Virtual Ergonomic and Cost Justification Tools

April 13, 2022

Your Speaker: Ellen Gallo

Your Presenter
Ellen Gallo, CSP, CPE, MBA
• Senior Consultant, Aon Global Risk Consulting
• 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)
• Contact Information:
  • ellen.gallo@aon.com

Resolving Ergonomics Issues
The ARECC Process
  • Anticipate
  • Recognize
  • Evaluate
  • Control
  • Confirm
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)

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

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/ergoprix.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?
**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

**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](https://ergo.human.cornell.edu/ahREBA.html)

**Evaluate - REBA Worksheet**
### Evaluate

**Example – Assembling a Frame**
- Trigger is activated 20 times per minute
- 4 attachments per frame
- Each attachment requires turning and rotating the frame

### Evaluate – REBA Data Table

<table>
<thead>
<tr>
<th>Body Region</th>
<th>Figure 1</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck</td>
<td>Maximum Flexion: 12°</td>
<td>Side bending: no</td>
</tr>
<tr>
<td>Trunk</td>
<td>Maximum Flexion: 15°</td>
<td>Side bending: no</td>
</tr>
<tr>
<td>Arms</td>
<td>Shoulder weight bearing</td>
<td>In contact with object, hurting in hand across the moment arm</td>
</tr>
<tr>
<td>Legs</td>
<td>Maximum Flexion: 40°</td>
<td>Lower arm awkward</td>
</tr>
<tr>
<td>Upper arms</td>
<td>Maximum Flexion: 15°</td>
<td>Shoulder weight bearing on upper arm, awkward on lower arm</td>
</tr>
<tr>
<td>Lower arms</td>
<td>Maximum Flexion: 15°</td>
<td>Shoulder weight bearing</td>
</tr>
<tr>
<td>Hands</td>
<td>Maximum Extension: 90°</td>
<td>Reach or another way</td>
</tr>
</tbody>
</table>

- **Head Anticipation Force:** 8 pounds
- **Wrist/Hand Injury:** Hand/forearm discomfort when impacted
- **Coping:** Acceptable tool and direct hand hold or coping acceptable with negative feedback

### Evaluate

- **REBA Neck Region**

<table>
<thead>
<tr>
<th>Observed Postures:</th>
<th>REBA Neck Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Neck Flexion: 12°</td>
<td>+1</td>
</tr>
<tr>
<td>Neck Twisting: none</td>
<td></td>
</tr>
</tbody>
</table>
Evaluate
• REBA Trunk Region

<table>
<thead>
<tr>
<th>Observed Postures</th>
<th>REBA Trunk Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Trunk Flexion: 31°</td>
<td>3+1=4</td>
</tr>
<tr>
<td>Trunk Twisting: Yes</td>
<td></td>
</tr>
<tr>
<td>Trunk Side Bending: No</td>
<td></td>
</tr>
</tbody>
</table>

Evaluate
• REBA Leg Region

<table>
<thead>
<tr>
<th>Observed Postures</th>
<th>REBA Leg Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unilateral weight bearing (e.g. one leg raised)</td>
<td>2+0=2</td>
</tr>
<tr>
<td>Maximum knee flexion: 70°</td>
<td></td>
</tr>
</tbody>
</table>

Evaluate
• REBA Upper Arm Region

<table>
<thead>
<tr>
<th>Observed Postures</th>
<th>REBA Upper Arm Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum flexion: 72°</td>
<td>3+1=4</td>
</tr>
<tr>
<td>Step 1: Locate Upper Arm Positions:</td>
<td></td>
</tr>
<tr>
<td>Step 2: Adjust Upper Arm Positions:</td>
<td></td>
</tr>
<tr>
<td>Step 3: Assess Upper Arm Positions:</td>
<td></td>
</tr>
<tr>
<td>Step 4: Evaluate Upper Arm Positions:</td>
<td></td>
</tr>
<tr>
<td>Step 5: Adjust Upper Arm Positions:</td>
<td></td>
</tr>
<tr>
<td>Step 6: Assess Upper Arm Positions:</td>
<td></td>
</tr>
<tr>
<td>Step 7: Evaluate Upper Arm Positions:</td>
<td></td>
</tr>
</tbody>
</table>
- Tallying the Score

