Ergonomics and its Consequences for Businesses

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Ergonomics and its two objectives

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

To do good may involve challenges...

- Difficult to motivate improvements & prioritize among investments
- To quantify benefits, both visible and hidden effects
- Different stakeholders and ‘actors’
- Knowledge and power

Why ergonomics?

- Reduce the risk of injuries
- Increase usability
- Legal reasons
- Equal opportunities
- Productivity reasons
- Quality reasons

Occupational Health Costs = Cancer Costs


4th Survey on Working Conditions in EU Parent-Thielen et al 2007. n= 15 000 EU workers

Signs of increasing ‘intensity’ at work
Effects of the working environment - visible and hidden effects

Brainstorm with your neighbour for a minute:

What ‘cost’ or ‘benefit’ elements have you seen to be related to Ergonomics in your operations?

WE Cost Elements

- Production stoppages related to WE problems
- Productivity losses
- Quality-related losses (in-house and customer side)
- Costs related to increased turnover of personnel
- Absenteeism Costs
- Reduced Managerial Focus Costs
- Presenteeism Costs (e.g. worker at work with pain/injury)
- Maintenance Costs
- Costs for loss of brand image
- Other

What is needed?

1. Awareness…
2. Usable tools (methods) for estimations
3. Communication of results to stakeholders & managers
4. Knowledge and power to act

Systematic review evaluating Human & System Effects manufacturing Operations System performance (N=38)

Example 1: Economic effects of the working environment at company level

Productivity- and quality reasons

“Old” ladle handling: Quality problems, production stops, accidents and illnesses at SSAB

New, improved methods for handling ladles

Cost or investment?

Investment 11 million SEK

“Saving” 5 million SEK/year

Or 110 years for ROI?
Example 2: From the automotive industry
Falck et al. [2009] followed the assembly of 24,443 cars & found that for tasks with medium and high load levels:
• 3.5 times higher risk for quality deficiencies
• 8.5 times higher costs for managing the errors
• 80% lead to quality deficiencies

Example 3: How much do you have to sell to compensate an incident?
1. Divide the company’s total direct costs associated with an incident by the company’s profit margin, e.g.
\[
\frac{1000}{\text{profit margin}} = 20,000.
\]
2. Divide $1000 / 0.05 = $20,000.
This is the amount of product/service the company must sell to recover the direct cost of an $1000 incident.
3. Add the direct and indirect cost, e.g.
\[
1000 + 4000 = 5000.
\]
4. Divide this sum with the company’s profit margin, e.g.
\[
\frac{5000}{0.05} = 100,000.
\]
This is the amount of product/service the company must sell to recover the direct and indirect costs of the incident.
5. Relate this to something you sell, e.g.
500 weeks selling groceries for $200 a week = 9.6 years’ worth $200/week

[Schulte, 2000]

Example 4: LCC approach Hörlins Welding visor

<table>
<thead>
<tr>
<th>Cost (in SEK)</th>
<th>Advanced visor</th>
<th>Traditional visor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employee cost</td>
<td>350.00 SEK/h</td>
<td>350.00 SEK/h</td>
</tr>
<tr>
<td>Overhead (equipment, etc)</td>
<td>150.00 SEK/h</td>
<td>150.00 SEK/h</td>
</tr>
<tr>
<td>Visor 3000 or 300 SEK</td>
<td>+ 0.50 SEK/h</td>
<td>+ 0.05 SEK/h</td>
</tr>
<tr>
<td>System cost</td>
<td>500.50 SEK/h</td>
<td>500.05 SEK/h</td>
</tr>
<tr>
<td>Productivity</td>
<td>110 units/h</td>
<td>100 units/h</td>
</tr>
</tbody>
</table>

(Productivity can increase by 5-30%)
In addition: improved quality
Different analyses give pay-back times of 1-4 months
[e.g. Oxenburgh et al., 2004; Lagerström et al., 2008]

Example 5: Corporate safety management & share value from the Australian stock market
[Larsson et al., 2007]
35% greater increase in value

Example 6: Consequences for society
The Swedish Ministry of Employment put the cost of work-related long-term sick leave and stress in Sweden in 2000, including the cost of production losses, at an estimated 4.7 billion Euro
Just over the total state budget for the \( \Sigma \) judiciary, health service and social care in 2000.

