Session No. 527

Applied Ergonomics: Tools and Methods for Improving the Fit of the Workplace

Kent Hatcher, CPE
Managing Consultant
Humantech, Inc.
Ann Arbor, MI

Walt Rostykus, CSP, CIH, CPE
Vice President
Humantech, Inc.
Corrales, NM

Introduction

Many safety engineers can readily identify, measure, and control most safety hazards, although an area of challenge continues to be ergonomics. With the multitude of assessment checklists, booklets, and devices available today, basic and proven methods are hard to find. Additionally, information about stretching, back belts, exercise balls, and other approaches tends to confuse and distract from controlling the true ergonomic hazard.

Occupational ergonomics is defined as "designing the workplace and job to fit the capabilities of the working population." Following a continuous improvement process, safety engineers and safety teams can effectively identify and reduce exposure to the root causes of work-related musculoskeletal injuries (WMSDs). A common improvement process familiar to most safety professionals is the Safety Management System (OHSAS 18001 or ANSI Z10). Although this system is comprised of five sections, this session will focus on three: planning, implementation, and checking and corrective action. Included are the basic fundamentals and tools to conduct valid and quantitative risk assessments, identify and quantify the root causes of ergonomic risk factors, and provide specific engineering controls that help reduce risk.

Planning

"A problem well-defined is half solved." — John Dewey

Assessments and evaluations are key tools for planning. At this stage of the process, an organization must answer three key questions:

- What is our problem?
- Where is it?
- How do we know when we have fixed it?

To assist with answering these questions, there are two levels of tools: screening (qualitative) and assessment (quantitative) methods.

Qualitative Screening

Screening is a good first step that allows you to quickly identify your specific problems and where they are in your facility (and where they are not). The results help define the extent of the resources required to improve workplace ergonomics. Screening tools are valuable in determining what has happened in the past. Examples of such tools include:

- Injury/illness data
- Productivity and quality performance
- Employee input
- Observations

Injury/illness records help identify the types and frequency of injuries caused by poor ergonomic conditions. Depending on the quality of your accident investigation process, the records may also help determine the general root causes. Records of productivity and quality performance help identify where poor ergonomic conditions have affected the ability of employees to perform their work. This can help further determine the answer to "What is our problem (caused by poor ergonomic conditions)?" It could be any combination: safety, quality, cycle time, employee satisfaction, employee retention, etc.

Employee input is another good source of screening information. After all, the person who performs work is the expert and can help identify difficulties they encounter, and potential solutions for reducing the risk or barriers to job performance. Interviewers should use open-ended questions, for example, "What is the hardest thing about this job?" and "What would you do to improve this job?"

Observation is powerful. As safety professionals, we have experience, professional judgment, and common sense that enable us to look at a job and identify poor workplace conditions and evidence of hazards. Unfortunately, common sense is not always common, and different experiences result in variations in professional judgment and interpretations.

A solution to this variation is a common language. Observation-based tools provide us with a common method we can use to evaluate, and a common language we can use to communicate the findings. Checklists, pocket "hit lists," and cue cards are common tools for ensuring consistency in observations. The critical element when selecting an observation-based tool is the *content*. The tool should help the user identify the presence of ergonomic risk factors in all body segments. Critical risk factors are awkward postures, high forces, and time (long duration or high frequency).

The qualitative tools used for screening may be sufficient to find and fix an ergonomic problem. Typically, a good observation-based tool will enable operators and supervisors find obvious issues, and to make simple fixes. But observation does not allow us to compare the level of ergonomic risk exposure to threshold of the human body. By comparing the two you can determine if the exposures exceeds the limitations of humans. This is where quantitative tools come in.

