Economic Justification of an Intervention in the Power Industry

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Topics

- **Task evaluated:*** Crimping and cutting cable
  - Analysis performed:
    - Records review
    - Ergonomics of the jobs
    - Economic justification of the interventions

* Research sponsored by Electric Power Research Institute (EPRI) and conducted at Marquette University, Milwaukee and WE Energies in Milwaukee
Lessons Learned

- Many sources of data, analysis untapped:
  - Indirect cost data
  - Economic analysis methods
    - How to use the “time value” of money
    - Several recommendations made
Utility Case Study

- A utility knew it had a problem
- They wanted to see:
  - Where cases were occurring
  - The costs of those cases
  - How best to use their resources

- First, step -- they decided to look at:
  - Types of cases
  - Timeliness of reporting
# Timeliness of Reporting at Host Utility


<table>
<thead>
<tr>
<th>Body Part</th>
<th>Early (first-aid)</th>
<th>Mid (OSHA recordable)</th>
<th>Late (lost time or restricted duty)</th>
<th>Total</th>
<th>% Reported Late</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back</td>
<td>25</td>
<td>12</td>
<td>20</td>
<td>57</td>
<td>35%</td>
</tr>
<tr>
<td>Upper extremity</td>
<td>16</td>
<td>19</td>
<td>16</td>
<td>51</td>
<td>31%</td>
</tr>
<tr>
<td>Lower extremity</td>
<td>15</td>
<td>8</td>
<td>2</td>
<td>25</td>
<td>8%</td>
</tr>
<tr>
<td>Neck</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>100%</td>
</tr>
<tr>
<td>Other</td>
<td>16</td>
<td>9</td>
<td>6</td>
<td>31</td>
<td>19%</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>72</strong></td>
<td><strong>48</strong></td>
<td><strong>47</strong></td>
<td><strong>167</strong></td>
<td><strong>27%</strong></td>
</tr>
</tbody>
</table>
# Sample of Severe Cases at Host Utility


<table>
<thead>
<tr>
<th>Type of Case</th>
<th>Lost wages</th>
<th>Medical costs</th>
<th>Other costs</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper extremity</td>
<td>$62,053</td>
<td>$49,532</td>
<td>$3,163</td>
<td>$114,748</td>
</tr>
<tr>
<td>only</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Back only</td>
<td>$12,234</td>
<td>$34,329</td>
<td>$904</td>
<td>$47,467</td>
</tr>
<tr>
<td>Totals</td>
<td>$74,287</td>
<td>$83,861</td>
<td>$4,067</td>
<td>$162,215</td>
</tr>
</tbody>
</table>

Economic Justification
Utility Case Study

- Second step:
  - The utility wanted to look at “indirect costs” that could be tied to the injuries
  - Indirect costs:
    - Often 4 – 8 times the direct costs
    - Limited data used in this case study
## Replacement Worker Costs

<table>
<thead>
<tr>
<th>Body Part</th>
<th>Restricted Duty</th>
<th>Lost Workday</th>
<th>Total Days Missed</th>
<th>Replacement Worker Cost (@ $36/hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cases</td>
<td>Days Missed</td>
<td>Cases</td>
<td>Days Missed</td>
</tr>
<tr>
<td>Back only</td>
<td>15</td>
<td>407</td>
<td>3</td>
<td>90</td>
</tr>
<tr>
<td>Upper extremity only</td>
<td>17</td>
<td>416</td>
<td>2</td>
<td>52</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>136</td>
<td>1</td>
<td>43</td>
</tr>
<tr>
<td>Totals</td>
<td>35</td>
<td>959</td>
<td>6</td>
<td>185</td>
</tr>
</tbody>
</table>
Replacement Workers

- **Costs included:**
  - Wages, benefits and training

- **Costs *NOT* included:**
  - Recruitment of new employees
  - Lower productivity during initial training
  - Reduced quality of work
  - Education investment in lost employee (turnover)
Utility Case Study

- Third step:
  - Defined the issues
  - Identified solutions
  - Conducted cost-benefit analysis

Manual vs. Battery Operated Crimpers and Cutters
Crimper Use and Extended Reaches

- High compression force needed (up to 72 pounds)
  - 1% has strength
  - Extended reaches common
- Risk of shoulder, elbow and back strains
Proposed Solution
Battery Operated Crimper

- Significantly less force to use the tool
- Better crimp quality and repeatability
- Much less chance of injury
  - Some extended reaches, but greatly reduced forces and duration
# Benefits of Battery Operated Press

<table>
<thead>
<tr>
<th>MSD Risk Factor</th>
<th>Improvements (Battery Press)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handle force = 70 lbs. (manual press)</td>
<td>99% of workers have shoulder strength</td>
</tr>
<tr>
<td>Shoulder forces (from pole)</td>
<td>Peak force: Reduced by 20%</td>
</tr>
<tr>
<td>Shoulder forces (from bucket)</td>
<td>Peak force: Reduced by 35%</td>
</tr>
<tr>
<td>Flexor forearm muscle forces (from pole)</td>
<td>Peak force: Reduced by 30%</td>
</tr>
<tr>
<td>Flexor forearm muscle forces (from bucket)</td>
<td>Peak force: Reduced by 40%</td>
</tr>
</tbody>
</table>

Handle force = 70 lbs. (manual press)
Use of a Cable Cutter

Manual Cutter:
- High forces needed
- Extended reaches
- Good chance of a shoulder, elbow and back strain

Battery-Operated Cutter:
- Significantly less force
- Much less chance of injury
- Frees up other hand
Economic Justification

- **Proposed solution**
  - Purchase battery-operated crimpers and cutters
    - 100 sets of tools (total = $300,000)
    - $3,000/5 years/3 workers
      (press = $2,000 each; cutter = $1,000 each)

