonomic Guide for Risk Management

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A CONSTRUCTIVE ERGONOMIC GUIDE FOR RISK MANAGEMENT

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Topics

- Basic Ergonomics
  - What is Ergonomics?
  - Risk Factors
- CTDs
- Ergo Cost Model
- Design principles and Basic Ergonomic Program
- Job Rotation
  - What is Correct
  - Why it is Beneficial
  - OCRA analysis
- Summary

What is Ergonomics?

"Ergonomics (or human factors) is the scientific discipline concerned with the understanding of the interactions among humans and other elements of a system, and the profession that applies theoretical principles, data and methods to design in order to optimize human well being and overall system performance.." IEA 2000

Ergos = Work

Nomos = Law or Norm

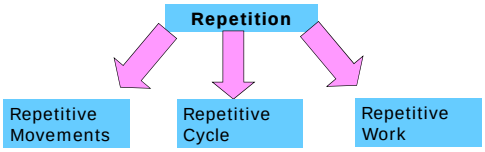
Ergonomic Risk Factors

Repetition	Force	Posture
High: • Any one or more tasks that involve a common body part(s) that together comprise(s) 50% or more of the total available cycle. Or • Any tasks that are repeated every 30 seconds or less, with the operator being active for at least 80% of the total available cycle. Or • Any tasks performed by the same operator for three or more hours a day.	Amount of physical effort required to perform an action or movement. (Measure Actual force and Compare to Ergonomic Guidelines for Reference on level of Risk) • Pushing, Pulling, Carrying, Holding, Pressing, etc. • Sewing, cutting, holding the part, guiding the part in the machine, etc.	Refers to the position of the body, limb, or body segment when performing an action The movement that leads the body away from neutral posture at each body segment, compared to Ergonomic Guidelines for posture
Medium: • Any one or more tasks that involve a common body part(s) that together comprise(s) 25% to 50% of the total available cycle. Or • Any tasks that are repeated every 90 seconds or less, as part of a job where an operator is active for at least 70% of the total available cycle.	Ergonomic Force Guidelines: • Forces exerted with both hands (lifting, pushing, pulling, or carrying): ≤ 10 lbf (44.5 N) • Forces exerted with one hand (lifting, pushing, pulling, or carrying): ≤ 6 lbf (26.7 N) • Forces exerted with one thumb (lifting, pushing, pulling, or carrying): ≤ 5 lbf (22.2 N) • Pinch/grip force exerted to assemble, grasp, pull, push, or hold: ≤ 6 lbf (26.7 N)	Ergonomic Posture Guidelines: 
Low: • Any remaining unrated tasks which do not qualify as High or Moderate		

Risk Factors

Repetition

- Number of times, or amount of time, a muscle group is active during a task
- Performing the same acts or motions over and over again
- Operation Cycle time less than 60 seconds



Risk Factors

Force

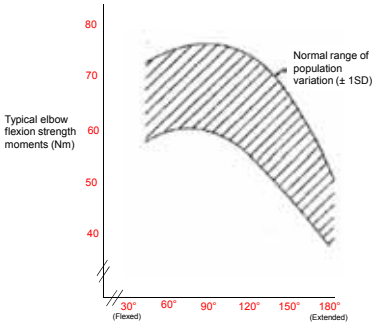
- Amount of physical effort required to perform an action or movement

Risk Factors

Posture

- Refers to the position of the body, limb, or body segment when performing an action
- One or more joints that have a different angle than what is considered neutral

Risk Factors



(Chaffin and Andersson, 1991)

Other Risk Factors

Contact Stress (pounding on parts, resting on sharp edges, etc.)

