Increase your Productivity with these Ergonomic Principles

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Presenters

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Objectives

- The Economics of Ergonomics
- Results of Washington State Department of Labor 250 Case Studies
- Principles to Consider when Designing an Industrial Workstation
- New Ergonomic Time and Motion Study
The Economics of Ergonomics
Impact of Work-related Musculoskeletal Disorders (WMSDs)

WMSD’s are among the most frequently reported causes of lost or restricted work time.

WMSD’s account for 33% of all Workers compensation costs

Source: Bureau of Labor Statistics
Need for Ergonomics

Top 10 Causes and Direct Costs of the Most Disabling U.S. Workplace Injuries

Total Cost: $58.5 billion
Cost of top 10: $51.4 billion
Cost of WMSD’s: ~$20 billion

Source: 2018 Liberty Mutual Workplace Safety Index
Costs of WMSD’s

Indirect Cost of WMSD’ are up to **five** times the direct costs

<table>
<thead>
<tr>
<th>Direct Costs</th>
<th>Workers comp, medical &amp; legal expenses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indirect Costs</td>
<td>Training replacement, accident investigation, lost productivity, lower employee morale &amp; turnover</td>
</tr>
</tbody>
</table>

Source: [https://www.osha.gov/safetypays/background.html](https://www.osha.gov/safetypays/background.html)
Culture of Safety & Health

Tracking the Market Performance of Companies that Integrate a Culture of Health & Safety

Source: Journal of Occupational & Environmental Medicine
OSHA Calculator

Calculate the Impact of WMSD’s on Your Business

Source: https://www.osha.gov/safetypays/estimator.html
250 Case Studies
Washington State Department of Labor and Industries Reviewed Effect of Ergonomics

ERGONOMICS
Reduce Cost
250 Case Studies
Washington State Department of Labor and Industries Reviewed Effect of Ergonomics

ERGONOMICS
Improve Productivity
250 Case Studies
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ERGONOMICS
Improve Accuracy & Quality
250 Case Studies
Washington State Department of Labor and Industries Reviewed Effect of Ergonomics

ERGONOMICS
Improve Employee Engagement
250 Case Studies
Washington State Department of Labor and Industries Reviewed Effect of Ergonomics

ERGONOMICS
Create a Better Safety Culture
# 250 Case Studies

Washington State Department of Labor and Industries Reviewed Effect of Ergonomics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Number of Examples</th>
<th>Mean</th>
<th>Median</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>WMSDs</td>
<td>90</td>
<td>59%</td>
<td>56%</td>
<td>8% - 100%</td>
</tr>
<tr>
<td>Lost workdays</td>
<td>78</td>
<td>75%</td>
<td>80%</td>
<td>3% - 100%</td>
</tr>
<tr>
<td>Workers’ comp costs</td>
<td>52</td>
<td>68%</td>
<td>70%</td>
<td>15% - 100%</td>
</tr>
<tr>
<td>Productivity</td>
<td>61</td>
<td>25%</td>
<td>20%</td>
<td>-0.2% - 80%</td>
</tr>
<tr>
<td>Payback period</td>
<td>36</td>
<td>0.7 yrs.</td>
<td>0.4 yrs.</td>
<td>0.03-4.4 yrs.</td>
</tr>
</tbody>
</table>

Source: Washington State Department of Labor and Industries
# 250 Case Studies

Washington State Department of Labor and Industries Reviewed Effect of Ergonomics

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<th>Mean</th>
<th>Median</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality (scrap/errors)</td>
<td>8</td>
<td>67%</td>
<td>75%</td>
<td>8% - 100%</td>
</tr>
<tr>
<td>Turnover</td>
<td>34</td>
<td>48%</td>
<td>48%</td>
<td>3% - 100%</td>
</tr>
<tr>
<td>Absenteeism</td>
<td>11</td>
<td>58%</td>
<td>60%</td>
<td>14% - 98%</td>
</tr>
<tr>
<td>Cost:Benefit ratio</td>
<td>6</td>
<td>1:45.5</td>
<td>1:10</td>
<td>1:2.5 - 1:140</td>
</tr>
</tbody>
</table>

Source: Washington State Department of Labor and Industries
Ergonomic Calculator

Calculate Your Ergonomic Cost Benefits

Source: https://pshfes.org/cost-calculator
Workforce Diversity

Challenges to workstation set-up and design.
Ergonomic Principles

- Optimize Position
- Eliminate Extreme Movements
- Minimize Forces & Repetition
- Order & Color Coding
- Optimize Lighting
Optimize Position

Challenge:
Multi-Operator processes
Varying heights

Danger Zone
Bending, stretching, and/or reaching
Optimize Position

Solution:
Height-adjustable workstations

Neutral Position
Most operators stay in 1\textsuperscript{st} and 2\textsuperscript{nd} zone
Optimize Position