- **Cost-benefit analysis performed**
  - Direct costs (injuries)
  - Indirect costs (limited data used)
## Costs of Using Hand-Operated Tools

<table>
<thead>
<tr>
<th>Specific Cost</th>
<th>Assumptions</th>
<th>Projected annual savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical, Workers Comp. Costs</td>
<td>7 upper extremity MSD cases</td>
<td>$22,951</td>
</tr>
<tr>
<td>Replacement Workers</td>
<td>187 restricted and lost time days @ $36/hour</td>
<td>$26,928</td>
</tr>
<tr>
<td>Retraining</td>
<td>10% of new apprentices no longer needed</td>
<td>$45,500</td>
</tr>
<tr>
<td>Cost of MSD cases reported late</td>
<td>2 cases per year</td>
<td>$80,000</td>
</tr>
<tr>
<td>Totals</td>
<td>--</td>
<td>$175,379</td>
</tr>
</tbody>
</table>
## Projected Payback of Battery Operated Tools

<table>
<thead>
<tr>
<th>Product type</th>
<th>Annual benefits (savings)*</th>
<th>Est. annual cost of tools**</th>
<th>Est. cost over 5 years</th>
<th>Payback period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery press</td>
<td>--</td>
<td>$40,000</td>
<td>$200,000</td>
<td>--</td>
</tr>
<tr>
<td>Battery cutter</td>
<td>--</td>
<td>$20,000</td>
<td>$100,000</td>
<td>--</td>
</tr>
<tr>
<td>Totals</td>
<td>$175,379</td>
<td>$60,000</td>
<td>$300,000</td>
<td>5 months</td>
</tr>
</tbody>
</table>

* Medical, retraining, replacement worker savings
** $3,000/5 years/3 workers (press = $2,000 each; cutter = $1,000 each)
Conclusion

- **Was the project worth pursuing? Yes!**
  - **Ergonomic benefits:**
    - Less strain on employees
    - More employees can use tools and do jobs
    - Big drop expected in Workers Compensation costs
  - **Other benefits:**
    - Better safety
    - Better quality
Other Payback Methods*

- Don’t rely on one method of analysis
- Many robust methods available:
  - Sales needed to cover costs
  - Benefit-to-cost ratio
  - “Time value” of money
    - Return on Investment
    - Net Present Value
    - Net Present Worth

* Check what methods are used in your organization
Sales to Cover Costs of Cases

Sales needed to cover costs = \frac{\text{Case costs}}{\text{Profit margin}}

Assumptions:
Case costs = $175,379
Profit margin\textsubscript{1} = 10%
Profit margin\textsubscript{2} = 5%

\[ S_1 = \frac{175,379}{0.1} \]
S\textsubscript{1} = $1,753,790

\[ S_2 = \frac{175,379}{0.05} \]
S\textsubscript{1} = $3,507,580
 Benefit-to-Cost Ratio

\[
\text{Benefit to Cost Ratio} = \frac{\text{Benefits or Savings of Project}}{\text{Costs of Project}}
\]

\[
\text{Benefit to Cost Ratio} = \frac{\$175,379}{\$60,000} = 2.92
\]

Benefit-to-Cost Ratio = 3 : 1
Return on Investment

\[
\text{Return on Investment} = \frac{\sum_{n=1}^{5} \frac{A_n}{(1+i)^n}}{C} \times 100\%
\]

\[
\text{Return on Investment} = \frac{\frac{175,379}{(1+0.1)^1} + \frac{175,379}{(1+0.1)^2} + \ldots}{300,000} \times 100\%
\]

\[
\text{Return on Investment} = 222\%
\]

A = Savings each year
n = Number of years
i = Interest rate
C = Initial project cost

A = $175,379
n = 5
i = 10%
C = $300,000
Net Present Value

\[ \text{Net Present Value} = \sum_{n=1}^{n} \frac{A_n}{(1+i)^n} - C \]

\[ \text{NPV} = \left( \frac{175,379_1}{(1+0.1)^1} - 60,000 \right) + \left( \frac{175,379_2}{(1+0.1)^2} - 60,000 \right) + \ldots \]

\[ \text{Net Present Value} = \$364,864 \]

A = Savings each year
n = Number of years
i = Interest rate
C = Project cost

A = $175,379
n = 5
i = 10%
C = $60,000/yr.
Net Present Worth

Net Present Worth = \( \frac{A[(1+i)^n - 1]}{i(1+i)^n} - C \)

Net Present Worth (1) = \( \frac{\$175,379[(1+0.1)^1 - 1]}{0.1(1+0.1)^1} \) - $60,000

\[ A = \text{Savings each year} \]
\[ n = \text{Number of years} \]
\[ i = \text{Interest rate of money} \]
\[ C = \text{Project cost} \]

Net Present Worth (1) = $99,435

Net Present Worth (2) = $184,377

Net Present Worth (3) = $256,142

Net Present Worth (4) = $315,928

Net Present Worth (5) = $364,612

A = $175,379
n = 5
i = 10%
C = $60,000/yr.
Economic Analysis

- Economic benefits were clear:
  - Simple analysis
  - Time value of money methods
- Use of other indirect costs crucial to making many cases
Factors Not Included

- Improved productivity
  - Less cycle time per job
  - More projects done in a day with less ergonomic stress
- Better quality
  - Faster restoration of service
  - Better consistency and less rework
  - Less rescheduling
- Administration time
  - Incident investigation
  - Case administration and management time
Acknowledgements

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    - Dr. Richard Marklin, et al. Marquette University, Milwaukee, WI
    - Ms. Trisha Seeley, WE Energies, Milwaukee, WI

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