Virtual Ergonomic and Cost Justification Tools

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Your Speaker: Ellen Gallo

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Your Presenter

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- Education
  - ✓Bachelor of Science, Industrial Engineering (University of Wisconsin)
  - ✓Master of Science, Environmental Management (Illinois Institute of Technology)
- 25+ years of Safety/Ergonomics experience
  - ✓Over 10 years in insurance and consulting
  - ✓15 years in private industry (site, HQ, director, global)
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Resolving Ergonomics Issues

The ARECC Process

- Anticipate
- Recognize
- Evaluate
- Control
- Confirm

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Anticipate

Are principles of Prevention through Design (PtD) practiced?

- ✓ Easily reached components, tooling, and controls to reduce awkward postures, especially of the upper extremities
- ✓ Reasonable force requirements involving weights or forces to lift or move items
- ✓ Reasonable force requirements involving use of tools or assembly tasks, especially grip forces by the hand(s)
  - ?

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Anticipate

The impact of good ergonomic design

- ✓ Increased candidate pool since a higher population percentage of workers can safely perform job tasks
- ✓ Increased diversity and inclusion in the candidate pool from reduced physical demands
- ✓ Reduced potential for stress/injury
- ✓ Less product and component touches, possibly improving finished product quality and process efficiency
- ✓ Reduced absenteeism, and decreased soreness and fatigue since the physical demands of the job tasks are lessened
- ✓ Increased number of healthy uninjured workers
- ✓ Reduced turnover since workers are safer and likely have increased job satisfaction

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Recognize

- Symptom Survey
  - Indication of emerging issues
  - May trigger new reports/cases but allows early intervention
  - NIOSH has examples at https://www.cdc.gov/niosh/topics/ergonomics/ergoprimer/step3.html
- New processes or equipment that introduce manual tasks?
- Is there absenteeism at certain jobs?
- Is there excessive turnover at certain jobs?
- Are team members wearing splints or rubbing joints?

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Evaluate

- Data Driven Approach
  - Variety of tools to evaluate
  - Many online tools
- There are many assessment tools
  - NIOSH has examples of a variety of tools
  - OSHA has examples of case studies, including evaluation
  - 23 tools listed in AIHA's Ergonomic Toolkit
- Three assessment tools for this presentation
  - REBA – Rapid Entire Body Assessment
  - NIOSH's – NIOSH Lifting Equation or NLE
  - Use of Snook Push-Pull Calculator

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Evaluate – REBA

- REBA is Rapid Entire Body Assessment
  - Uses awkward postures to determine risk combined with force
  - Easy to choose icons that match postures
  - Takes a long time to get through the tool
  - Helpful to use videos and photos to capture posture
  - Can download the worksheet at https://ergo.human.cornell.edu/ahREBA.html

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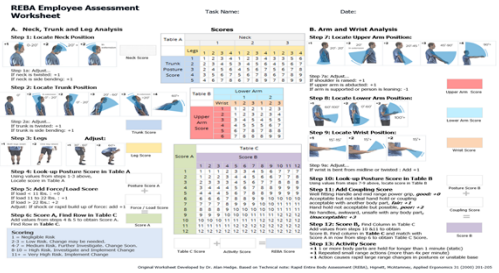
Evaluate - REBA Worksheet



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Evaluate

Example – Assembling a Frame

- Trigger is activated 20 times per minute
- 4 attachments per frame
- Each attachment requires turning and rotating the frame

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Evaluate – REBA Data Table

Body Region	Posture	Notes
Neck	Maximum Flexion = 12°	Twisting: no Side bending: no
Trunk	Maximum Flexion = 31°	Twisting: yes Side bending: no
Stance	Unilateral weight bearing	On occasion due to having to lean to reach across the worksurface
Knees	Maximum flexion = 7°	-
Upper Arms	Maximum flexion = 72°	Extension: no Shoulder raised: no Upper arm abducted: yes Arm supported/person leaning: no
Lower Arms	Maximum flexion = 18°	-
Wrists	Maximum flexion = 8° Maximum extension = 18°	Bent at midline: yes Twisted: no
Tool Activation Force	8 pounds	shock/rapid build-up of force when triggered: yes
Coupling	Acceptable but not ideal hand hold or coupling/acceptable with another body part: fair	
1 or more body parts held for longer than 1 min (static): no	Repeated small range actions (more than 4x per minute): yes	Actions cause rapid large range changes in postures or unstable base: no

