Ergonomics During Lean Times

Paul Schwab, CPE
Ergonomics Program Manager
Texas Instruments, Inc.
Overview

• During tough economic times it might be tempting to cut back on ergonomics efforts
  – Just like safety and industrial hygiene, ergonomics should be a sustainable process

• Ergonomics related claims may increase during downsizing
  – Fewer employees available to perform the same work
  – Employees may perform different, unfamiliar jobs
  – Low moral, increased mental stress
  – Employees may submit claims for unreported injuries fearing a layoff
Objective of Ergonomics

Ergonomic principles can be used to balance of worker capabilities and job demands.
Benefits of Ergonomics

- Reduced Injuries
- Increased productivity
- Increased product quality
- Increased product throughput
- Enhanced user comfort
History of Ergonomics

• Early 1900’s: ergonomics was used to optimize human productivity (e.g. Scientific Management)

• Late 1940’s: ergonomics was expanded to include the reduction of physical stress to workers

• Early 1990’s: increase in Musculoskeletal Disorders (MSDs) prompts an increased focus on reducing physical stress to employees

• 1988-present: Lean manufacturing, perfected by Toyota, gains interest. Lean manufacturing can benefit from using ergonomic principles to increase productivity
Lean Manufacturing

Focus
- Increased efficiency
- Reduced waste
- Continuous improvement

Tools used to increase productivity
- Value Stream Mapping (eliminate waste)
- Six Sigma (defect reduction)
- Five S (Sort, Set, Shine, Standardize, Sustain)
- Kanban (pull systems)
- Poka-yoke (error-proofing)
Waste and Inefficiency

Before

Currently, WIP Rack is 36 feet away

After

Rotating the Tool 90 degrees for WIP Rack storage 4-6 feet away
Waste and Inefficiency

Semiconductor specific issues

- Human-related wafer scrap incidents
- Misprocessed wafers
- Resist changeout
- Filter changeout
Five S Program

Work In Process (WIP) table eliminated through 5S process
Five S Program

Cart Design

Before

After
Five S Program

Standardization of carts
Sustainable Programs

• Ergonomics is not a stand-alone process
• Incorporating ergonomics into other programs and processes helps to ensure sustainability
• Examples at TI:
  – Office ergonomics program
  – Equipment acquisition program
Ergonomics Program Success

• Recordable ergonomics-related injuries decreased by 89% from 1999 to 2008

• Days Away/Restricted/Transferred (DART) ergonomics related injuries decreased by 95% from 1999 to 2008
Equipment Acquisition
EQUIPMENT ACQUISITION PROCESS

All manufacturing equipment reviewed for ergonomics, safety and environmental concerns

- Ergonomics considerations are included in the equipment purchase specifications and negotiations
- Equipment suppliers are required to submit third party safety, ergonomic and environmental assessment reports for all new and used equipment
  - Semiconductor industry safety and ergonomic design guidelines used as the primary assessment tools
Equipment Acquisition Process

Supplier provides a third party ergonomics assessment report
- Report is reviewed and ergonomics concerns and equipment database is searched for machines with similar ergonomics related concerns.

Machine identified and procurement process starts
- Capital (money) approved
- Request for quote sent to supplier with requirements
- Conformance to ergonomics design guidelines is part of the request for quote
Equipment Acquisition Process

If there are no ergo-related problems after installation, last 10% of the purchase price is released to supplier

• If problems are not resolved, TI keeps 10% (this can be over $1-3 Million per machine)

Machine is shipped and installed

• Safety must sign off on installation
• Ergonomics is reviewed is part of the equipment installation checklist

Assessment reports are reviewed by Safety and Ergonomics group

• Report is reviewed and ergonomics concerns and equipment database is searched for machines with similar ergonomics concerns.
• Any concerns are resolved with supplier before shipment
Guidelines Clarify Expectations

He needs a chair
Ergonomic Design Guidelines

SEMI®¹ S8 Safety Guidelines for Ergonomics Engineering of Semiconductor Manufacturing Equipment

- Prescriptive guidelines for the design and assessment of semiconductor equipment
- Created by a committee comprised of equipment manufacturers, users and evaluators
- Most semiconductor manufacturers require conformance for new equipment

¹ Semiconductor Equipment and Materials International
Ergonomic Design Guidelines

SEMI\(^1\) S8 has benefited the industry and manufactures alike by:

– Reducing the need to make special configurations for each buyer
– Improving user interface standardization

\(^1\) Semiconductor Equipment and Materials International
Equipment Purchasing Requirements

Equipment suppliers are required to provide third party safety and ergonomics reports including SEMI S8 Ergonomics Design Guidelines which includes the Supplier Ergonomics Success Criteria (SESC) Checklist

*Used with permission from SEMI

<table>
<thead>
<tr>
<th>Section</th>
<th>Indicator</th>
<th>Acceptance Criteria</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Manual Material Handling</td>
<td>Analysis and results documentation. Table A2-2, Attachment 2, or the equivalent, should be used to document 2 hand lift/lower analysis.</td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Manual material handling tasks performed as part of operations, maintenance, or service tasks are analyzed utilizing appropriate procedures. Note: All two hand lifting or lowering tasks should be analyzed: if the object being handled weighs more than 44.5 N (10 lbs); OR, if the object weighs more than 22.2 N (5 lbs) and the anticipated frequency is greater than one lift every 5 minutes. See Attachment 2 for further information.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Product loading in a standing posture (Applicable to all media other than wafer cassettes including: JEDEC trays, magazines, and reticle cassettes.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Clearance provided for finger thickness.</td>
<td>minimum 38 mm (1.5 in)</td>
<td></td>
</tr>
</tbody>
</table>
Material Handling Assessment

Potentially hazardous manual material handling tasks performed as part of operations, maintenance, or service are analyzed utilizing appropriate procedures.