Static Load/Posture (staying in one position for long periods of time)

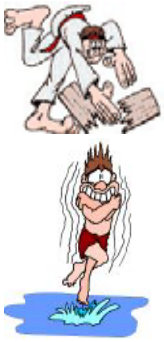
Vibration

Noise

Cold Temperatures

Personal Factors

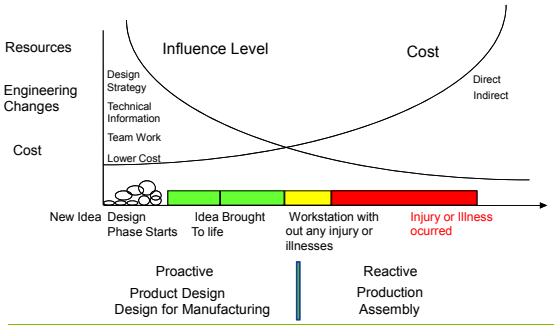
- Rheumatoid Arthritis
- Endocrinological Disorders (diabetes, etc.)
- Acute Trauma (bruises, laceration, etc.)
- Gender
- Pregnancy
- Surgery



Ergonomic Risk Factors: Hierarchy of Controls

Repetition	Force	Posture
Design/ Engineering Controls: •Design for motion efficiency and use the best method to perform a task •Process (Work Balance, intelligent way to work) •Workload / Rest Periods •Work balance (Rebalance based on tasks)	Design/ Engineering Controls: • Product Design that gives less resistance if possible • Workstations that will provide support for the operator (Fixtures, Jigs, Nests, etc), • Height Adjustable workstations • Part Presentation at the right height and reach • Provide assistive tools where they are needed (lift assists, tote movers, hand tools, etc.) • Keep workstation and operations design under the force guidelines depending on body part used	Design/ Engineering Controls: • Height adjustable workstations: work envelope within: 34 inches to 46 inches for US, Canada, England, Spain, Czech Republic; 35 inches to 47 inches for Germany; 33 inches to 45 inches for Russia and Baltic Countries • Workstation design within Forward Reach envelope, for work, tools, and part presentation (from the first physical barrier to the front: 0 to 18 inches for US, Canada, England, Spain, Czech Republic, Germany, Russia and Baltic Countries) • Part movement within the work envelope
Administrative Controls: • Work Hardening • Stretches at the Beginning and End of Workday • Programmed Breaks at least every hour for 2 -3 minutes with stretches (Approx. 40% risk reduction based on OCRA analysis) • Ergonomic Based Rotation: Create a rotation path within 8 to 12 workstations where the operator can rotate every hour in a Standard and Organized manner, where the workstations use different body parts and motions • NOTE: Operators going through different workstations in less than 5 minutes is not considered an Ergonomic Based Rotation; the workstations will be considered as one cycle time in order to measure the risk	Administrative Controls • Work Hardening (muscle conditioning) • Stretches at the Beginning and End of Workday • Ergonomic Based Rotation: Create a rotation path within 8 to 12 workstations where the operator can rotate every hour in a Standard and Organized manner, where the workstations use different body parts and motions	Administrative Controls: • Training :correct movements to perform task to avoid unnecessary awkward movements and postures • Supervise the operators to ensure that the standard work is being followed • Programmed Breaks at least every hour for 2 -3 minutes with stretches (Approx. 40% risk reduction based on OCRA analysis)

Why is Ergonomics Important



CTD'S OR WMSD'S

MSD's (Musculoeskeletal Disorders)

WMSDs are work-related injuries and disorders of the musculoskeletal system, which includes the muscles, tendons, tendon sheaths, nerves, bursa, blood vessels, joints and ligaments.

WMSDs have been related to various ergonomic risk factors, including, but not limited to:

- repetitive, forceful, or prolonged exertions
- frequent or heavy lifting, pushing, pulling, carrying of objects
- fixed or awkward work postures
- local or whole-body vibration
- cold temperatures
- work organization (e.g. task variability, work rate)

MSD's (Musculoeskeletal Disorders)

KEY POINT = develop gradually over weeks, months, and years from exposure to repetitive, awkward, and/or forceful tasks

- Also referred to as:
  - Repetitive Strain Injuries
  - Cumulative Trauma Disorders
  - Repetitive Motion Disorders
  - Etc.

MSD's (Musculoeskeletal Disorders)

Development of a MSD

Phase 1	Phase 2	Phase 3
*Symptoms are present when performing certain activities, and disappear when the body part is not in use *Does not affect productivity, movement, or force of the person *It can be present for weeks, months, or even years	*Symptoms are present even when not performing the activity that cause them. May start to be present even while sleeping *Productivity and force are decreased *It can be present for weeks, months, or even years; but may not be reversible.	*Symptoms increase and are present 24/7 *Productivity, movement, and force are decreased *Not reversible, usually requires surgury to get relief.