Challenge:
Position of work instructions or other documentation

Solution:
Use monitor arms to position screens in correct height

Danger Zone
Neck bending

Neutral Position
For body and neck
Optimize Position
Accessories that help ensure an ergonomically sound position:

- Height-Adjustable Arms
- Articulating Arms
- Combined Arms
- Keyboard Trays
Eliminate Extreme Movements

Challenge:
Box building and packaging of large boxes on work surface:

Solution:
Under work surface shelving system:

Danger Zone
Reaching above the shoulder

Neutral Position
Keeping arms under shoulder height
Eliminate Extreme Movements

Challenge: Store packing material under work surface

Solution: Specialty holders / spools

Danger Zone Bending hips and waist

Neutral Position Allows the body to remain upright
Workstation Examples

- Box Building Shelf
- Spool Holders for Bubble-wrap
- Corrugate Storage Cart
- Printer Pull-out Shelves
- Label Trough
Minimize Repetitive Movements

Challenge:
Frequently used items for repetitive tasks placed at the rear of workstation forcing the operator to reach and twist to Reach **Zone 3**.

Solution:
Arm and rail systems bring items into Reach **Zone 1**.
Minimize Forces and Repetitive Exertions

Challenge:
Repetitive motions using manual tools w/o support

Solution:
Powered tools and balancers
Order and Color Coding

**Challenge:** When variety of items is needed for work process, uniform color of bins challenges productivity and accuracy.

**Solution:** Clear color coding and labeling. Order top to bottom, left to right for sequencing.
Workstation Example

Tool Track with Trolley and Balancer

Bin Rail with Color-coded Bins

Articulating Bin Holder
Lighting

Overhead Lighting

Room Lighting

Natural Light

Task Lighting
Lighting

Accessories that help provide ergonomically sound lighting:

- LED Overhead Light
- Task Light
- LED Ring Magnifier
- Max Magnifier
Workstation Example

LED Overhead Light

LED Ring Magnifier

Height-adjustable Monitor Arm

Height-adjustable Keyboard Arm
Online Configurator

Easy-to-use Online Configurators Help You Plan Ergonomic Details of Your Workstations

Source: https://www.bostontec.com/design-workstation/
Task Analysis Tool

**FREE**, online suite of assessment tools designed to assist your company in providing the best analysis of your operations and tasks.

Source: [https://www.ergocenter.ncsu.edu/resources_tools/ergodata/](https://www.ergocenter.ncsu.edu/resources_tools/ergodata/)
New Ergonomics Time & Motion Study

The Ergonomic Center
North Carolina State University

- Conducted in November - December 2019
- Ten subjects (5 M, 5 F), varied height, weight, BMI
- Typical assembly task: Cycle time <5 min
- Typical fulfillment task: Cycle time <3 min
- One workstation in traditional, fixed-height set-up
- One height-adjustable workstation following ergonomically sound principles
New Ergonomics Time & Motion Study

Objective Measures:

1. Productivity / time differences

2. Motion differences
   a) Total No. of upper extremity motions
   b) No. of upper extremity value-added motions
   c) No. of upper extremity non-value-added motions

3. Ergonomic risk differences:
   a) No. of reaches outside of acceptable reach zones
   b) REBA or RULA scores - risk differences
New Ergonomics Time & Motion Study

Subjective measures:

1. Performance preference (rank order workstation type)
2. Comfort preference (rank order workstation type)
3. Ease of use (System Usability Scale)
4. Participants open comments/feedback
Results: Productivity (Cycle Time)

Assembly Task - Cycle Time by Workstation Type

<table>
<thead>
<tr>
<th>Workstation Type</th>
<th>Cycle Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional (fixed)</td>
<td>4.62</td>
</tr>
<tr>
<td>Ergonomic (adjustable / optimized)</td>
<td>3.78</td>
</tr>
</tbody>
</table>

18% Improvement
Results: Productivity (Cycle Time)

18.5% Improvement
Results: Ease of Use (System Usability Scale)

Average System Usability Scores (SUS) by Workstation Type

- **Assembly Task**
  - Traditional (fixed): 54.75
  - Ergonomic (adjustable / optimized): 90.0
  - **64% Improvement**

- **Packaging Task**
  - Traditional (fixed): 45.25
  - Ergonomic (adjustable / optimized): 82.8
  - **76% Improvement**

Classification as suggested by Bangor et al., 2008
Results: Performance Preference

Assembly & Packaging Tasks — Preference by Workstation Type

I prefer the following workstation type to help me . . .

<table>
<thead>
<tr>
<th>Preference Rank Percentage (%)</th>
<th>Perform tasks more safely</th>
<th>Perform tasks more easily</th>
<th>Perform tasks faster</th>
<th>Perform tasks with less effort</th>
<th>Improve quality of products I made</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Ergonomic (Adjustable & Optimized Workstation)
Examples of Custom Workstations
Examples of Custom Workstations
Examples of Custom Workstations
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Or visit MODEX Booth #6404