NOTE: Two hand lifting or lowering tasks should be analyzed:

- if the object being handled weighs more than 44.5 N (10 lbf.);
- OR, if the object weighs more than 22.2N (5 lbf.) and the anticipated frequency is greater than 1 lift every 5 minutes.

Assessment tool options:

- NIOSH Lifting Equation (recommended)
- Biomechanical models
- Psychophysical capacity data
**SEMI S8 Design Guideline Example**

**Keyboard and input device height guidelines**

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**Sit-Down Workstation**

- 5th Percentile
  - Asian Female*: 1471 mm (57.9 in.) tall

- 95th Percentile
  - N. American Male*: 1895 mm (74.6 in.) tall

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**Adjustable foot rest provided for shorter users**

- Maximum 760 mm (30.0 in.)
- Minimum 710 mm (28.0 in.)

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**Stand-Up Workstation**

- Maximum 1020 mm (40.0 in.)
- Minimum 970 mm (38.0 in.)
USER INTERFACE DESIGN

Touchscreen interface design guidelines

Top of active area
- 1370 mm (54.0”)
- 1220 mm (48.0”)
- 1042 cm (41.0”)
- 910 mm (36.0”)

Bottom of active area

Before

After
SEMI S8 Design Guideline Example

Recommended body clearances for maintenance activities

**Standing**
- Upper body clearance minimum: 610 mm (24 in.)
- Overhead clearance minimum: 1980 mm (78 in.)

**Stooping**
- Forward horizontal clearance minimum: 690 mm (27 in.)
- Overhead clearance minimum: 1980 mm (78 in.)
- Working height minimum: 640 mm (25.2 in.)

**Kneeling**
- Forward horizontal clearance minimum: 1020 mm (40.0 in.)
- Overhead clearance minimum: 1450 mm (57.0 in.)
- Working height minimum: 640 mm (25.2 in.)
Equipment Safety / Ergo Database

- Ergonomics-related concerns and abatements are documented using a standardized format
  - Reports posted on a server with worldwide access
    - Fast access in the US, Mexico, Europe and Asia
  - Allows best practices to be shared between users and for new equipment purchases
  - Over 1,000 reports
Office Ergonomics
Ergonomic Assessments

Dedicated computer workstations are adjusted for each employee

- All systems furniture components at US sites and most international sites are height adjustable by facilities technicians in 1 inch (25 mm) increments.
- Keyboard trays, footrests, etc. available for small sites with non-adjustable casegood furniture

<table>
<thead>
<tr>
<th>Lowest Work Surface Height</th>
<th>Median Work Surface Height</th>
<th>Highest Work Surface Height*</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 in (558 mm)</td>
<td>27 in (686 mm)</td>
<td>32 in (813 mm)</td>
</tr>
</tbody>
</table>

* Excludes sit-stand
Ergonomic Assessments

1. Adjust **chair seat pan** height so that your feet are flat on the floor and legs are parallel with the floor.

2. Adjust **keyboard height** so the home row is approximately at the same height as the elbow.

3. Adjust **monitor height** so that the top of the display is below eye level. Bifocal users should consider computer glasses.

4. Arrange your **work area** so that items used most often are close at hand to avoid overreaching.
Ergonomic Assessment Process

Employee has ownership of the process

- Request entered into online system by:
  - Employee
  - Manager
  - Occupational Nurse
  - New Hire (automatic)

  E-mail automatically sent to evaluator responsible for site

  Evaluator schedules assessment with employee

  Evaluator performs assessment

  Evaluator performs assessment makes recommendations and enters information into database

  Employee submits an online request to Facilities to adjust work surfaces, order a chair, etc… (with supervisor’s approval)

  Facilities technician looks up preferred work surface heights in database and adjusts work surfaces

  Employee orders ergonomic accessories from online catalog as needed (with supervisor’s approval)

  Items delivered (usually within 24-48 hours)

  Evaluator follows up with employee as needed
Ergonomic Assessments

- Ergonomic assessments are conducted by trained professionals:
  - Ergonomics Specialists (TI employees and consultants)
  - Environmental, Safety, Health and Medical staff at sites
  - Facilities technicians
Ergonomic Assessments

Workstation assessments are performed:

- As requested by the employee, manager or coworker
- If an employee moves and there’s not an assessment on record
- For all new hire employees assigned to administrative/office positions
  - Ergonomic assessments are performed during the first day of new hire employee orientation by an ergonomics consultant using a motorized fit station
  - Data is entered into an electronic database
Online Assessment Request