Quantitative Assessment

Quantitative assessment tools are essentially dosimeters for measuring exposure to ergonomic risk factors. Just as a noise dosimeter combines the force (dB) and duration (time) of exposure to noise and compares it with a threshold (OSHA standard), quantitative ergonomic assessment tools measure exposure to ergonomic risk factors (posture, force, and time) and compare them to the known limitations (threshold) of each joint structure of the body

There are many quantitative ergonomic assessment tools available today, in both the public domain and proprietary. As with any assessment tool, proper selection and correct use are critical. Examples of such tools include:

- NIOSH Lifting Equation
- Rapid Upper Limb Assessment (RULA)
- Rapid Entire Body Assessment (REBA)
- Baseline Risk Identification of Ergonomic Factors (BRIEF™)

When selecting a qualitative ergonomic assessment tool, ensure that the method has these key characteristics:

- Valid – based on valid, current research
- Differentiates – distinguishes between exposure to risk factors *within* a task, and *between* tasks
- Reliable – reliability is dependent up on primary aspects of the user. The user must know the limitations of the method, and they must use the method correctly.
- Reproducible – comparable results are achieved when used by different assessors

Ideally, the chosen assessment tool will be quick and easy to use. This is critical in the workplace, where assessments, and the resulting improvements, must be achieved quickly and efficiently. Tools and devices used in laboratory research on ergonomics are rarely used the workplace. In the occupational setting, the tool must be easy enough for a safety committee or an ergonomics team member to use and get results quickly, with minimal training.

It must be stressed that the primary purpose of using a quantitative ergonomic risk assessment tool is to get a number, a score that measures exposure to the ergonomic risk factors of awkward posture, high force, and duration/frequency. Like a TLV, the risk exposure score is your measure to determine if the exposure is within the limits of the human body, or exceeds those limits. Ideally, we should be able to determine the risk exposure level for each part of the body, and get a single score for the whole body. The former allows you to identify the “root cause” of exposure and select the right engineering controls. The latter (whole body score) allows you to map ergonomics risks throughout the workplace, and prioritize them to determine which tasks to work on first.

So far we’ve discussed only risk assessment tools. Anthropometry, static strength tables, 3-D modeling, and Push-Pull-Carry tables provide other ways to determine a design mismatch between the workplace and the worker. Interestingly, these resources can be used to identify workplace characteristics, dimensions, and tools that are within or outside the capabilities of people, and they can be used to design improvements.

Whether used to screen ergonomic issues or measure risk factors, conducting an assessment is only the halfway point. You are now provided with a diagnosis that will help you realize the full benefits of ergonomics as a science: designing the workplace, job, tool, and task to fit the capabilities of people.

Implementation

"You will never plough a field if you only turn it over in your mind". — Irish Proverb

Planning is diagnosis. Implementation is prescription and treatment.

Once you've identified the root causes of a high exposure to ergonomic risk factors, the presence of non-value-added motions, or potential for error, it is time to implement controls that reduce the error/injury. As safety professionals, we know the Hierarchy of Controls dictates engineering controls first, then administrative, and finally, personal protection. Since ergonomics is an engineering discipline (design of the workplace and job), the most effective and sustainable means of reducing WMSDs are engineering controls.

The common challenges with engineering controls are identification, selection, justification, funding, and implementation. Unfortunately, many organizations default to "administrative controls" like training, reinforcement, stretching programs, and rest breaks. As a result, they keep employees busy, but have no impact on risk.

Engineering controls are changes to the workplace that reduce or eliminate the awkward postures, reduce the weight lifted and force applied, and shorten the duration or reduce the frequency of the exposure. The key to successful engineering controls is to engage your engineering department. Furthermore, once you reduce the risk for one operator, you have reduced it for everyone currently working on, and the people who *will be* working on, that equipment or task.

Identification

Product catalogs, design guidelines, and "best practices" abound for identifying engineering controls. Yet, the challenge is finding the right ones. Anthropometric tables, static standing strength tables, and Push-Pull-Carry tables are basic tools for engineers. The challenge is to have all your engineers using common and correct references, and to ensure that they apply the information.