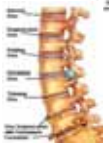
MSD's (Musculoeskeletal Disorders)

Tendonitis

Carpal Tunnel

DeQuervain's

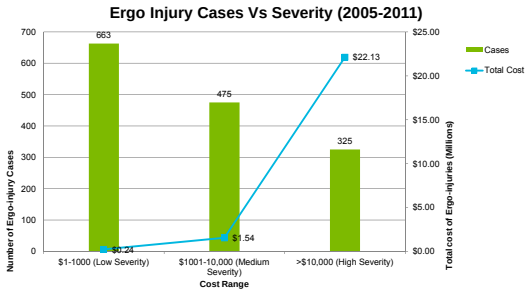
Rotator Cuff



Back Disorders

COST OF ERGONOMICS

Cost Model



Indirect Costs related to Poor Ergonomics

- Productivity loss
- Overtime
- Time for Incident investigation
- Maintenance and update of the case
- Worker replacement
- Scrap
- Low self-esteem and work environment impact
- For every incident cost there is a higher indirect cost:
  - From $1 to $5 indirect cost for every $1 of direct cost (*Liberty Mutual, 1998)

Cost of CTDs

CTD (WMSD's) injuries can get very expensive:

According to 'Safety Pays' program for US:	
Direct Costs	Indirect Cost Ratio
$0 - $2,999	4.5
$3,000 - $4,999	1.6
$5,000 - $9,999	1.2
$10,000 or more	1.1

Examples of Different Injury Costs				
Direct Cost ($)	Indirect Cost ($)	Total Cost ($)	Profit Margin of Program (%)	Maximum Potential Impact on Revenue ($)
1,000	4,500	5,500	5	110,000
4,000	6,400	10,400	5	208,000
7,000	8,400	15,400	5	308,000
10,000	11,000	21,000	5	420,000

Ergonomic Assessment: Costs

Costs Related Incidents:

Actual Shoulder Injury (End of line workstation, related to bad design, height, reach, and force exceeded design guidelines)

Direct Cost	$ 17,785.00	Cost that has paid the company until this day
Indirect Cost (1.1 X Direct Cost) *OSHA Ratio for Indirect cost from direct cost above $10,000 USD	$ 19, 563.50	Cost for replacing the employee, training the employee, having the employee at restricted work, scrap due to the learning curve, etc.
Total Cost (Direct + Indirect Cost)	$ 37,348.50	What the company is actually paying due to this incident
Profit % (*Profit % for the project not revealed, 5 is used in this case due to the product line)	5%	What is expected to be obtained as a profit for this particular project
Revenue Impact ((Total Cost * 100)/ % Profit) Actual Impact on Revenue per Incident	$ 746,970.00	Amount of additional sales that need to be done in order to maintain the Calculated Profit at the beginning of the project due to this injury

Ergonomic Assessment: Costs

Example of cases for a facility:

Injury Type Total	Direct Cost	Indirect Cost	Total Cost	Revenue Impact (5% Profit)
Finger Injuries	$ 7,266	$15,193.80	$22,459.80	$449,196.00
Shoulder Injury	$ 17,785.00	$19, 563.50	$ 37,348.50	$746,970.00
Any injury	$1.00	$ 4.50	$5.50	$110.00

The direct costs in the calculation are only the ones reported in WC.