- All employees and contractors can request an assessment online.
- System automatically sends an e-mail to the ergonomics coordinator for the worker’s site.
Assessment Procedure

Evaluator performs assessment in the employee’s office

- Addresses any specific employee concerns
- Measures existing setup
- Instructs employee how to adjust chair and posture
- Measures elbow and eye heights and makes recommendations based upon the employee’s job tasks, work habits, equipment and furniture
Ergonomics Database

Workstation preferences for each employee are stored in a database with worldwide access

- Preferred workstation dimensions for over 11,000 employees are stored in the database (1995 to present)
- Average of 1,800 assessments performed each year
- Move Coordinators and Facilities technicians have access to the database and use the data to set up offices for moving employees
Ergonomics Database

Database interface is accessible to move coordinators and facilities technicians.
Workstation Adjustments

At most sites, employee submits a request to have work surfaces adjusted or furniture ordered using the online Service Tracking and Resolution System (STARS)
Cost Savings

Assessment system and database pays for itself

- During employee moves, work surfaces only need to be adjusted once since there’s no need to adjust the work surfaces to a “standard” height before the new user arrives
- No work disruptions for the employee since work surfaces are adjusted while the office is unoccupied
- No need to perform an assessment for each move made by an employee since employee’s preferred work surface heights are in a database
  - If the employee has two offices then both can be set up identically
  - Assessments can be requested any time and employees often ask for an ergonomics “checkup” every few years
QUESTIONS?

Paul Schwab, CPE
Ergonomics Program Manager
Worldwide Environmental, Safety & Health
Texas Instruments, Inc.
p-schwab@ti.com

SEMI S8-0701 Safety Guidelines for Ergonomics Engineering of Semiconductor Manufacturing Equipment. Published by SEMI (Semiconductor Equipment and Materials International) URL: www.semi.org Phone: (800) 974-SEMI or (650) 940-7985
Backup Slides
## Improved Lot Tracking

![Lot Tracking System Image]

The Lot Tracking system is an essential tool for managing and tracking large quantities of inventory. It provides real-time information about the location and status of lots, enabling efficient and accurate management. The system integrates with other software applications to ensure无缝的数据传输 and provides comprehensive reports for audit and analysis.

### Key Features
- **Real-time Tracking:**实时跟踪每个lot的位置。
- **Efficient Management:**简化lot管理流程，提高效率。
- **Detailed Reports:**生成详细报告，支持决策制定。

### Benefits
- **Increased Efficiency:** 提高运营效率。
- **Accuracy:** 确保数据的准确性。
- **Compliance:** 支持遵守行业标准和法规。

### Implementation
- **Hardware Integration:** 集成硬件设备，如条码扫描器。
- **Software Integration:** 与ERP系统等集成，实现数据同步。

### Future Enhancements
- **Automation:** 自动化处理，减少人工干预。
- **AI Integration:** 利用AI进行预测和优化。

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*Image credits to [Vendor]*
Internal Ergonomic Requirements

1. Supplier will provide the following information if not already included in the S8 ergonomics report:
   a) Machine footprint with access zones and support items,
   b) List of items needed for the [equipment] to comply with SEMI S8 (e.g., cassette rotation devices, work platforms, lifting devices, work stands, ladders) and,
   c) Material handling analysis of maintenance or service
2. Supplier shall list ergonomic options.
   - (e.g., height-adjustable workstations, adjustable displays) offered as separate line item responses to the TI Request for Quote.
3. Supplier shall manage ergonomic items agreed between TI and Supplier to be “Standard” ESH Modifications.
- (e.g., maintenance platforms, task lighting, workstations, load port modifications, special hand tools, lifting devices).
4. Supplier shall define the workstation type as ≥1 of the following, and provide TI with installation instructions, post-installation options, and any other information required for safe use of each option.

This information allows the receiving site to budget for and purchase the appropriate seating product.

a) Sit  b) Sit-stand (w/ tall chair)  c) Stand  d) User’s choice of sit or stand  e) Sit-lean
### Equipment Report

Environmental, Safety, Health and Ergonomics Equipment Safety (ESHEER) Report

<table>
<thead>
<tr>
<th>3rd Party Non-acceptance</th>
<th>Abatement/Acceptance</th>
<th>Date Closed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>8_S2_B01181_4_06JUL1997</strong>: SSEC Section 8.1.2 Standing height of touch screen monitor. Actual standing touch screen monitor is too high, 1880 mm (74”) from floor to top of touch screen. <strong>Acceptance Criteria</strong>: Maximum 1470 mm (58 in.) If &lt;48 in. must be tilted upward 30 degrees. If &lt;41 in. must be tilted upward 45 degrees.</td>
<td><strong>P. Schwab 18DEC2005</strong>: Touch screen is normally used for tasks lasting a few minutes. Technicians may use touch screen for periods lasting over one hour during machine setup. Supplier offers a retrofit option (shown).</td>
<td><strong>14MAR2006</strong> P. Schwab. Site verified that touch screen is mounted on the side of the machine</td>
</tr>
</tbody>
</table>