Selection

The engineering solution for an ergonomic issue must be founded and selected based on both validity and feasibility. *Validity* merely means ensuring that the engineering control actually addresses and reduces the ergonomic risk factor(s) identified as a root cause (or causes). If you cannot demonstrate this, the engineering control should not be pursued. *Feasibility* refers to the usability and acceptability by the operator and key stakeholders. Simply put, if a powered lifting device is not accepted by operators, they will not use it, so the improvement is not feasible. One way of ensuring use and improving feasibility is to involve operators in selecting and designing solutions; after all, they have the primary stake in the success of the improvement.

The “key stakeholders” referred to include Quality, Productivity, and Safety personnel .If the engineering control causes quality defects, slows production, or introduces another safety hazard, it is not feasible.

Justification

Justification refers to proving the value of investing in the engineering solution. Fortunately, about 80% of ergonomic risks can be controlled by low-cost (non-capital) engineering controls. The remaining 20% may require an investment of capital monies.

Justifying capital investment for an improvement based on injury rate and cost avoidance is rarely successful. What is successful is using valid, tangible measures, and return on investment (ROI). For example, calculating cycle time improvement from the elimination of non-value-added motions is a powerful way of determining the ROI for a solution that also reduces the risk of WMSDs.

Funding

Obtaining funding for ergonomic improvements is always an issue when (1) there is no budget for “ergonomic improvements,” (2) justification is weak, and/or (3) there is no clear owner for ergonomics. Solutions to these issues vary with each organization, accounting model, and budget. The most critical tools to help you with funding challenges are strong justification and clear ownership. Justification was addressed in the previous section; tangible ROI based on real-life data (cost of productivity) communicated in the terms of dollars is a clear message that the financial decision makers in any organization understand.

The second half of this equation is clear ownership. The safety department does not (and should not) own the cost to reduce ergonomic risk factors in the workplace. They did not design the conditions in the first place. The cost and accountability/ownership rests with the people responsible for the quality of the work, equipment, and processes in their respective areas. This typically includes managers, supervisors, engineers, and facilities personnel. When you hold them accountable for the level of quality in their areas of responsibility, they will make decisions and fund improvements.

Implementation

Making changes to the workplace is easy to do but hard to get done. Engineers and maintenance personnel may not have the time, other priorities take precedence, and excuses abound. If you don’t change the workplace, you cannot improve ergonomic conditions. Remember, holding individuals accountable for reducing ergonomic risk in their areas of responsibility is the key to changing the workplace, making the right changes, and making those changes in a timely manner.

Checking and Corrective Action

“*We must never assume that which is incapable of proof.” — G. H. Lewes*

The forgotten step in most ergonomic improvement efforts is verification. After diagnosing (planning), and the prescribing and treating (implementation and operations), you must verify that the treatment/solutions were effective in reducing the problem to the level desired. Simply put, use the same ergonomic assessment tool to reassess a workstation or task after it has been

improved, and compare the results. Did the risk score go down? Did you reduce the risk level to a low- or no–risk level that is within the threshold of the human body? If so, you've improved the fit of the workstation to the operators and reduced an ergonomic risk. If not, you have not resolved the problem and you'll need to start the improvement process again.

This step is the only way to prove the real-time, valid benefits of the ergonomic improvement process. The results of follow-up assessments provide top management with tangible proof that the improvements yielded a measurable benefit (value) from the time and money invested. This step is critical for the ongoing success and sustainability of an effective ergonomic improvement process. The best part is that you don't need more tools to Check. The same assessment tools used in planning are used again in checking.

Summary

This presentation has focused primarily on the basic tools critical for the success of an ergonomic improvement process. As with any tool or method, they must be selected and used correctly to be effective. Only a small, simple set of tools is needed for improving ergonomic conditions in the workplace: qualitative and quantitative assessment tools, design criteria based on the capabilities and limits of human performance, and cost justification methods. These three, applied in a continuous improvement approach, will lead any organization to success.