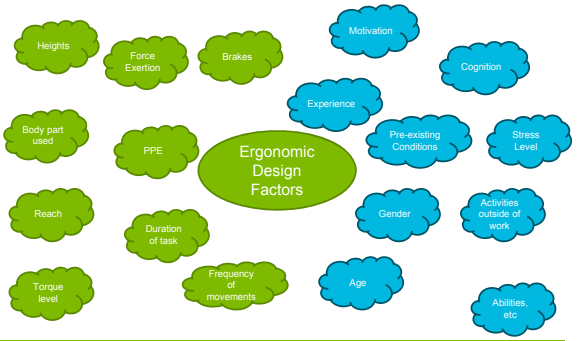
Ergonomic Assessment: Costs

Costs

Incident	Actual Impact on the Revenue	No. of Employees Exposed to Risk	Action	Cost of Action
Shoulder Injury	$746,970.00	8 X Shift (4 on each rotation path) on the load off station	Re design lift assist control	- $1,800.00 X 2 lift assists $3,600.00
		8 X Shift (4 on each rotation path) on station 170	Adjustable Platform	-$5,500.00 X6 platforms $ 33,000.00
		8 X Shift (4 on each rotation path) on loading metal frame	Sensor Connected to line for usage of the lift assist	-$2,000.00 X 2 Sensors $ 6,000.00
		8 X Shift (4 on each rotation path) on Torque with no mechanical arm	Appropriate mechanical arm	-$ 800.00 X 2 mechanical arm $1,600.00

ERGONOMICS BASIC PROGRAM AND ROTATION

Ergonomic Design Criteria



Basic Ergonomics Program Structure

Training
•Specific Ergonomics Training to different functional Groups
•Management
•Engineers
•Supervisors
•Team Members

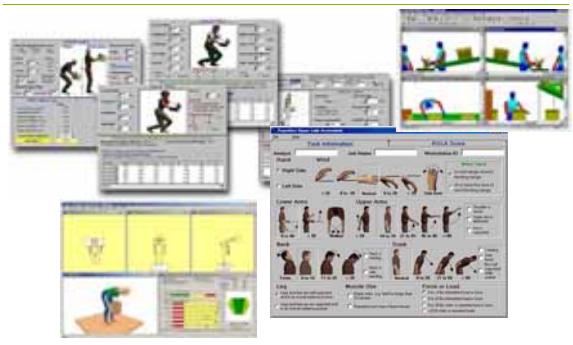
Design (Proactive Ergonomics)
•Design Guidelines
•Design Checklist
•Mock-ups
•Ergonomic Analysis Tracker

Ergonomics Program

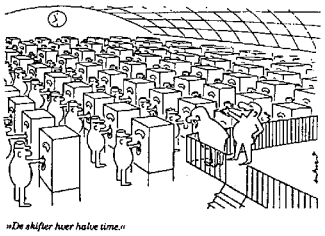
Production (Reactive Ergonomics)
•Ergonomic Team
•Ergonomic Investigation
•Tools:
•RULA
•NIOSH lifting Equation
•Energy Expenditure
•HAL
•Strain Index
•REBA
•OCRA
•3DSSPP
•Job Rotation (Rotation Paths)
•Stretching Exercises
•Buyoffs

Office Ergonomics
•Training
•Analysis for cases with illnesses or complaints

Ergonomic Analysis Tools



Rotation



»De skifter hver halve time.«

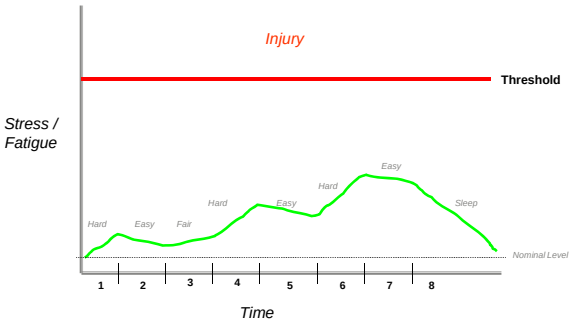
They rotate every 30 minutes

Rotation

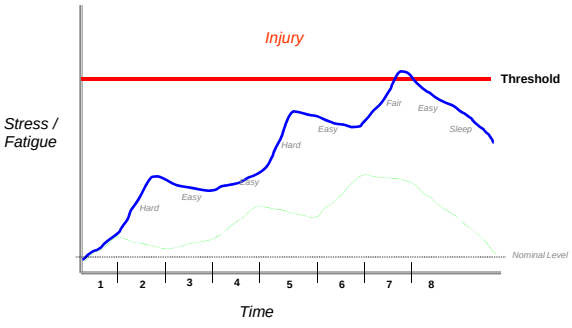
- Rotation should vary the different level of risk on different body parts

