Human factors and system design
... synergy for safety

Louise Whitby
Ergonomics is a multi disciplinary science that focuses on the needs of the human in the design of products, work processes and technology systems.

**Ergonomics = Human factors**
Role of ergonomics …

Engineers make things that are useful to people. In collaboration with designers, ergonomists make things that are usable by people.

Stanton N and Young M, Nature, 399, May 1999

Ergonomics is about usability .... making things easy, efficient, comfortable and safe to use.
Aims for C21 Healthcare ...

- Safe
- Effective
- Patient-centred
- Timely
- Efficient
- Equitable

Source: IOM, 2001
Design ...

- Task
- Environment
- Furniture
- Technology
- Information systems

Microergonomics
Design ...

Macroergonomics

External Influences

Job / Task

Equipment

Organisation

Environment
Case study ...

New data/information management system to replace existing DOS-based system.

The new system was intended to be used by every employee for a range of applications.

Because of its complexity, a group of twenty people were initially trained, with the planned roll-out to all personnel within six months. Data input was limited to new data and did not involve any migration of old data.

What happened ...
What was done ...

- Comparative evaluation of two systems: keystrokes and mouse usage
- Identified 7 priority tasks common to both systems
- Subjects all proficient in both systems + capable for entering data for 1½ hrs continually
- Batched data, entered into both systems but not by same subject
- Work environment – secluded, one computer, new keyboard and mouse
## Results: Entering data ...

<table>
<thead>
<tr>
<th>Activity</th>
<th>New System</th>
<th>Old System</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>89 min</td>
<td>48 min</td>
<td>2:1</td>
</tr>
<tr>
<td>Keystrokes</td>
<td>2-3,000</td>
<td>2-3,000</td>
<td>Identical</td>
</tr>
<tr>
<td>Typing speed</td>
<td>101-174</td>
<td>104-174</td>
<td>Identical rates</td>
</tr>
<tr>
<td>Mouse Usage</td>
<td>7.9mc/min</td>
<td>0.25mc/min</td>
<td>New system has: 32 x more mouse clicks</td>
</tr>
<tr>
<td>Mouse travel</td>
<td>Max 366 or 4 vertical widths of screen / min</td>
<td>Max 10 or 1 vertical width of screen / min</td>
<td>New system has: 20 times more mouse travel</td>
</tr>
<tr>
<td>Function Keys</td>
<td>1076 -avg</td>
<td>1114 -avg</td>
<td>Equal use of function keys - altern to mouse.</td>
</tr>
<tr>
<td>Work Intensity</td>
<td>5.7 - avg</td>
<td>4.0 – avg</td>
<td></td>
</tr>
<tr>
<td>Risk Assessment</td>
<td>High</td>
<td>Medium</td>
<td></td>
</tr>
</tbody>
</table>
### Results: File processing ...

<table>
<thead>
<tr>
<th>Activity</th>
<th>New System</th>
<th>Old System</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>66 min</td>
<td>10 min</td>
<td>6:1</td>
</tr>
<tr>
<td>Keystrokes</td>
<td>1,500</td>
<td>600</td>
<td>2:1</td>
</tr>
<tr>
<td>Typing speed</td>
<td>103-166</td>
<td>94-122</td>
<td>New system faster</td>
</tr>
<tr>
<td>Mouse Usage</td>
<td>13.7mc/min</td>
<td>0.4mc/min</td>
<td>New system has 34 x more mouse clicks</td>
</tr>
<tr>
<td>Mouse travel</td>
<td>Max 382 or 5.8vertical widths of screen / min</td>
<td>Max 9 or &lt;1 vertical width of screen / min</td>
<td>New system has: 6 times more mouse travel</td>
</tr>
<tr>
<td>Function Keys</td>
<td>425</td>
<td>217</td>
<td>2:1 - altern to mouse</td>
</tr>
<tr>
<td>Work Intensity</td>
<td>5.7 - avg</td>
<td>2.5 – avg</td>
<td></td>
</tr>
<tr>
<td>Risk Assessment</td>
<td>High</td>
<td>Low</td>
<td></td>
</tr>
</tbody>
</table>
Recommendations...

**High order controls**
- Review functionality requirements
- Refer to software supplier to address revised functionality, improve data input and limit mouse
- Trial before rollout

**Interim, but low order controls**
- Limit individual exposure to new system
- Increase personnel skilled in use
- Balance exposure with non-computer tasks
- Monitor after implementation
All design has potential to affect...

**Decision making**
- Decision density
- High cognitive load
- Multi-tasking
- High distractions
- Fatigue
- Signal:noise ratio
- Diagnostic uncertainty
- Production pressures
- Staffing #
- Skill level
- Physicality

**Individual Compliance**
- Risk taking behaviour
- Group pressure
- Coping skills
- Personality
- Under confidence
- Over confidence
- Authority issues
- Disregard for safety
- Likelihood of detection
Strategies ...

- Consult, consult and consult
- Optimise layout
- Improve usability – trial
- Automate processes where possible
- Manage staffing mix and rostering
- Increase protocols and guidelines
- Manage noise and interruptions
- Patient safety and staff safety must coexist – one does not override the other
At the end of the day ...

**Ergonomics** provides the bridge between care and cure.
Commercial ...

Human Factors and Ergonomics Society of Australia has recently approved the formation of a SIG in Healthcare Ergonomics.

To be kept informed ... please email me to be added to the mailing list.

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