Example 7: Consequences for the individual

**Assumptions:**
- Construction worker gets MSD after 10 years of monotonous work. Injury not classified as work injury.
- Salary: 2500 Euro/month;
- Sick-leave wages: 1600 Euro/month (64%)  
- 30% tax & simplified assumptions

**Loss of income:**
- 7560 Euro per year
- 264 600 Euro in 35 years & 20% lower pension

[Lagerström et al., 2009]  

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**Ergonomics and economics**

- **Production development (internal):**
  Improved ergonomics
  Favourable for the individual, company & society

- **Product development & sales (external):**
  Several of Sweden’s largest international industrial companies highlight ergonomics in their products: Atlas Copco, Scania, Volvo, Saab, BT, …

Competitive advantages on the markets

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**Survey => Three types of WEE tools identified**

1. Tools to analyse WE risks and calculate their economic impact:
   - The Tool Kit, SCA, MAWRIC & WEST
2. Tools to develop and evaluate suggestions for intervening measures combined with investment analysis
   - ROHSEI & The Balloon Model
3. Tools incorporating investment analysis only:
   - The Net-Cost Model, The Potential & The ProductAbility Tool

Fields of application: proactively reactively strategically

[Rose & Orrenius, 2007]  

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**The ProductAbility Tool**

Five step cost calculation:

- Number of productive hours worked/year
- Salary costs per hour worked
- Remaining costs due to short-time absence
- Employee turnover and training costs
- Productivity and "quality" losses due to short-term absence

[Oxenburgh, 1991]

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**Example from Swedish Meats & ProductAbility Tool (for one year)**

**Cutting**

- Direct costs for sick-leave: 860 KSEK
- Productivity loss due to sick absence: 3 310 KSEK

**Packaging**

- Direct costs for sick-leave: 438 KSEK
- Productivity loss due to sick absence: 1 950 KSEK

**Project results:**

- More positive attitude towards WE issues
- No direct actions taken to improve the working environment
- Method not implemented in the company after the study
- Language problems, …
Statistically-based Cost Analysis method, SCA

Estimation of risks leading to injuries and costs

Cost estimation based on:
- Sick-leave wages, social contributions, holiday pay
- Incidental staff costs (approx. 150% of the costs above)
- Rehabilitation
- Productivity loss due to reduced working ability
- Preventive actions

[Rose, 1999]

Example from Earth Moving Industry using SCA
(for a company with 22 employees)

<table>
<thead>
<tr>
<th>Injury</th>
<th>Occupational group</th>
<th>No. of injuries in the occupational group at the company/year</th>
<th>Sick-leave days per injury</th>
<th>Total cost for the company/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work accident</td>
<td>EM Operators</td>
<td>0.23</td>
<td>9.0 (30)</td>
<td>18 868 SEK</td>
</tr>
<tr>
<td>Work disease</td>
<td>EM Operators</td>
<td>0.18</td>
<td>9.0 (122)</td>
<td>34 594 SEK</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.18</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Productivity loss due to reduced capacity, (10% of operators over 45 years old)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SUM</td>
</tr>
</tbody>
</table>

This is in the same magnitude as about 1/3 of the company’s profit

[Prevent, 2004]

Why are existing methods not widely spread/used?

- Na/poor knowledge of methods
- Considered to be difficult to understand or use in practice
- Considered to not link the WE factors to core values in sufficient detail, e.g. due to lack of relevant input data
- The cross-functional interaction between different actors needed (e.g. HR & production management)
- No top management demand
- Difficult to incorporate into the company’s standard management system
- ... [Johanson, 1997; Rose & Orrenius, 2007]

Evaluation of tools: Productivity & Quality

<table>
<thead>
<tr>
<th>Method</th>
<th>Productivity considered?</th>
<th>Quality deficiencies considered?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The Tool Kit</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>2. SCA</td>
<td>YES, as mark-up</td>
<td>YES, as fix mark-up</td>
</tr>
<tr>
<td>3. MA6RSC</td>
<td>YES, as mark-up</td>
<td>YES, as fix mark-up</td>
</tr>
<tr>
<td>4. WEST</td>
<td>NO</td>
<td>YES, psychosocial</td>
</tr>
<tr>
<td>5. ROHSEI</td>
<td>YES, possible</td>
<td>YES, possible</td>
</tr>
<tr>
<td>6. The Balloon model</td>
<td>YES</td>
<td>YES, possible</td>
</tr>
<tr>
<td>7. The Net-cost model</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>8. The Potential</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>9. The ProductAbility Tool</td>
<td>YES</td>
<td>NO</td>
</tr>
</tbody>
</table>

[Rose & Orrenius, 2007]

What is needed?

1. Awareness...
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A guide to find pathways...? "Ergonomics Infrastructure - An organizational Roadmap to Improved Production Ergonomics"

Would you like to join a network on WEE?
If yes, please sign the list

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