- Good Job Rotation Path Requirements
- Absolute minimum of 4 jobs in a rotation cell (8 or less hours shifts)
- Recommendation is to have 8 – 12 jobs in a rotation cell
- If jobs need to be removed from a rotation path due to RTW, restrictions, etc.
  - As long as # Healthy Workers - # Injured Workers ≥ 4 (for jobs in the rotation path), then the injured operator can be accomodated
  - If it comes out less than that, the injured operator cannot be accomodated

Good Rotation Path



Deficient Rotation Path



Job Rotation

Requirements	Exceptions

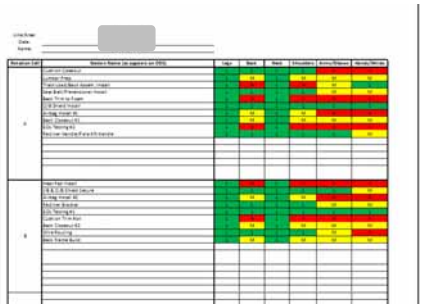
• Maximum job rotation frequency/cumulative time spent at one station/job should be 2 hours per day
• Job ratings for specific body parts/muscle groups associated with the task should be identified by applicable and validated risk assessment tool to help create the job rotation schedule
• Each job rotation cell should consist of a minimum of 4 jobs (a higher target of 8 jobs is recommended for optimal performance)
	• There are some cases where it is not possible to implement a job rotation schedule:
	  • Jobs where pay grades or union agreements prevent adequate rotation paths
	  • Areas where there is no variation (or not enough variation for adequate rotation paths) on body parts and their level of risk.
	  • For specialized/skilled operations (skilled trade, welding, etc.).
	• A break schedule can be implemented instead:
	  • At least 5 minutes of stretching at the beginning of the shift
	  • 2 – 3 minute breaks for every hour of work with stretching focused on the body parts being used at the specific station
	  • At least 5 minutes of stretching at the end of the shift

Risk Reduction by Break vs. Rotation

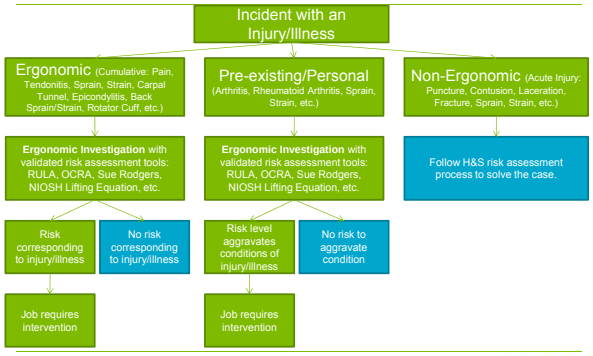
	Level of Risk exposure at station: High risk Automotive industry. OCRA Index		Foreseen % of WMSDs for work seniority of 10 years	
	Right upper limb	Left upper limb	Right upper limb	Left upper limb
8 hours shift, no programmed breaks except 20 minutes for breakfast and 30 minutes for lunch	10.3	8.5	43.3	35.7
8 hours shift, with natural breaks (break every 2 hours and 20 minutes for breakfast and 30 for lunch)	8.8	7.3	37	30.7
8 hour shift with the program break of 20 minutes for breakfast and 30 minutes for lunch, plus a programmed break (2-3 minutes) for stretches every hour	6.2	5.1	26	21.4
3 hours of exposure through out the day with out any breaks	5.4	4.4	22.7	18.5
3 hours of exposure through out the day with programmed breaks (2-3 minutes) every hour	3.8	3.1	16	13
1 hour exposure, based on Ergonomic Rotation (accumulation)	2.8	2.3	11.8	9.7

Job Rotation Worksheet

Let's analyze a rotation path!



Summary



Thank you all from the Ergo Team

Monica **Maria** **Parag**

Thanks!!!

Comments or Questions?!?

If you would like to discuss an issue, please don't hesitate to contact us!