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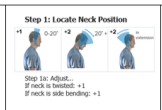
Evaluate

- REBA Neck Region

Observed Postures:		REBA Neck Score
-Maximum Neck Flexion: 12º -Neck Twisting: none		+1

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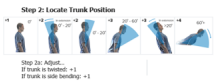
Evaluate

- REBA Trunk Region

Observed Postures		REBA Trunk Score
-Maximum Trunk Flexion: 31° -Trunk Twisting: Yes -Trunk Side Bending: No		3+1=4

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Evaluate

- REBA Leg Region

Observed Postures		REBA Leg Score
-Unilateral weight bearing (e.g. one leg raised) -Maximum knee flexion: 7°		2+0=2

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Evaluate

- REBA Upper Arm Region

Observed Postures		REBA Upper Arm Score
- Maximum flexion: 72°	 Step 7a: Adjust... If shoulder is raised: +1 If upper arm is abducted: +1 If arm is supported or person is leaning: -1	3+1=4

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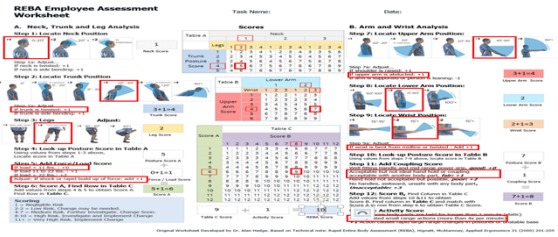
Evaluate - Tallying the Score

- Using the same logic, calculate remaining regions
- Total score = 10



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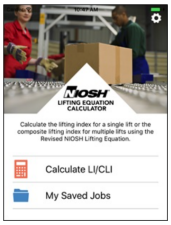
Evaluate – NIOSH Lifting Equation

- Download the app!
  - https://www.cdc.gov/niosh/topics/ergonomics/nlecalc.html
  - Other apps out there so you can pick and choose what works best for you
  - Calculates the Recommended Weight Limit (RWL) that tells you the maximum weight of the item lifted, based on the task parameters
  - Also calculates the Lifting Index that calculates the percentage of the item's weight over the RWL
  - An LI of > 1.0 exceeds what is considered safe based on the NIOSH Lifting Equation



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Evaluate

Example – Lifting produce box from trailer bed floor to the top of a pallet

Task Parameters on next page

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Evaluate

Parameter	Description	Measurement
Horizontal Location (origin of lift)	Horizontal location is from the front part of the body to the object.	H=19 inches
Horizontal Location (destination of lift)		H=25 inches
Vertical Location (origin of lift)	Vertical height of the hands above floor.	V=9 inches
Vertical Location (destination of lift)	The Vertical Travel Distance (D) is defined as the vertical travel distance of the hands between the origin and destination of the lift.	V=42 inches
Asymmetry (origin of lift)	The angle of hip twisting	A=47 degrees
Asymmetry (destination of lift)		A=11 degrees
Frequency	Average number of lifts per minute (lpm), as measured over a 15 minute period	F=3 lifts/minute
Task duration	The amount of time engaged in the lifting task	4 hours
Coupling	Hand-to-object gripping method	Fair
Load weight	Current weight of the load being lifted in the task	20 lbs

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Evaluate - Results

Recommended Weight Limit	12.37 lbs.
Lifting Index	1.62

- Interpreting the Results
  - 12.37 RWL < 20 lb. box
  - 1.62 = Lifting Index
  - Lifting Index indicates the box weight exceeds the RWL by 62%
  - By altering the parameters, the Lifting Index can be reduced

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Evaluate – Push Pull Calculators