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

Evaluate – NIOSH Lifting Equation

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

Evaluate

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

Task Parameters on next page
Evaluate

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headroom</td>
<td>Clearance from the head of the object</td>
<td>4.5 ft. (minimum)</td>
</tr>
<tr>
<td>Backroom</td>
<td>Clearance from the back of the object</td>
<td>3 ft. (minimum)</td>
</tr>
<tr>
<td>Contact</td>
<td>Vertical height of the box above the floor</td>
<td>V-Box</td>
</tr>
<tr>
<td>Contact</td>
<td>Contact height (distance between the hand and the object)</td>
<td>C-Box</td>
</tr>
<tr>
<td>Angle of incline</td>
<td>The angle of incline</td>
<td>A-Box (degrees)</td>
</tr>
<tr>
<td>Intensity</td>
<td>Average number of lifts per minute (15 minutes)</td>
<td>30 lifts/min</td>
</tr>
<tr>
<td>Force</td>
<td>The amount of force required</td>
<td>400 lbs.</td>
</tr>
<tr>
<td>Coupling</td>
<td>Hand or object pushing or pulling</td>
<td>Poor</td>
</tr>
<tr>
<td>Load weight</td>
<td>Current weight of the object</td>
<td>30 lbs.</td>
</tr>
</tbody>
</table>

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

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/mip/calculator/
    - https://libertymutualtables.libertymutual.com/
Evaluate

Example – Pushing a Wheeled Cart
Task Parameters for Data Entry

<table>
<thead>
<tr>
<th>Task Parameter</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency of Push (pushes/min)</td>
<td>2 pushes/min</td>
</tr>
<tr>
<td>Initial Force (lbs)</td>
<td>47 lbs</td>
</tr>
<tr>
<td>Sustained Force (lbs)</td>
<td>31 lbs</td>
</tr>
<tr>
<td>Horizontal Distance (ft)</td>
<td>30 feet</td>
</tr>
<tr>
<td>Vertical Hand Height (in)</td>
<td>30 inches</td>
</tr>
</tbody>
</table>

Evaluate

Example – Pushing a Wheeled Cart – Male Results
Calculated results

Suggested maximum initial force:
23 kg / 50 lbs

Suggested maximum sustained force:
19 kg / 42 lbs

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.

Evaluate

Example – Pushing a Wheeled Cart – Female Results
Calculated results

Suggested maximum initial force:
11 kg / 25 lbs

Suggested maximum sustained force:
8 kg / 17 lbs

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.
Evaluate

Summary – Pushing a Wheeled Cart – Using the results

• Max Forces Permitted – Use female limits of:
  o Female limits: 33 lbs. initial force and 17 lbs. sustained force
  o Male limits: 50 lbs. initial force and 28 lbs. sustained force

• Task Parameters – Push force
  o 47 lbs. initial; 31 lbs. sustained
  o Initial force exceeds female limit of 33 lbs.
  o Sustained force exceeds both female (17 lbs.) and male (28 lbs.)

Control

Step 1 – Discuss options and feasibility
  • 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
    o Injury costs – OSHA’s Safety Pays
    o National Safety Council Injury Facts
    o 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

Cost Justification

Improvement Cost
• Adding a rotating surface to reduce wrist rotation
• Five turntables/five workstations costing $300 each – $1,500 total spend
• Installation – minimal and can be done in-house so estimate at $500

Estimate Cost Justification
• Injury costs – OSHA’s Safety 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 = $15/shift * 5 days/week * $30/wk/hr = $225/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!
Cost Justification

<table>
<thead>
<tr>
<th>Cost Component</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Injury Cost Avoidance</td>
<td>$32,023</td>
</tr>
<tr>
<td>Indirect Injury Cost Avoidance</td>
<td>$35,225</td>
</tr>
<tr>
<td>Efficiency Gain/Loss</td>
<td>$10,420</td>
</tr>
<tr>
<td>Cost of Control</td>
<td>-$1,500</td>
</tr>
<tr>
<td>Control Installation Cost</td>
<td>-$500</td>
</tr>
<tr>
<td>First Year Payback</td>
<td>$75,668</td>
</tr>
<tr>
<td>Return on Investment</td>
<td>38.1</td>
</tr>
</tbody>
</table>

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

Thank You