- Determine which type of tool needed
  - Push/pull/carry – Snook tables
  - In 2020, Snook, Ciriello, et.al., developed predictive equations
  - Equations replace the tables
  - Calculators available from Work Safe BC and Liberty Mutual
    http://worksafebcmedia.com/misc/calculator/
    https://libertymmhtables.libertymutual.com/

The Liberty Mutual manual materials handling (LM-MMH) equations

Jim R. Potvin, Vincent M. Ciriello, Stover H. Snook, Wayne S. Maynard & George E. Brogmus

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Evaluate

Example – Pushing a Wheeled Cart

Task Parameters for Data Entry

Task Parameter	Measurement
Frequency of Push (pushes/minute)	2 pushes/min
Initial Force (lbs)	47 lbs
Sustained Force (lbs)	31 lbs
Horizontal Distance (ft)	32 feet
Vertical Hand Height (ft)	39 inches

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Evaluate

Example – Pushing a Wheeled Cart – Male Results

Calculated results

Suggested maximum initial force:
23 kg / 50 lb

Suggested maximum sustained force:
13 kg / 28 lb

What does this mean?
75% of males should be able to exert these forces under the conditions selected. Force is not the same as the weight of the object.

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Evaluate

Example – Pushing a Wheeled Cart – Female Results

Calculated results

Suggested maximum initial force:
15 kg / 33 lb

Suggested maximum sustained force:
8 kg / 17 lb

What does this mean?
75% of females should be able to exert these forces under the conditions selected. Force is not the same as the weight of the object.

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Evaluate

Summary – Pushing a Wheeled Cart – Using the results

- Max Forces Permitted – Use female limits of:
  - Female limits: 33 lbs. initial force and 17 lbs. sustained force
  - Male limits: 50 lbs. initial force and 28 lbs. sustained
- Task Parameters – Push force
  - 47 lbs. initial; 31 lbs. sustained
  - Initial force exceeds female limit of 33 lbs.
  - Sustained force exceeds both female (17 lbs.) and male (28 lbs.)

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Control

Step 1 – Discuss options and feasiblity
- Helps arrive at achievable outcome
- Gains buy-in with plant team

Step 2 – Estimate Cost Effectiveness
- Gather control/equipment cost, including installation
- Estimate cost savings
  - Injury costs – OSHA's $afety Pays
  - National Safety Council Injury Facts
  - Don't Forget Efficiency Gains!

Step 3 – Gain Agreement
- Present to decision makers to grant cap ex
- Cost justification should seal the deal – no one wants to make a bad business decision

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Cost Justification

Improvement Cost
- Adding a rotating surface to reduce wrist rotation
- Five turntables/five workstations costing $300 each - $1500 total spend
- Installation – minimal and can be done in-house so estimate at $500

Estimate Cost Justification
- Injury costs – OSHA's $afety Pays - $32,023 = average cost of a strain
- Efficiency gains –
  - 20 seconds/part *50 parts/shift * 5 workstations * 2 shifts/day = 10,000 seconds/day
  - 1000 seconds/day *1 hr/3600 seconds * 5 days/week *$15/hour * 50 wks/yr = $10,420/yr
  - Efficiency alone would pay for the improvement in about 40 weeks!
  - If overtime is used and no shutdown occurs, savings would be even higher!

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Cost Justification

Direct Injury Cost Avoidance	$32,023
Indirect Injury Cost Avoidance	$35,225
Efficiency Gain/Loss	$10,420
Cost of Control	-$1,500
Control Installation Cost	-$500
First Year Payback	$75,668
Return on Investment	38:1

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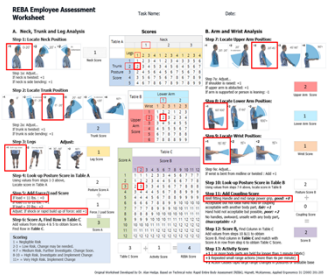
Confirm - REBA

Step 1 – Define control and impact

- Rotating table eliminated reach and forward bend

Step 2 – Recalculate REBA risk

- REBA risk score reduced from 10 to 4, a 60% reduction
- ***Control confirmed***



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Thank You

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